Differential Impact of the Global Financial Crisis:

Explaining the Cross-Country Real Impact and “Advanced Economies Nature” of the 2008–2009 Crisis

by

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Abstract

This dissertation advances the literature on the cross-country differential real impact of the 2008–2009 Global Financial Crisis (GFC), and explains the apparent "Advanced Economies (AE) Nature" of the crisis. The literature's AE Nature result finds higher levels of pre-crisis income (logged per capita GDP) correlating with worse GFC-outcomes; but it does not address why this is so. Dependent variables (DVs) here measure GFC outcomes as the depth and duration of the peak-to-trough contraction in seasonally adjusted quarterly real GDP within 2007–2010. Following an introduction, Chapter 2 shows that the linear income relationships on both DVs represent spurious results, better characterized by a step-function between better performing lower-middle-income countries (LMICs) and similarly worse-off upper-middle-income and high-income countries (UMICs and HICs). Chapter 3 then undertakes a step-wise regression specification search on a broad set of pre-crisis independent variables (IVs), excluding those directly related to income. The search process addresses methodological issues found in the literature, including omitted variable bias, contingent significances, outlier influence, multicollinearity, and heteroscedasticity. IVs considered expand on those tested in the literature, newly adding measures for 2003–2007 "boom-period" growth for most indicators. Six IVs explain 75 per cent of depth DV variation: credit boom; manufacturing share of exports; FDI assets boom; food, fuels and mining share of exports boom; government expenditures boom; and an exchange rate regime dummy. Two IVs explain 46 per cent of duration DV variation: foreign debt liabilities; and bank assets boom. The models explain-away the AE Nature, in both LMIC-difference and linear-income forms. The depth model also explains an emerging Europe difference identified in the literature. However, several extreme outliers on the raw depth DV remain poorly-explained, including Ukraine and the Baltics. Chapter 4 undertakes comparative case studies on Ukraine and Latvia, paired with Romania and Belarus, respectively, as otherwise similar cases that are well-explained by the regression model. The analysis identifies factors helping explain Ukraine and Latvia's extreme contractions, primarily reflecting their different experiences-of and responses-to balance of payments crises.

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Contents

Contents

Contents

Contents

Tables

Figures

Figures

Figures

Figures

Figures

Abbreviations

(Note: Table 2A.2 in Appendix 2A lists 2-letter country codes alphabetically.)

AE	Advanced Economy
AIC	Akaike Information Criterion
AREAER	Annual Report on Exchange Arrangements and Exchange Restrictions (IMF)
BEER	Behavioural Equilibrium Exchange Rate
BIC	Bayesian Information Criterion
BIS	Bank for International Settlements
BLIR	Bank Lending Interest Rate
BMA	Bayesian Model Averaging
BoP	Balance of Payments
BR	Business Regulation (EFW indicator) (or 2-letter code for Brazil)
CA	Current Account (or 2-letter code for Canada)
CAGR	Cumulative Average Growth Rate
CB	Central Bank
CBFL	Central Bank Foreign Liabilities
CBRL	Central Bank Reserve Liabilities (MB+CBFL)
CMR	Credit Market Regulation (EFW indicator)
CPI	Consumer Price Index
CRR	Country Risk Rating (*EuroMoney*)
DE	Developing Economy (or 2-letter code for Germany)

Abbreviations

DOTS	Direction of Trade Statistics database (IMF)
DV	Dependent Variable
EC	European Commission (or two-letter code for Ecuador)
ECB	European Central Bank
EFW	Economic Freedom of the World database (Fraser Institute)
EME	Emerging Market Economy
EmEur	Emerging Europe
EMU	European Monetary Union (aka Eurozone)
EQCHANGE	Couharde et al.'s (2017) database global database of annual indicators on effective exchange rates
ERER	Equilibrium Real Exchange Rate
ERM II	Exchange Rate Mechanism II (EU)
EU	European Union
EWN	External Wealth of Nations, Mark II dataset (Lane and Milesi-Ferretti 2009 revision)
FA	Financial Assets
FBC	Foreign Bank Claims (Llaudes, Salman, and Chivakul 2011)
FBO	Foreign Bank Ownership (Claessens and van Horen 2012)
FC	Financial Centre (Lane and Milesi-Ferretti 2011)
FDS	Financial Development and Structure dataset (Beck et al. July 2017 revision)
FDI	Foreign Direct Investment
FFM	Food, Fuels and Mining products
FL	Financial Liabilities

Abbreviations

FMP	Fuels and Mining Products
FXR	Foreign Exchange Reserves
GDP	Gross Domestic Product
GDP/c	per capita Gross Domestic Product
GFC	Global Financial Crisis (2008–2009)
GWP	Gross World Product
HIC	High-Income Country
IFS	International Financial Statistics database (IMF)
IMF	International Monetary Fund
IV	Independent Variable (or Roman numeral 4 in "IMF Article IV")
JEDH	Joint External Debt Hub (BIS, IMF, OECD, World Bank)
LIC	Low-Income Country
LMIC	Lower-Middle-Income Country
LMR	Labour Market Regulation (EFW indicator)
log[GDP/c]	per capita GDP, logged (base-10); a.k.a. "Income"
MB	Monetary Base
MIMIC	Multiple Indicators Multiple Causes
MTC	Merchandise Trade by Commodities database (WTO)
NEER	Nominal Effective Exchange Rate
NFA	Net Financial Assets (FA−FL)
OECD	Organization for Economic Cooperation and Development
OFI	Other Financial Institution

Abbreviations

OLS	Ordinary Least Squares regression
pp	percentage points
PIP	Posterior Inclusion Probability
PMP	Posterior Model Probability
Pop	Population
REER	Real Effective Exchange Rate
SBA	Stand-By Arrangement (IMF)
SCC	Small Crisis Country (Rose and Spiegel 2010)
SDR	Special Drawing Right (IMF)
STED	Short-Term External Debt
SUR	Seemingly Unrelated Regressions
SVO	Simultaneous Bayesian Variable selection and Outlier identification (within BMA framework)
TMT	Total Merchandise Trade database (WTO)
UBS	full name of a Swiss multinational investment bank
UMIC	Upper-Middle-Income country
UNCTAD	United Nations Conference on Trade and Development
VIF	Variance Inflation Factor
WDI	World Development Indicators database (World Bank)
WEO	World Economic Outlook (IMF)
WGI	Worldwide Governance Indicator (World Bank)
WTO	World Trade Organization
XR/XRR	Exchange Rate/Exchange Rate Regime

Executive Summary/Briefing Note

Overview: This dissertation examines why countries faced different real outcomes during the 2008-2009 Global Financial Crisis. It identifies regression models explaining-away the apparent "Advanced Economies Nature" of the crisis, seen as a correlation between higher pre-crisis income (logged per capita GDP) and worse outcomes. Case studies then examine the extreme contractions of Ukraine and Latvia, which are poorly-explained by the general model. Policy advice to mitigate crisis impact includes:

1) Manage the domestic economy in the boom-period by limiting credit and bank asset booms, and shifts in exports toward commodities undergoing global price booms.
2) Promote longer-term forms of cross-border capital for both inward and outward flows.
3) Maintain exchange rate flexibility, or peg the XR via a highly credible currency board.

Methodology:

Dependent variables (DVs) measure real GFC outcomes as the depth and duration of the peak-to-trough contraction in seasonally adjusted quarterly real GDP within 2007–2010.

This work first challenges the literature's "AE Nature" premise, showing that the income relationship spuriously reflects an underlying LMIC difference, which outperforms more-complex models on income and development. On average, LMICs faced shallower and shorter contractions than UMICs and HICs, with no significant UMIC-HIC differences. Nonetheless, the 'empirical regularity' of this LMIC difference still requires explanation.

A step-wise specification search then identifies the best regression model for each DV. A large group of independent variables (IVs) builds on those considered in the literature, adding novel measures for 2003–2007 boom-period changes in most indicators. The search process addresses methodological problems identified in the literature, including omitted variable bias, contingent significances, and outlier influence. The models explain-away the LMIC differences (and income relationships). The depth model also explains away an emerging Europe difference. Comparative case studies then examine Ukraine and Latvia as depth DV outliers poorly explained by the depth model.

Results:
(+/–: higher values correlate with worse (deeper, longer)/better (shallower, shorter) contractions)

Six IVs explain 75 per cent of contraction depth variation:

+ credit boom (by banks and OFIs)	+ boom in exports share of food, fuels & mining
+ manufacturing share of exports	– boom in government expenditures
– boom in outward FDI assets	– flexible exchange rate regime

Two IVs explain 46 per cent of variation in contraction duration:

+ foreign debt liabilities	+ bank assets booms

Case studies find that Ukraine and Latvia's very deep contractions relate primarily to their different experiences-of and responses-to GFC-period balance-of-payments (BoP) crises. Despite maintaining adequate reserves before the crisis, Ukraine and Latvia's low-credibility conventionally-pegged exchange rate (XR) arrangements led to capital flight and BoP pressures. Capital flight added to the other GFC-shocks; and maintaining their XR pegs (i.e., requiring internal adjustment) magnified all of those shocks. Ukraine was unable to maintain its peg, and under an IMF program accepted uncontrolled XR depreciation (undergoing a currency crisis, as distinct from a BoP crisis). Ukraine then pursued further internal adjustment under a new peg, deepening its contraction further. In contrast, Latvia was supported by the IMF, and especially the European Commission, in undertaking full internal adjustment (avoiding an actual currency crisis). Latvia thus maintained its aspirations for euro accession, but at the cost of a much deeper contraction. Meanwhile, Romania's flexible XR minimized capital flight and shock magnification. Estonia and Lithuania's highly credible currency board arrangements also limited capital flight, though internal adjustment still magnified the underlying shocks significantly.

Policy Advice: To avoid the worst real economic effects from international financial crises similar to the GFC, policy makers should consider the recommendations below, though trade-offs and political considerations may constrain policy adoption. These points largely—but do not strictly—align with mainstream counter-cyclical advice.

1) Manage the domestic economy during the boom-period—i.e., *do* "take away the punch bowl just as the party is getting started"—in particular by limiting:
   - growth in bank and OFI credit and bank assets during global credit booms, and
   - shifts in exports toward commodities experiencing global price booms (which may be different from the FFM set identified as critical for the pre-GFC boom).

Importantly, this first piece of advice is country-specific: regardless of whether other countries allow booms to proceed unchecked, an individual country can act to mitigate crisis fallout within its own economy.

2) Encourage cross-border capital flows that are longer-term in nature, especially:
   - Inward: promote lower levels of foreign debt owed, and
   - Outward: promote greater boom-period accumulation of FDI assets abroad.

3) Maintain a more-flexible exchange rate regime.
   - Or, if choosing a less-flexible arrangement, ensure regime credibility, such as through a legally-binding currency board arrangement supported by more-than adequate reserves.

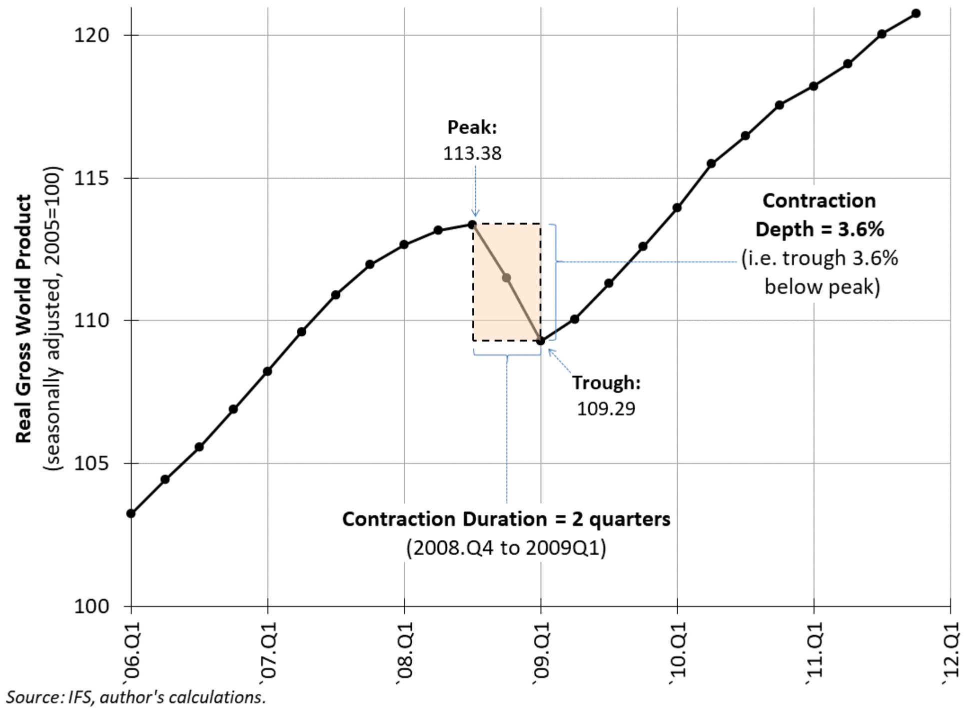
Recognizing likely trade-offs, consideration can also be given to diversifying away from over-reliance on manufacturing exports. However, recommendations cannot be made regarding the government expenditures boom result. That result is not consistent with mainstream advice to undertake for counter-cyclical fiscal policy; but it is consistent with theory on the delayed effect of fiscal stimulus. More research is needed on why this result was obtained, and whether it can be usefully operationalized in the face of future crises.

Chapter 1: Introduction

The Global Financial Crisis (GFC) of 2008–2009 was a truly global phenomenon. Global output contracted by 3.6 per cent during the two-quarter (2008Q4 to 2009Q1) "acute phase" of the crisis (Figure 1.1), and all but a handful of the 76 (non-low-income) countries considered in this study experienced outright contractions in quarterly output. This global perspective, however, masks the wide range of country-level experiences in terms of the depth and duration of GFC-associated output contractions. A small post-GFC literature seeks explanations of the wide range of country experiences of the crisis, focusing especially on the real impacts of the crisis. This thesis examines important remaining gaps in that "differential impact" literature.

The primary gap in that differential impact literature, and focus of this thesis, concerns the ostensible "advanced economy nature" of the crisis (Lane and Milesi-Ferretti 2011, 25, 30; Claessens et al. 2010, 285), short-hand for the surprise that a financial crisis could affect the Advanced Economies (AEs) at all, let alone as profoundly as this one did. The pre-GFC expectation was that Emerging Market Economies (EMEs) would be much more vulnerable to financial crises than AEs, as was the case in many crises of the late-20th century. Post-GFC research typically uses regression analysis to investigate relationships between crisis outcomes (as dependent variables: DVs) and pre-crisis country characteristics representing potential causal mechanisms (as independent variables: IVs). These studies often found (logged) per capita GDP ("income"; log[GDP/c]) to be strongly associated with worse outcomes, with richer countries experiencing deeper and/or longer

Figure 1.1. Gross World Product 2006Q1–2011Q4



contractions. This unexpected relationship is quite robust, even after controlling for a variety of other explanatory factors, the identification of which constituted the primary focus of many existing papers. In the general commentary published with one of the papers in the differential impact literature (Blanchard, Faruqee, and Das 2010), Gregory Mankiw emphasizes that: "The important question is *why the developed countries fared differently* in the crisis from emerging market countries…" (321, emphasis added). Yet, none of the papers seek to unpack the AE nature of the crisis and explain why richer countries appear to have fared worse.

This puzzle is heightened by the fact that the only theoretical explanation raised in the literature relating to a direct (i.e., causal) income-outcome relationship, suggests that the additional resources available to richer countries could help mitigate crisis effects, pointing towards a positive relationship, opposite to the observed negative correlation. A second theory suggests that the income-outcome relationship may also be influenced indirectly, with other explanatory factors—themselves correlated with income—better explaining the AEs' apparent vulnerability. This possibility is not investigated further in the existing literature, a gap that will be the focus of this dissertation.

This dissertation thus seeks to improve on the existing literature's efforts to explain the cross-country differential real impact of the GFC, and in particular to understand why countries at different levels of income experienced notably different contractions.[1] Following this introductory chapter, Chapter 2 of this thesis examines the AE characterization of the GFC more closely. The evidence for an AE nature in the existing literature involves primarily the empirical regularity of a negative linear correlation between income (as log[GDP/c]) and particular measures of GFC outcomes, a relationship which is robust to controlling for a variety of other significant explanatory factors. As an important first step in unpacking the AE nature of the GFC, Chapter 2 examines in more detail the income-outcome relationship, beyond the simple linear income specification considered in the existing literature. That analysis proceeds by considering alternate income-based and development-related models—which use combinations of different

[1] This dissertation does not engage with the Early Warning System (EWS) questions raised in the differential impact literature, treating them as out-of-scope. Rose and Spiegel (2009, 2010, 2011) argue that their inability to identify factors that explain the cross country "incidence" of the crisis suggests that EWS development is basically impossible. I see this as a red-herring, distracting from the work of understanding the GFC and other crises, as distinct from (though possibly leading to) EWS development.

orders of continuous income functions (constant, linear, quadratic, and cubic) across different income groups (lower-middle-, upper-middle- and high-income countries: LMICs, UMICs and HICs) or different development groups (developing, emerging or advanced economies: DEs, EMEs, AEs)—and identifying which of these best-characterizes the overall income relationship. In short, the analysis seeks to identify whether AEs did actually “fare differently” during the GFC.

Chapter 3 builds on these results by systematically investigating other factors that may explain the apparent AE nature of the crisis. An exhaustive process is undertaken, testing different versions of variables identified in the literature as being potentially or plausibly linked to the severity of the crisis as experienced in different countries. The intention is to construct the most robust regression model that best explains the differential impact of the crisis. In addition, the procedure identifies negative results—that is, factors that do not have a robust statistically significant relationship with the crisis outcome when other variables are included in the model. Finally, Chapter 3 assesses whether the resulting model explains away the overall income relationship identified in Chapter 2.

The final substantive chapter, Chapter 4, takes the results of Chapter 3 as the starting point for comparative case study analysis. Country case pairs are chosen based on having similar pre-crisis conditions but quite different outcomes. Two pairs of countries are chosen for primary comparison: Ukraine-Romania and Latvia-Belarus. In each pair, the first country (Ukraine or Latvia) experienced a contraction much deeper than predicted by the model developed in the third chapter, and are thus investigated as “deviant cases”. The pairing countries (Romania and Belarus) were selected as well-predicted cases, otherwise as similar as possible to the corresponding deviant case, in terms of having similar values on the explanatory factors identified as significant in the Chapter 2. These two case-pairs facilitate examination of factors affecting crisis outcomes beyond the model developed in chapter three.

To summarize, then, this dissertation has three key objectives in contributing to our knowledge about the GFC. First, I examine whether or not crisis outcomes are indeed worse for higher income countries, the AE nature of the crisis. Second, I systematically test different variables in order to construct the model that best predicts the depth and duration of the crisis in different countries based on their pre-crisis characteristics. Finally, I examine paired case studies to see if it is possible to identify either systematic or idiosyncratic factors that further explain crisis outcomes in cases not well accounted for by the model, and to provide a more comprehensive narrative of how some countries performed during the crisis.

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Chapter 2: Unpacking the "AE Nature" of the GFC

2.1 Introduction

In a commentary published along with one of the papers in the differential impact literature, Gregory Mankiw emphasizes that: "The important question is *why the developed countries fared differently* in the crisis from emerging market countries…" (Mankiw, in Blanchard, Faruqee, and Das 2010, 321; emphasis added).[1] This chapter examines whether or not the developed countries did in-fact "fare differently" and, if so, whether the linear income-outcome relationship found in the literature is actually the best characterization of how GFC severity is connected to levels of country income or development. As such, this chapter provides a crucial starting point for Chapter 3, which seeks to identify which theoretically relevant characteristics of countries actually explain their differential crisis outcomes, including between countries at different levels of income and/or development.

This chapter proceeds through five sections. Following this introductory section, Section 2.2 reviews the existing literature's analysis of the "Advanced Economies (AE) nature" of the crisis. Section 2.3 then outlines the regression-based methodology used in the chapter, detailing the dependent variables (DVs) and independent variables (IVs) used and the sample investigated, as well as the process used to assess potential specifications. Section 2.4 then presents the empirical results, with section 2.5 concluding.

[1] This quote may represent a rapporteur's paraphrase of Mankiw rather than quoting him directly.

2.2 Literature Review

Rose and Spiegel (2009) provide the only paper to explicitly consider the possible theoretical relationship between income and crisis-outcome, presenting two theories indicating different directions of effect.[2] They first suggest that richer countries may have more resources available, helping to mitigate crisis effects (e.g., enabling "a government to assist troubled financial institutions credibly": 5), thereby predicting a positive relationship between income and (a better) outcome. They alternatively consider that a country's average income level may merely be correlated with the "degree of exposure that domestic private agents took during the boom years, leaving rich nations as or more vulnerable than those of lower income" (5). In other words, other explanatory factors that are correlated with income could underpin a negative relationship between income and outcome. Rose and Spiegel explicitly consider this "matter to be an empirical one, and accordingly… condition on income throughout" their Multiple Indicators Multiple Causes (MIMIC) analysis (5).[3] They find that income and better economic performance are

[2] Note that Rose and Spiegel 2009 is a CEPR working paper, and the first in a sequence comprising Rose and Spiegel 2009, 2010 and 2011. That 2009 working paper has since been published in a peer reviewed journal as Rose and Spiegel 2012, but I retain the "2009" designation—which is also referenced in the 2010 and 2011 papers—to emphasize to the sequential order.

[3] Rose and Spiegel (2009, 2010) use a Multiple Indicators Multiple Causes (MIMIC) analysis approach, in essence a more sophisticated form of multiple regression analysis. MIMIC"s "Multiple Causes" are the multiple IVs being tested as predictors of variation in a DV; but in MIMIC the DV is itself an unobservable "latent variable" representing "crisis impact", which is measured indirectly through "Multiple Indicators". For these indicators, Rose and Spiegel use changes over 2008 in countries' output, country credit rating, stock market prices, and IMF Special Drawing Right (SDR) exchange rates. For the purposes of this literature review—in terms of MIMIC providing correlations between a set of IVs and a measure of crisis impact—MIMIC results are conceptually quite similar to those from ordinary multiple regression analysis, but with a more complicated DV. However, this approach appears to combine different "aspects" of crisis

robustly and negatively correlated, thus providing empirical evidence of the AE nature of the crisis. Although they note this empirical regularity, they do not pursue it further.

A significant and negative linear income-outcome relationship is also detected by Lane and Milesi-Ferretti 2011) for a 2008–2009 output growth DV on a broad sample of countries (N≤176), with the authors noting the result as "highlighting" the "advanced economies nature" of the crisis (30). Similarly, on sample of AEs and Emerging Market Economies (EMEs) (N≤58) Claessens et al. (2010) find a consistently significant relationship between higher income and a longer contraction duration DV (very similar in definition to the duration DV used here), which they see as "reflecting the advanced-economy nature of this crisis" (285).[4] Neither of these studies considers why this apparent "AE nature" holds. Others finding a significant negative relationship between income and GFC-outcome, without considering the implications further, include: Berglöf et al. (2009), Rose and Spiegel (2010, 2011), Frankel and Saravelos (2011), Rose (2012), Fraga and Rocha (2014), Ho (2015), and Bashar and Bashar (2020).

In contrast, Giannone, Lenza, and Reichlin (2011) do consider more directly the

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outcome—not recognizing that their different indicators should perhaps be treated as entirely distinct DVs, rather than as indirect measures of a single more fundamental "unobservable" DV. This critique is not, however, central to the issues immediately at hand.

[4] In addition to their duration DV, Claessens et al. (2010) also consider a "contraction severity" DV (very similar to my depth DV), a "decline in growth" DV (decline in average growth from 2003–2007 to 2008–2009), and a financial stress index DV, on a sample of AEs and EMEs (N=59). In separate regressions on ten individual test IVs, including income as a single control IV in each, income is consistently insignificant for the severity DV, but is negative (showing worse outcomes with higher income) in eight out of ten of those regressions. For the decline in growth DV, the income control is negative with all but one test IV, but is significant (and negative) with only two of the IVs. Higher income is also consistently and significantly correlated with a higher financial stress during the crisis.

income-outcome relationship (between logged per capita GDP and their 2008–2009 output growth DV), but still do not pursue the issue fully. In particular, they find that income—included along with population (logged) and pre-crisis average output growth (2003–2007) as control IVs in all specifications—becomes insignificant when a *EuroMoney* country risk rating (CRR) IV is introduced as a broad measure of regulatory quality. Better CRRs are significantly correlated with worse outcomes (as for income). They interpret this result as follows: "It is not income that explains the depth of the crisis, but *other variables* which are associated with it and which are captured by the [*EuroMoney* CRR IV]" (116; emphasis added). That is, they see neither income nor country risk as causally explanatory, but rather as correlated each other and with more fundamental (and unidentified) explanatory factors.

While they do not discuss the income relationship issue further, Giannone, Lenza, and Reichlin's subsequent regression results show two notable results. First, the *EuroMoney* CRR is rendered insignificant ("dominated") by the inclusion of the Worldwide Governance Indicator (WGI) for regulatory quality, with the income term remaining insignificant. Second, WGI regulatory quality is in-turn dominated by a trio of IVs from the Fraser Institute's Economic Freedom of the World (EFW) database—indicators for countries' quality of credit market regulation (CMR), labour market regulation (LMR) and business regulation (BR)—but with income now regaining its significant negative relationship with outcome. Whatever it is that explains the income-outcome relationship and was "captured" in the *EuroMoney* CRR IV appears also to be "captured" in WGI regulatory quality, but not in the EFW-trio. Giannone, Lenza, and

Reichlin's primary focus is on those EFW variables—the robustly significant credit market regulation in particular—showing that countries with more liberalized credit markets (higher CMR values) experienced worse during-crisis growth. The coefficient on income remains significant and negative throughout Giannone, Lenza, and Reichlin's analysis (wherever it is reported-on explicitly). Again, however, Giannone, Lenza, and Reichlin do not pursue the question of why this is so.

It should be noted that not all papers in the differential impact literature include an income term in their final specification. Several studies do not seem to have tested an income term at all, including: Tsangarides (2010), Keppel and Wörz (2010), Cecchetti, King and Yetman (2011), Bussière et al. (2015), and Allegret and Allegret (2019). Additionally, a common feature of most studies that find no robust income relationship is that their samples focus on a limited segment of the global income range. For example, some consider only EMEs (Blanchard, Faruqee, and Das 2010; Llaudes, Salman, and Chivakul 2011), only EMEs and developing economies (DEs) (Berkmen et al. 2012), or only EMEs and AEs (Claessens et al. 2010; Feldkircher 2012), while Ólafsson and Pétursson (2010) more explicitly consider only "countries in the upper half of the income spectrum". In each case the authors exclude at least one end of the income spectrum, either low (DEs) or high (AEs).[5] As such, it seems possible that the insignificance of the income

[5] Ólafsson and Pétursson (2011) find income insignificant in their "preferred" specifications reported for their depth or duration of output or consumption contraction DVs, for a sample representing the "upper half of the income spectrum" (N=46), which excludes LICs and most LMICs (with the exception of Thailand). Berglöf et al. (2009) do not include an income term in regressions on their (quite-small) emerging Europe sample (N=24), but find it robustly significant on global (N=176) and EME (N=59) samples.

term—if not simply omitted due to oversight or as not representing a theoretically justifiable causal mechanism—may in fact represent a sample effect, rather than a meaningful result.[6] Meanwhile, Hausmann-Guil, van Wincoop and Zhang (2016) explicitly find no significant income term, on a broad sample (N=150)—as do Kondor and Staehr (2011), on a sample of EU countries (N=27), with incomes spanning €9.4k to €68.6k. However, both of these studies appear to have tested the income terms in unlogged forms, potentially obscuring the 'AE nature' observed elsewhere. Only Cuaresma and Feldkircher (2012) appear to actually contradict the 'AE nature' result, finding on a broad sample (N=150), find that "the [logged] level of real GDP per capita in 2006 is *negatively* associated with real output *loss*" (55; emphasis added).

As discussed in the introduction, in the general commentary accompanying Blanchard, Faruqee, and Das (2010), Mankiw emphasises the importance of the AE nature question: "The important question is *why the developed countries fared differently* in the crisis from emerging market countries…" (321, emphasis added). Mankiw's comment is raised particularly in the context of critiques of Blanchard, Faruqee, and Das's EME-only sample focus, in which no income relationship was detected. In a formal commentary, Forbes suggests that the sample be expanded to include "countries that are traditionally classified as developed even though they share some characteristics with countries in the

[6] Examining Rose and Spiegel's (2011) results shows that the income term result is sensitive to sample choice, with reduced significance particularly discernable when LICs or AEs are excluded from the sample (in their "Only high-income", "Drop Advanced Economies" and "Drop poor, oil, and financial centers" sub-samples in their Table 5a on page 321); but they do not discuss this pattern explicitly.

emerging market sample," specifically identifying Greece, Iceland, Italy, Portugal, and Spain, despite recognizing the "political challenges" around doing so (311). It is, however, unclear to me why any analysis should a priori deliberately restrict the sample to any particular income grouping. In the absence of compelling theory about why countries in different income groups should behave qualitatively differently, or where on the income spectrum any such structural break should occur, a more comprehensive characterization of the crisis should use as broad a sample as possible. While explicitly recognizing limits due to data paucity, the use of a broader sample should permit more formal testing of the presumed differences between such classifications.

In contrast to considerations of the theoretical underpinnings of an AE nature, Didier, Havia and Schmukler (2012) add further empirical insight regarding the GFC income-outcome relationship. They explicitly "question the usual claim that, on impact, emerging market economies suffered less than advanced economies in terms of economic activity," as evidenced by significantly negative linear income-outcome relationships in the existing literature (2053–2055). Considering a large sample of 183 economies, they do find that "advanced economies" (defined as high-income economies under the World Bank 2010 designation) experienced higher raw growth in 2009 than did "emerging economies" (non-high-income economies with access to IBRD borrowing). But when taking into account relative pre-crisis growths by considering the "collapse" in growth (i.e., the percentage point difference in real GDP growth between 2007 and 2009), the emerging economies' mean growth collapse (6.1pp) was not statistically significantly smaller than that for the advanced economies (7.2pp). While the authors also show that "low-income economies" (non-high-income economies, with IDA—but not IBRD—borrowing access) did experience significantly smaller average growth collapses (-3.2pp), the rest of the paper focuses on explaining the EME-AE non-difference given that EMEs faced worse outcomes than AEs during the crises of the late 1990s.[7] However, their regression analysis of correlates of growth collapses leaves that "low-income difference" significant, when their five "arguably uncontroversial explanatory variables" identified in the existing literature (2065, footnote 18) are added—each individually or all simultaneously—to regressions including the income group dummies.

Didier, Havia and Schmukler thus raise important questions about the basic premise of the AE nature issue: whether—and in what form—GFC outcome was related to income. It should be noted, though, that their results are obtained using a measure of crisis impact based on annual-level data (2009 growth minus 2007 growth), which may mask the higher-frequency details of the economic collapse, potentially conflating deeper collapses with earlier contraction onset (including that not directly related to the GFC) or shallower collapses with faster recoveries (which for many countries began early in 2009).

This chapter thus seeks to unpack these ideas about income and crisis severity,

[7] In fact, Didier, Havia and Schmukler (2012, 2057) first identify a statistically significant "U-shaped" quadratic relationship between their growth collapse DV and income (as 2007 logged per capita GDP PPP). Although they appear to prefer the quadratic designation, the dummy variables for their advanced, emerging and low-income groupings actually provide much better explanatory power (R^2=.573, versus .253 for the quadratic specification; see their Table 2: p2059). Additionally, their Figure 1, illustrates the quadratic relationship, showing more of a levelling-off at higher incomes, rather than the actual U-shaped reversal in direction after reaching a quadratic's extreme (minimum or maximum) value (2058).

testing whether or not Mankiw's starting-point is actually correct: Did more-advanced economies in-fact have worse crisis experiences than those less-advanced? Specifically, I examine whether any differences in crisis outcome related to income are best represented by a continuous relationship that transcends different income or developmental categories, or whether any structural breaks in performance align with discrete classifications such as the World Bank's income group classification, or a development classification based on AE, EME and DE categorization.

2.3 Methodology

This chapter investigates the apparent AE nature of the GFC, questioning whether the simple linear income-outcome relationship identified in the differential impact literature is in-fact an appropriate characterization. The empirical analysis examines whether AE countries actually experienced the GFC in a qualitatively different manner than other countries. Doing so requires examining at whether, and in what way, countries' GFC outcomes are best characterized in relation to income or level of development, and identifying whether there are distinct thresholds of crisis experience that correspond roughly to distinct income thresholds. In this context, income and development are not themselves considered explanatory factors: there is no theoretical expectation that they themselves represent causal mechanisms directly influencing country outcomes during crises like the GFC. As such, this chapter tests specific hypotheses describing broad patterns in the cross-country differential impact of the GFC. Rather than testing explanatory theories, the focus is on identifying the most accurate descriptive pattern. The associated explanatory work will be undertaken in the next chapter, testing whether or not any successful estimating models—those identified as providing significant explanatory power—also "explain away" any income or development related patterns identified here.

The overall approach follows the methodology of the differential impact literature closely, undertaking regression analysis testing hypotheses concerning the relationship between independent variables (IVs) representing pre-crisis country characteristics—pre-crisis, so as to avoid issues of endogeneity—and dependent variables (DVs) reflecting measures of crisis outcome. As this work is exploratory in nature, numerous regression models are tested, involving a wide-range of increasingly complex IV specifications representing particular hypotheses concerning the "nature" of any income or development-related pattern in crisis outcomes. As such, the analytic process and selection criteria for selecting between different models, as well as robustness and sensitivity concerns, will be addressed in this section, before the analysis is undertaken.

2.3.1 DVs, IVs and Sample

For this study, two distinct DVs will be considered: the "vertical" depth and "horizontal" duration of the country-specific contractions in output (seasonally adjusted quarterly real GDP) associated with the GFC.[8] In this simple model of crisis experience,

[8] Quarterly output data was obtained from the IMF's IFS database. Some countries' quarterly output data was available *already* seasonally adjusted. Other countries' data were available only in non-adjusted form, but covering a long-enough time-span prior to the crisis to allow seasonal adjustment by the author

each country's GFC-associated contraction is defined by its pre-crisis peak output (in 2007Q4–2008Q4) and the subsequent trough after 2008Q4 (which occurs for all countries by 2010Q1). The duration of the contraction is then the number of quarters between peak and trough, while depth is the relative difference between peak and trough output values, expressed as a percentage.[9] Using quarterly- rather than annual-level data, these DV definitions provide the benefits of finer resolution of crisis experiences, country specific contraction periods, and distinct contraction durations. Of note, the depth and duration measures of crisis impact are only mildly correlated, with less than a quarter of each DV's variation accounted for by variation in the other (R^2=.232 with iterated outliers excluded). Depth and duration thus appear to represent distinct dimensions of a country's crisis experience; while some overlap between factors explaining these two measures of GFC-outcome seems likely, there will also likely be explanatory factors unique to each.[10]

(using WinX12). Only Colombia was available both seasonally adjusted and not, and seasonal adjustment through WinX12 produced results corresponding very closely with the existing seasonally adjusted version. Many countries—particularly LICs—do not provide quarterly data, and others did not have adequate coverage for seasonal adjustment, and thus were excluded from the sample.

[9] A deeper contraction is represented by a larger *positive* value for the depth DV, which is the reverse of the "growth" DVs used in some papers. As a country's contraction may last only one quarter, I use the term "contraction" rather than "recession" to avoid confusion with the two-quarter definition for a "technical recession". There are also countries that experienced no contraction, and are treated as having *zero* quarters of contraction duration, and 0% contraction depth.

[10] The relatively weak relationship between the depth and duration DVs also undermines the view that a single DV, *combining* measures of depth and duration into a single measure of "recession magnitude" or "strength" would represent well the cross-country variation in the output contraction. Mazurek and Mielcová (2013) "propose" a new "quantitative recession magnitude scale" intended to represent the "strength" of a recession. This measure is defined as $M=\log_2(D\cdot G)$, where: D is the recession duration in quarters (with $D\geq 2$, focusing on technical recessions); and G is the "mean percentage decline… of real GDP for the respective D quarters" (185–6). This measure in essence represents the *logged* area of the rectangle D×G. The resulting measure has a number of mathematical properties described by Mazurek and Mielcová (186–7) that would be appropriate for a hypothetical single-value measure of recession strength; but crucially

As many countries as possible are included in the sample in order to obtain global representation across a broad range of income levels. Nevertheless, the use of quarterly data from the IMF's International Financial Statistics (IFS) database for calculating the depth and duration crisis outcome variables excludes many countries that do not report output below the annual frequency. The result is a basic sample of 76 countries (N=76), including 36 high-income countries (HICs), 22 upper-middle-income countries (UMICs), and 17 lower-middle-income countries (LMICs), but only one low-income country (LIC). This sample largely expands on those of other studies using quarterly level output data—also improving on their coverage across the income spectrum—such as Claessens et al.'s (2010) sample of 58 AEs and EMEs, Ólafsson and Pétursson's (2010) sample of 46 countries from the "upper half of the income spectrum", and Llaudes, Salman, and Chivakul's (2011) sample of 50 EMEs.[11] However, this sample is much narrower than

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the measure fails to distinguish between recessions that *are deep-but-short* and those that are *long-but-shallow*, arguably representing quite different contraction experiences. Their single measure would, e.g., roughly equate the contractions experienced by Botswana (BW) and Jamaica (JM), or by Kyrgyzstan (KG) and New Zealand (NZ) or perhaps Norway (NO) (see Figure 2A.1). As such, the distinctiveness of these "vertical" and "horizontal" (i.e., "temporal") dimensions appears important, while also acknowledging that these measures still represent quite a simple model of contraction dynamics and experience.

[11] Claessens et al.'s (2010) sample of 58 AEs and EMEs includes the Dominican Republic and El Salvador not present in the sample used here, but does not include 20 countries added here: 3 HICs (Malta, Brunei, Taiwan), 7 UMICs (Belarus, Jamaica, Serbia, Uruguay, Belize, Botswana, and Mauritius), 9 LMICs (Ecuador, Egypt, Georgia, Guatemala, India, Indonesia, Jordan, Macedonia FYR, Tunisia), and the lone LIC (Kyrgyzstan). Ólafsson and Pétursson's (2010) 46 country sample from the "upper half of the income spectrum" does not include any countries not in the sample here, but omits 32 of them: 3 HICs (Brunei, Singapore, Taiwan), 12 UMICs (Argentina, Brazil, Bulgaria, Costa Rica, Malaysia, Belarus, Jamaica, Serbia, Uruguay, Belize, Botswana, Mauritius), all 16 LMICs (except Thailand), and the lone LIC (Kyrgyzstan). Llaudes, Salman, and Chivakul*'s* (2011) 50 EMEs exclude 29 of the UMICs in this thesis's sample, as well as 3 UMICs (Belize, Botswana, Mauritius) , and 1 LIC (Kyrgyzstan), but does include 14 countries not included here: 5 UMICs (Kazakhstan, Lebanon, Montenegro, Panama, Venezuela), 7 LMICs (Albania, Bosnia and Herzegovina, Dominican Republic, El Salvador Mongolia, Paraguay and Sri Lanka) and 2 LMICs (Pakistan, Vietnam).

those with DVs relying only on annual-level data, such as Berglöf et al.’s (2009) global sample of 176 countries (reduced to 55 EMEs for later testing), Lane and Milesi-Ferretti’s (2011) global sample of 163 countries, and Rose and Spiegel’s (2009, 2010, 2011) sample—also used by Giannone, Lenza, and Reichlin (2011)—of richer and more populous countries (excluding those with per capita GDP less than USD 4,000 and with population less than 1 million).[12,13] However, because countries’ contractions often began in Q3 or Q4 of 2008 and often troughed in Q1 or Q2 of 2009, the quarterly peak-to-trough contraction provides a better measure of GFC impact than annual-level measures (e.g., considering the difference in output or growth between 2008 and 2009 as a whole), which may conflate smaller contractions in 2008 with larger recoveries in 2009

To characterize accurately the apparent AE nature of the GFC, different models will be considered, comprising combinations of continuous functions on income (as logged per capita GDP, in linear, quadratic, and cubic forms) and discrete country groupings classified either by income or development. The discrete income grouping follows the World Bank’s income Group classification from 2007, distinguishing between HICs,

[12] As compared to Berglöf et al. and Lane and Milesi-Ferretti, the sample here omits around 46 LICs (from a total of 47), 34 LMICs (of 51), 15 UMICs (of 37), and 11 HICs (of 46). Of additional note, the sample here includes only 4 of the 22 countries in Lane and Milesi-Ferretti’s sample identified as among the world’s top–25 oil exporters. The sample here also includes all but one of the countries in Lane and Milesi-Ferretti’s sample identified as having its 2007 financial openness ratio (financial assets plus liabilities to GDP) greater than 800 per cent, but includes only 2 of 10 identified as being an international banking center or with significant offshore activity.

[13] Berkmen et al. (2012) also consider first a sample of 40 EMEs and then a larger sample of 121 developing countries—i.e., excluding AEs from the scope of their investigation—while using an annual-level DV measuring 2009 forecast error. Likewise, Blanchard, Faruqee, and Das (2010) examine only 29 EMEs, with an acute phase unexpected growth DV, measured as the difference between actual 2008Q4–2009Q1 growth and the corresponding IMF forecast from April 2008.

UMICs and LMICs.[14] As Kyrgyzstan is the only LIC with adequate quarterly output data, to simplify the analysis it is included with the LMICs throughout. The discrete development grouping uses three categories of advanced, emerging, and developing economies, in which there are: 31 advanced economies (AEs), as per the IMF World Economic Outlook (WEO) of April 2007; 37 emerging market economies (EMEs), following the *Consensus Forecasts* identification, as per Berkmen et al. (2012); and 11 developing economies (DEs), those not identified as AEs or EMEs.[15,16,17]

2.3.2 Analytic Process

The analysis starts by examining the basic claim in the literature that there is a simple linear relationship between income and each of the depth and duration DVs. The

[14] The nine non-OECD HICs are: Brunei, Cyprus, Estonia, Hong Kong, Israel, Malta, Singapore, Slovenia and Taiwan. Consistent with visual inspection of Figures 2.3 and 2.4, formal testing (not reported explicitly) finds OECD and Non-OECD HICs insignificantly different, so they are not considered separately.

[15] Notwithstanding that classification, Brunei is treated here as an AE and Malta and Slovenia as EMEs. Brunei (BN) is an oil-rich HIC, but which is generally considered neither “advanced” nor “emerging” in any industrial sense. I include it here with the AEs, as it is the only non-AE (by the IMF classification) with such high GDP per capita, making it quite distinct from the other DEs.

Malta (MT) is a non-EME in Berkmen et al.’s (2012) classification (which includes no AEs), but attained IMF AE status as of the April 2008 WEO, following its January 2008 Eurozone accession. However, Malta only attained consistent HIC status as of 2002—after oscillating between UMIC and HIC since 1998—but has not yet joined the OECD. As such, Malta can arguably be considered an AE (as per the IMF), an EME (as not quite an AE, until its 2008 Eurozone accession), or a DE (as not an AE or an EME, as per Berkmen et al. With not as high an income as Brunei to clearly distinguish it from other DEs). I will treat it here as an EME, though this choice is largely arbitrary.

Slovenia (SI) is considered an EME in Berkmen et al.’s classification, and I follow that decision, despite it attaining AE status in the IMF’s April 2007 WEO, following Eurozone accession in January 2007

[16] The income and development groupings are both considered because the literature conflates them, treating evidence of a linear “income-outcome” relationship as reflecting or highlighting the “AE nature” of the crisis. Including both allows comparison of hypotheses related to each possible perspective.

[17] The full sample, organized by income group and also indicating developmental classification, is presented in Table 2A.1, and is also listed in Table 2A.2, arranged alphabetically by their two-letter country codes (also used for labelling the figures). Table 2A.3 explicitly lists countries excluded from the sample.

second step is to probe the relationship further, testing alternative hypotheses representing increasingly complex, alternate characterizations of the relationship between crisis outcome and a country's discrete income or development categorization. After considering the linear income relationship, simple combinations of the dummy IVs within each of the income and development classifications are considered, testing for differences between the groups' average depths and durations of contraction output. More-complex specifications then combine the linear income term with the dummies from each group, as well as with interactions between income and those dummies. The specifications with no interaction terms (i.e., with only the income term and some combination of non-interaction dummies from one of the two systems) represent a consistent income-outcome relationship across all countries, but further test whether—when controlling for that income-outcome relationship—different country groups fared differently on average than others. The specifications including the interaction terms then also allow the groups to have differently sloped income-outcome relationships. This arrangement is repeated with quadratic and cubic functions on income, and again adding the dummy IVs and interaction terms. The specifications without any interaction terms again represent a consistent polynomial (quadratic or cubic) shape across all countries, while allowing a further distinct vertical shift for the different groups. The specifications including interaction terms then allow groups their own distinct quadratic or cubic shape.[18] The numerous specifications under

[18] Note that while a quadratic relationship on income seems a theoretically reasonable possibility, the inclusion of the cubic form is more intended as the start of a Taylor Series polynomial expansion,

explicit consideration are then evaluated according to the model selection process outlined in the next sub-section, identifying a best specification for each DV.[19]

In the face of testing a large number of specifications, each representing slightly different hypotheses about the potential relationships between crisis outcome and either income or development status, the following analytic process provides transparent and explicit justification for final model selection. Two primary criteria are used: the statistical significance of IVs, with the presence of insignificant terms invalidating a specification, and full significance validating it (at least tentatively) for further consideration; and explanatory power, used as the final arbiter, selecting between "valid" specifications.

In addition, it is important to take into account the potential influence of outliers, heteroscedasticity and multicollinearity, and to address these issues "up-front" as part of the model selection process—that is, before applying the explanatory power criterion,

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representing an approximation of (and test for) more complex non-linear relationships. The further inclusion of the different classification systems' dummy IVs and their interactions with the quadratic or cubic functions on income primarily complete the extension of the similar analysis with the linear function of income. By allowing this large number unconstrained functional forms, it would be unsurprising to find *some* spurious specifications that fit the data relatively well, so vigilance against overfitting is also necessary.

[19] Note that not all of the possible specifications below cubic order can be examined explicitly. There are 32,767 ($=2^{15}-1$) possible combinations of the linear, quadratic and cubic income terms, the three dummy IVs (from one of the income or development classifications), and the nine dummy-income interaction terms (in linear, quadratic or cubic form), all including an Intercept term. This large number is reduced greatly by: (1) eliminating specifications that include all three dummy IVs, or all three dummy-income interactions at a given order, so as to avoid perfect linear dependence; and (2) eliminating specifications that include a higher order income term but not all of its corresponding lower order terms—i.e., if a cubic term is included, then so are the corresponding quadratic and linear terms—such that all polynomial functions are fully unconstrained. If a specification were to then show a significant higher order term, but an insignificant lower order term, the reduced form could be explicitly generated, if it had not already been generated elsewhere. Similarly, the models examined explicitly only consider specifications in which each of the income (or development) groups share the same order of income function (constant, linear, quadratic or cubic). The necessary information to identify more complex combinations—e.g., a constant function of income on LMICs, with a quadratic function for UMICs and a cubic function for HICs—is present in the specifications allowing independent functions of different orders for each group.

rather than only as part of post hoc robustness testing, thereby avoiding both false-positives and false-negatives. In comparing models involving related continuous variables (e.g., on income) and discrete groupings (e.g., income groups), the potential role of between-group effects as a confounding factor must also be considered. Each of these concepts—as well as the analytic concept of "isomorphic specifications"—is discussed further below.

In selecting specifications for further consideration, or rejecting them, **IV significance** is considered first, retaining only specifications in which all IVs are statistically significant. If, in a given specification, a particular term is statistically insignificant (i.e., insignificantly different from zero) that term can be eliminated, reducing the specification to one that is simpler. Then, if other terms that were significant in the original specification do not retain their significance in the reduced specification—that is, if their significances are not robust to the elimination of the insignificant term—their original significance would be rejected as a false-positive.[20]

Related to IV significance, the recognition of **isomorphic specifications** can also help in judging the validity of a particular specification. Isomorphic specifications here refers to a set of specifications involving dummy IVs which represent the same essential model, presented relative to different reference groups—that is, the combination of any groups with dummies excluded from the specification. Terms in the specification not involving dummies—individually or in interaction form—then describe the reference

[20] Thus, I follow the stepwise approach of eliminating insignificant IVs from particular specifications, justifying this choice based on robustness considerations and since their inclusion would technically impose a mis-specification of the equation.

group in absolute terms, while terms including any dummies describe the corresponding group(s) in relative terms, as a difference from the reference group. Isomorphic specifications then represent the same model, from the perspective of different reference groups, providing additional information about each group’s significances in absolute terms (when used as the reference group), and each other groups’ significances in terms relative to each reference group.

Outliers are observations with relatively extreme DV and/or IV values—usually defined as values beyond plus-or-minus two standard deviations from the sample mean—which can strongly influence statistical results, including regression coefficients, as well as the sample’s own mean and standard deviation. Outliers can be “influential” either in generating significant results that are not robust to outlier exclusion (false-positives), or in hiding significant results that would be discernable only with outliers excluded (false-negatives). Such false-positives are generally taken to represent outlier influence that does not represent a true relationship—because the relationship does not hold with those outliers removed—and so the model is deemed invalid. False-negatives, on the other hand, are taken to reflect a valid overall relationship, but which does not apply fully to those influential outliers: something is not accounted for in the model that does not adequately account for the outliers’ different results. Post-hoc analysis of outlier influence can only detect false-positives, but not false-negatives. To avoid outlier influence then, model selection should be undertaken on a sub-sample with outliers excluded. Subsequent analysis can then test whether or not any significant results are robust to outlier re-inclusion, indicating how well the outliers fit with the sub-sample

Two approaches to identifying outliers will be used: one “basic” and one “iterated”. **Basic outlier identification** follows the standard rule-of-thumb, identifying as outliers any observations with DV or IV values beyond the sample’s mean plus-or-minus two standard deviations (i.e., with Z-score magnitudes greater than 2). This approach identifies five outliers on the depth DV (Estonia, Botswana, Latvia, Lithuania and Ukraine), three on the duration DV (Estonia, Iceland and Jamaica), and two on the income IV (Kyrgyzstan and India). Basic outlier exclusion thus reduces the full sample (N=76) to sub-samples of N=69 observations for the depth DV, and N=71 for duration, with outliers on income excluded for both.[21] This basic approach is easy to implement, but may leave the resulting sample “with basic outliers excluded” including its own outliers—that is, with values beyond that smaller sample’s own “mean plus-or-minus two standard deviations” range.

Iterated outlier identification seeks to remedy this problem by iterating the basic outlier identification process, to obtain a “core-sample” containing none of its own outliers.[22] In the current analysis, further to the basic outliers identified above, three additional “iterated outliers” are identified for the depth DV (Turkey, Ireland and Iceland),

[21] Note that outlier analysis only applies to interval-ratio variables, and not to binary dummy IVs, for which means and standard deviations are of limited meaning.

[22] This problem of (potentially influential) outliers remaining within a sub-sample excluding outliers identified through the simple “basic” approach to outlier identification (of $|Z|\geq 2$) arises in the first place because any sample’s own mean and standard deviation may be influenced by its outliers. It would be preferable to identify outliers as those observations with Z-score magnitude greater than 2, with the Z-score defined in relation to the sub-sample *already excluding* outliers (and thus with Z-score, calculated using sample mean and standard deviation, not themselves influenced by any outliers); but as outliers have not already been identified, an indirect process must be used for identifying a “core sample” that contains none of its own outliers: this is the purpose of the iterated approach to outlier identification.

three for the duration DV (Ireland, Brunei, Latvia), and five more for income (Luxembourg and the Philippines, as well as Indonesia, Morocco and Bolivia); these iterated outliers reduce the full sample (N=76) to core-samples of N=61 observations for the depth DV, and N=63 for the duration DV.[23]

Heteroscedasticity refers to unequal variation in the residuals of an estimating model, which—when uncorrected for—potentially bias the standard errors of the estimated coefficients, altering the level of significance of estimated IV coefficients. As with outlier analysis, preliminary heteroscedasticity analysis is included "up-front", during the model selection process, rather than only as part of subsequent robustness testing, to avoid false-positives and false-negatives. A "false positive" occurs when heteroscedasticity exists and heteroscedasticity-corrected ("H-corrected") results indicate that the relationship is not significant, but uncorrected results (falsely) show a significant relationship. A "false negative" occurs where heteroscedasticity exists and H-corrected results indicate a significant relationship, but uncorrected results (falsely) show no significant relationship.[24]

[23] Two critiques of this iterated outlier approach arise. Iterated outlier identification has the potential to reduce sample size dramatically—particularly when considering numerous distinct IVs (as will be undertaken in the next chapter)—potentially to the point of rendering the subsequent analysis unusable. Additionally, the core-sample that excludes iterated outliers may itself be sensitive to the precise "basic" definition that is iterated. That is, a different core sample could result from using a slightly different K-value in the "mean plus-or-minus 'K' standard deviations" definition of basic outliers (e.g., using K=1.9 or K=2.1, rather than the standard K=2 rule-of-thumb). The "core sample" is thus not a clearly "analytic" concept, instead potentially depending on the particular rule-of-thumb value chosen for iteration. While recognizing these critiques, this chapter follows the iterated approach, with results tables showing regression estimates on the sample with iterated outliers excluded. Robustness to the re-inclusion of outliers is then considered explicitly for the specifications selected as best for each DV.

[24] Note that H-correction does not always correct SE values in one "direction" (e.g., always increasing, or always decreasing them). Auld (2012) discusses this in a blog post on "The Intuition of Robust Standard Errors".

To avoid such false-results due to failure to correct for heteroscedasticity, a fully rigorous analysis would first test for heteroscedasticity between the DV and each IV in a specification and H-correct (or not) the results accordingly—on an individual IV-by-IV basis—so that specification selection takes heteroscedasticity fully into account. A simpler approach, used here, instead generates both the uncorrected standard errors and p-values (SE and p) and generalized H-corrected versions (SE_r and p_r), and considers whether the two indicate different outcomes—that is, whether one indicates a significant relationship while the other indicates insignificance.[25] If the two approaches disagree, then further analysis would be necessary to determine whether heteroscedasticity is present and which result to accept; if they agree, then the issue of heteroscedasticity correction will be deemed moot and not pursued. As it turns out, heteroscedasticity concerns are of no concern in the current analysis: only a few instances of disagreement between uncorrected and H-corrected results occur—and exclusively-so in specifications that are deemed invalid, based on other selection considerations.

Multicollinearity arises when two or more IVs in a specification are themselves highly correlated, leading to potentially unstable coefficient estimates and difficulty interpreting any results obtained. For this study, multicollinearity analysis will use variance inflation factors (VIFs) to test for potential multicollinearity. A VIF value is calculated for

[25] The particular form of H-correction used for the p_r-values here is Davidson and MacKinnon's (1993) "HC2", as implemented as the default in Barreto and Howland's (2005) OLSReg Function Excel Add-In. (Their OLSReg function was modified by the author to present the output in slightly different way, and provide p- and p_r-values at the same time, but preserves the underlying mathematical calculations.)

each IV in a given specification. The VIF measures by how much collinearity inflates the variance of the IV’s coefficient estimate, thereby also inflating its standard error and p-value and reducing its significance. The VIF for IV_j (with j=1…M, where M is the number of IVs in the specification) is calculated as $VIF_j = 1/(1-R_j^2)$, where R_j^2 is the R^2-value obtained from regressing IV_j, treated as a DV, against the remaining M−1 IVs in the original specification. For example, a VIF value of 10 for a particular IV_j corresponds to an R_j^2 of .90, indicating that 90 per cent of the variation in that IV is accounted for by variation in the other IVs. In this case, as the standard error of the coefficient estimate is the square root of the variance, the corresponding SE_j is $\sqrt{10}$ (≈3.16) times what it would be if the IVs were perfectly uncorrelated (i.e., with VIF_j=1 and R_j^2=0). A common rule-of-thumb considers multicollinearity very likely if any IV’s VIF value is greater than 10, while some use threshold VIF values as low as four (R_j^2=.75) (O’Brien 2007, 674). However, O’Brien also clarifies that even a VIF value as high as 40 does not in and of itself discredit regression results, or require the use of techniques to reduce multicollinearity (e.g., by eliminating of one or more IVs, using ridge regression, or combining two or more IVs into a single index IV); such high VIF values do require additional consideration, including the possibility that clarity about results will not be obtained.

As with outliers and heteroscedasticity, it is also wise to consider multicollinearity “up front”—that is, during the specification selection process—rather than only during post hoc robustness testing of otherwise positive results, because multicollinearity can generate “false negative” results as well as (potentially) “unreliable positives” with unstable coefficients (see O’Brien 2007). In the presence of multicollinearity, a false negative occurs when a coefficient’s standard error is inflated enough that the coefficient estimate would be judged statistically insignificant at standard levels of significance. To address potential multicollinearity in this chapter, special consideration is given to specifications for which any IV has a VIF larger than four (i.e., using the very conservative VIF threshold of 4 to flag potential issues related to multicollinearity), whether or not all IVs in the specification have coefficients deemed significant.

Particular to this chapter is also the consideration of more complex specifications including combinations of the linear income term, income (and development) group dummies related to the income term, quadratic and cubic income terms, and interactions between these various terms. Because of the close mathematical relationships between all of these terms, the VIF values in those complex specifications will themselves necessarily be elevated. In the actual results for this chapter, this form of VIF inflation is present for most of the more complex specifications, including many for which some coefficient estimates are deemed insignificant, which could potentially represent false negatives due to correspondingly inflated standard errors. In nearly all of these cases the corresponding specification-level R^2 and adjusted-R^2 values are only modestly elevated relative to those of the specifications in which all coefficients are deemed significant, and—with only a few exceptions for the duration DV, requiring further consideration in the results section—all of the AICs and BICs (discussed below) are higher.

Additionally, of the specifications with all terms deemed significant, only two for the depth DV (and none for the duration DV) have any VIFs greater than 4; but these specifications all have lower R^2 and adj.-R^2 and higher AIC and BIC values than other specifications with coefficient estimates all significant. The remaining “all-terms-significant” specifications for both the depth and duration DVs all have all VIFs not only less than four, but less than two. As such, multicollinearity is judged to produce no problems here, either in terms of generating false negatives or unreliable positives.

In considering models involving continuous functions, an implicit assumption is that the continuous relationship (whether linear or higher order) captures a **within-group effect**, in which that relationship holds equally across the whole range of the continuous IV, and is not in-fact the result of a **between-group effect**. Simply comparing the explanatory power of competing specifications cannot rule-out between-group effects when any of those specifications includes a continuous term spanning more than one group. More explicit examination of whether that relationship reflects a similar within-group across all relevant groups, or whether it merely reflects a between-group effect, is required. As will be demonstrated, this analysis is achieved by examining sets of isomorphic specifications that isolate within-group from between-group effects, but which may have been excluded from consideration for final model status by the insignificance of some IVs.

Having narrowed the range of valid specifications being considered—particularly through IV significance, while avoiding possible false-positives and false-negatives of outlier influence and heteroscedasticity, and after ruling-out between-group effects—**explanatory power** will be considered decisive in selecting the “best” specification from among those deemed "valid". Explanatory power primarily refers to the coefficient of determination (the R^2-value), reporting the proportion of variation in the DV that is mathematically accounted for through variation in the IVs included in multiple regression. So long as there are no other overriding concerns (e.g., re IV significance, outlier influence, heteroscedasticity, or multicollinearity), a higher R^2-value indicates that one specification performs better at predicting DV values from the IV data than does another. The adjusted-R^2 (adj.-R^2) value is a refinement on R^2 that corrects for the mathematically automatic increase in R^2 occurring with the addition of further IVs, whether or not those IVs actually provide additional explanatory power (i.e., are themselves significant). Comparisons using adj.-R^2 values are only valid between "nested" specifications, in which one specification includes all IVs in the other, plus one or more others. Thus, a more nuanced rule-of-thumb is that one (otherwise valid) specification is "better" than another if it has a greater R^2 value, and—if the specifications are nested—also a greater adj.-R^2 value. In this way, the set of "valid" specifications can be ranked, and the "best" specification identified for each.

Standard "information criterion" approaches also seek to improve on the notion of explanatory power, and so provide alternate ways of ranking (otherwise valid) specifications. The Akaike information criterion (AIC) and the Bayesian information criterion (BIC) are two commonly used information criteria for which lower values indicate better fit (better "use" of information in the data). As these are readily calculable, and allow comparison between specifications that are not nested, the AIC and BIC values for each specification are included in the regression output, providing a second (and third) check on the rankings provided through the R^2 and adj.-R^2 rule-of-thumb. Any discrepancies between the approaches will be considered closely.

2.3.3 Robustness

As outlier influence, heteroscedasticity robustness, and multicollinearity testing are already included in the model selection process, minimal further robustness testing is required after specification selection. Outlier robustness will be discussed explicitly, highlighting differences between results with different outliers (iterated or basic) excluded or included. Some further consideration will also be given to specifications showing signs of potential multicollinearity. Additionally, the main presentation of results will focus on the income group (LMIC, UMIC, HIC) classification, with the weaker results relating to the development (AE, EME, DE) classification considered in the discussion on robustness.

2.4 Results

Table 2.1 provides the main results for regressions on the depth and duration DVs using the samples excluding iterated outliers on the income IV and corresponding DV. Table 2.2 provides additional results discussed explicitly: near-miss results for the depth DV; and results used for within- vs. between-group analysis for the duration DV. The regression output includes each term's coefficient value and regular (non-heteroscedastic robust) p-value, as well as the sample size (N) and measures of explanatory power (R^2,

Table 2.1. Main Regression Results

DV	**Contraction Depth**				**Contraction Duration**			
Model	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
log[GDP/c]	**3.65***** (.005)				**2.79***** (.001)			
LMIC		**-3.87***** (<.001)	**-3.89***** (<.001)			**-1.91***** (.002)	**-2.18***** (.001)	
UMIC			**-0.07** (.932)	**3.83***** (.001)			**-0.70†** (.180)	**1.48**** (.027)
HIC				**3.89***** (<.001)				**2.18***** (.001)
Constant	**-10.38**** (.050)	**5.87***** (<.001)	**5.90***** (<.001)	**2.01**** (.018)	**-8.37**** (.015)	**3.82***** (<.001)	**4.10***** (<.001)	**1.92***** (<.001)
N	61	61	61	61	63	63	63	63
R^2	.127	.232	.232	.232	.181	.151	.176	.176
Adj.R^2	.112	.219	.206	.206	.168	.137	.149	.149
AIC	308.3	300.5	302.5	302.5	254.8	257.0	257.1	257.1
BIC	314.6	306.8	310.9	310.9	261.2	263.5	265.7	265.7

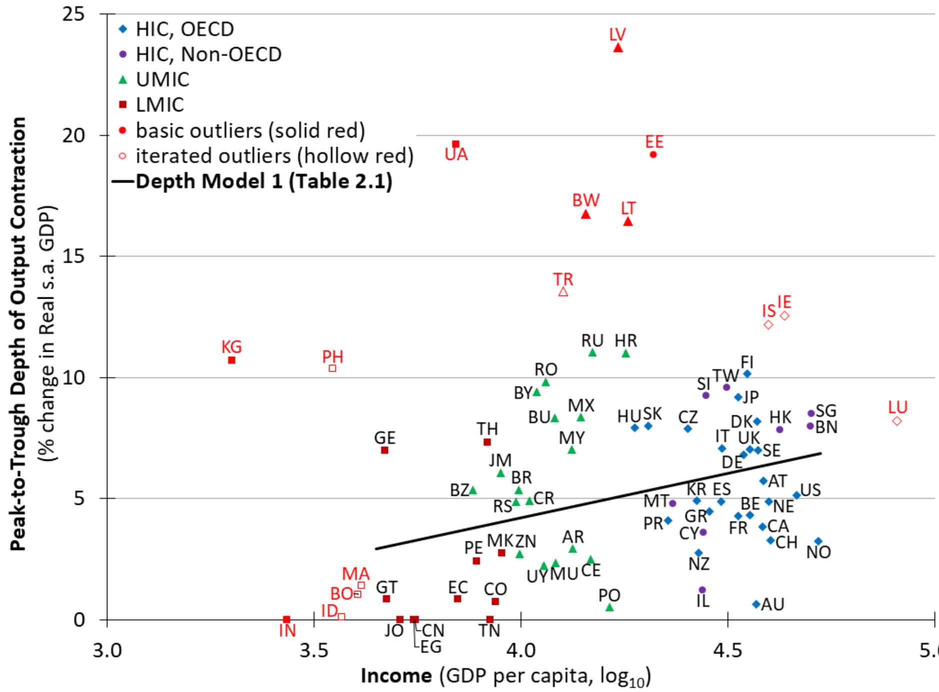
*p-values in parentheses; ***: p<.01; **: p<.05; *: p<.1; †: p<.2 (2-tailed tests)*

adj.-R^2) and information criteria (AIC, BIC) for each specification.[26]

For each DV, model [1] represents the simple linear income relationships, which are illustrated in Figures 2.1 and 2.2. For both DVs the significant and positive linear income-outcome relationships confirm the observation in the literature, reflecting the apparent AE nature of the GFC through significant and positive linear income-outcome relationships for both the depth and duration dimensions of the GFC-related output contraction. These linear models on income indicate that, ceteris paribus, a 25.9 per cent increase in per capita GDP (i.e., a 0.1 unit increase in logged per capita GDP) corresponds

[26] The VIFs have been supressed in the tables to save space, but are all less than 4.

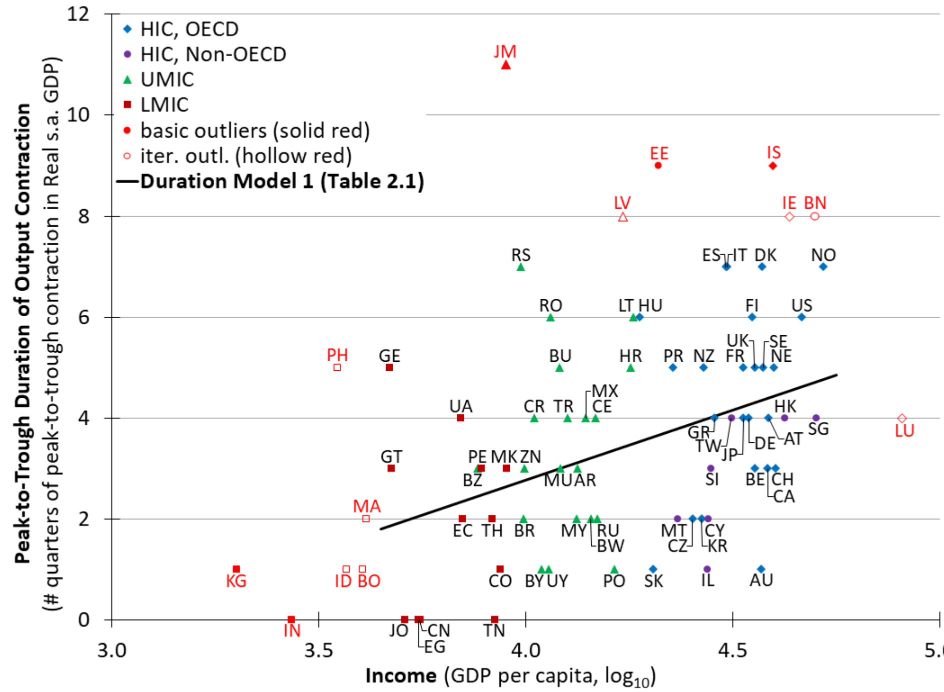
Figure 2.1. Depth DV vs. Income: Simple Linear Model



Source: IFS, author's calculations.

to a contraction that is 0.37 per cent deeper and 0.28 quarters (≈25 days) longer. Yet other factors at least somewhat unrelated to income must also be at play, with income accounting for less than 20 per cent of variation in either DV (R^2=.127 for depth and .181 for the duration). This low explanatory power is reflected visually in Figures 2.1 and 2.2 by the dispersal of many (non-outlier) observations away from the linear models. Additionally, many LMICs experienced very shallow contractions, including no actual contraction—only moderate slowing with growth remaining positive—for China (CN), Egypt (EG), India (IN), Jordan (JO) and Tunisia (TN), thus with both depth and duration IV values of "0". The average LMIC contraction also appears shallower than the averages for the more similar UMICs and HICs, although several LMICs—Kyrgyzstan (KG), the Philippines

Figure 2.2. Duration DV vs. Income: Simple Linear Model



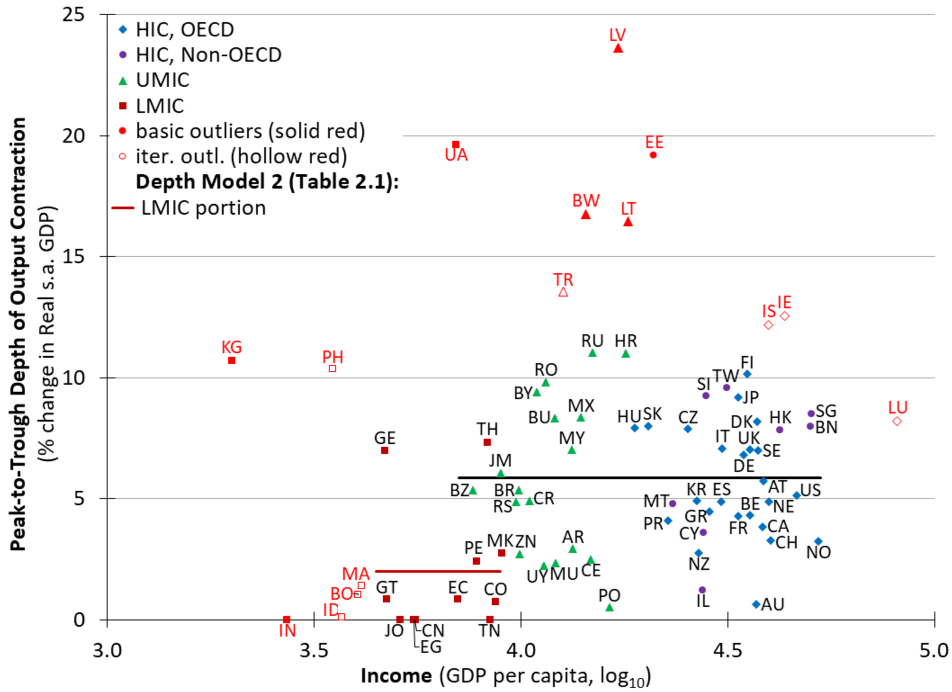
Source: IFS, author's calculations.

(PH), Georgia (GE) and Thailand (TH)—show contraction depths closer to the UMIC-HIC average. Such “visual analysis” is, however, very unreliable, and only inductively suggests potential hypotheses for further testing.

For each DV, specifications [2]–[4] in Table 2.1 show results for “step-function” models, comparing the averages of each group. These results show that the LMICs experienced both shallower and shorter average contractions than did the UMICs or HICs, and that the differences between the UMICs and HICs are insignificant.[27] For contraction

[27] Examining differences between groups’ mean DV values is often (and perhaps more familiarly) undertaken using ANOVA or T-tests, rather than the regression-with-dummy-IVs approach used here. The results here—particularly for the LMIC step-function models for depth and duration (models [2] in Table 2.1)—are robust to switching to the T-test approach.

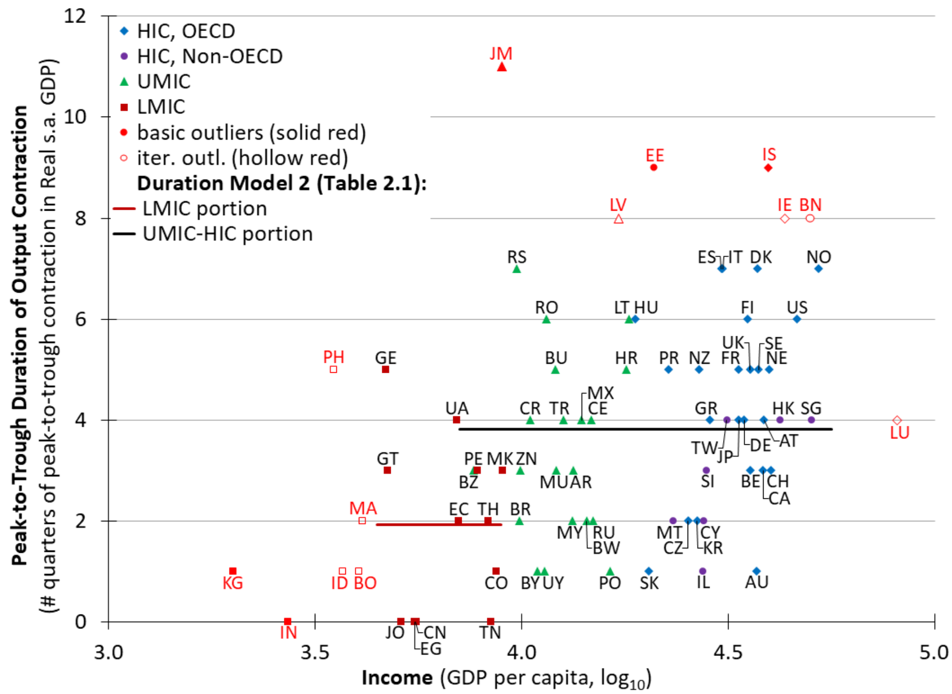
Figure 2.3. Depth DV vs. Income: LMIC Step-Function model



Source: IFS, author's calculations.

depth, the LMIC difference in specification [2] (illustrated in Figure 2.3) clearly provides the best step-function model, with the single LMIC dummy IV highly significant, and showing the highest R^2 and adjusted-R^2 values, and the lowest AIC and BIC values. In particular, the model indicates that the UMICs and HICs together had an average contractions depth of 5.9 per cent (significant at $p<.0005$), and that LMICs had an average contraction depth 3.9 percentage points (pp) shallower than the UMIC and HIC average ($p<.0005$). That LMIC difference is also present in specification [3], where the UMIC dummy shows an insignificant ($p>.9$) difference between UMICs and HICs (with HICs as the omitted-dummy reference group) when controlling for the LMIC difference. Specification [4] is isomorphic to specification [3], but uses LMICs as the reference group,

Figure 2.4. Duration DV vs. Income: LMIC Step-Function model



Source: IFS, author's calculations.

with the significant (p<.02) constant term indicating that the LMICs’ average contraction depth of 2.0 per cent is significantly non-zero.

The results are similar for the corresponding step-function models on the duration DV, with the LMIC step-function (illustrated in Figure 2.4) again providing the best model. UMICs and HICs together had an average contraction duration of 3.8 quarters, while LMICs average contraction duration was 1.9 quarters shorter (both significant at p<.0005). The UMIC-HIC difference in contraction duration is closer to significant, but remains below standard levels of significance (p>.17), when controlling for the LMIC difference in model [3]. The significant (p<.0005) constant term in depth model [4] again indicates that the average LMIC contraction depth of 1.9 quarters was non-zero.

Of the more complicated specifications—involving higher order (linear, quadratic and cubic) functions on income, and differences in those functions across the income groups (involving interaction terms)—only three modeling the depth DV (depth models [5]–[7] in Table 2.2), and none for the duration DV, showed adequate significance for further consideration—that is, with the highest order terms significant, and the specification not ruled-out due to insignificance in isomorphic terms. Depth model [5] represents a "linear relationship with UMIC-shift" (see Figure 2A.2 in Appendix 2A), in which the same significant linear relationship on income holds across all countries (LMICs, UMICs and HICs), but with the UMICs also experiencing contractions deeper than those of LMICs or HICs when controlling for those income differences. The "linear, with distinct HIC-linear" form of depth model [6] (Figure 2A.3), represents a continuous linear income relationship over LMICs and UMICs, with the HICs allowed a distinct income slope, which is flat (i.e., insignificantly different from zero).[28] And depth specification [7] models contraction depth as a simple quadratic function of income (Figure 2A.4), increasing through the LMICs and UMICs and peaking at log[GDP/c]=4.52 (or GDP per capita of roughly $33,000), and decreasing only slightly in the HIC range. That is, the particular quadratic shape obtained here represents a levelling-off of contraction depth at higher incomes, without any actual decrease; the more-complete (inverted) U-shape for which

[28] Technically depth model [6] in Table 2.2 only show that the HIC slope is significantly different from that for the LICs and UMICs, and is very close to zero in absolute terms (0.02 = 10.59 − 10.57). Regressions on an isomorphic model with a dummy for LMICs and UMICs combined—i.e., with the HICs as omitted-dummy reference group, show the HIC slope to be insignificantly different from zero.

Table 2.2. Additional Models

DV	Contraction Depth			Contraction Duration		
Model	[5]	[6]	[7]	[5]	[6]	[7]
log[GDP/c]	**5.01*****	**10.59*****	**79.09****	**5.30***	**1.05**	**-1.08**
	(<.001)	(.002)	(.050)	(.085)	(.807)	(.831)
log²[GDP/c]			**-8.95***			
			(.061)			
LMIC				**25.87**	**6.94**	
				(.277)	(.791)	
UMIC	**2.25****			**18.92**		**-6.94**
	(.011)			(.400)		(.791)
HIC		**43.55***			**-18.92**	**-25.87**
		(.083)			(.400)	(.277)
log[GDP/c] × LMIC				**-6.38**	**-2.13**	
				(.281)	(.749)	
log[GDP/c] × UMIC				**-4.25**		**2.13**
				(.422)		(.749)
log[GDP/c] × HIC		**-10.57***			**4.25**	**6.38**
		(.068)			(.422)	(.281)
Constant	**-16.82*****	**-37.75****	**-168.58***	**-19.84**	**-0.91**	**6.03**
	(.005)	(.039)	(.087)	(.222)	(.962)	(.782)
N	61	61	61	63	63	63
R^2	.220	.202	.179	.220	.220	.220
Adj.R^2	.193	.160	.151	.151	.151	.151
AIC	303.5	306.9	306.6	259.7	259.7	259.7
BIC	311.9	317.4	315.0	274.7	274.7	274.7

*p-values in parentheses; ***: p<.01; **: p<.05; *: p<.1; †: p<.2 (two-tailed tests)*

quadratic functions are usually selected does not present itself clearly in these results. Most importantly, though, all of these more complicated models of contraction depth show worse explanatory power—whether through higher R^2 and adj.-R^2 or lower AIC or BIC—than does the simple LMIC step-function (depth model [2] in Table 2.1: R^2=.232), which also outperforms the simple linear income model (depth model [1] in Table 2.1: R^2=.127).[29,30]

In contrast, for contraction duration, the linear income model (duration model [1] in Table 2.1: R^2=.181) outperforms the corresponding LMIC step-function (duration model [2] in Table 2.1: R^2=.151). However, that linear relationship is a continuous (linear) function that spans the three groups, and so potential between-group effects require consideration. Isomorphic duration specifications [5]–[7] in Table 2.2 make-explicit the between-group slope-differences, revealing income term insignificance in absolute terms for the LMICs and the UMICs (as the reference groups, in specifications [6] and [7], with p>.8 for those constant terms), and with the LMIC group's insignificant slope estimate even slightly negative in absolute terms (as the reference group's un-interacted income term in specification [7], with coefficient value -1.08). The HIC group's slope coefficient is also only weakly significant (p=.085 in specification [5], p_r=.139), though it is positive (and of larger magnitude than the slope estimate for the simple linear model). The highly significant slope of the simple linear model thus appears to be influenced primarily by

[29] This depth DV LMIC step-function result mirrors results of Didier, Hevia and Schmukler (2012), discussed in the literature review. They find that a step function on a different country group classification (non-AEs countries with only IDA borrowing access, rather than LMICs) on a 2007–2009 growth collapse DV (based on annual rather than quarterly data) performs better than linear or quadratic income models.

[30] One further specification of minor note is the one allowing independent cubic functions for each income group. In that specification, the coefficient estimate for the cubic term on the LMIC group was significant (at p<.05), while that for the UMIC group was only weakly significant if heteroscedasticity was present (p_r<.1, but p>.14). However, both of these cubic functions clearly reflect overfitting, showing variation over the LMIC income range far too granular to expect from these simple models. Recall that the cubic functions provide the start of a Taylor series approximation, and with many additional more-complex specifications presenting the danger of overfitting (see Footnote 18). In that context, it is gratifying (and even comforting) that—with the exceptions described above—those more-complex models were ruled out as insignificant, further reinforcing the credibility of the simple LMIC step-function result.

differences between the three groups, but also possibly by a weak effect within only the HICs, but not within the LMIC and UMIC groups.[31] The simple linear income model for contraction duration is thus deemed invalid—as largely representing between-group differences—leaving the LMIC step-function as the only remaining valid specification, and therefore the best specification for the duration DV, just as it was for the depth DV.

These results are robust to the use of the development-based AE, EME, DE country group classification instead of the income group (LMIC, UMIC, HIC) classification. For the depth DV, a DE-step function—similar to the LMIC step-function, but with fewer DE countries than LMIC countries—dominates all other development group step-function models. Further, only "linear, with EME-shift" and "linear, with AE-shift" models on contraction depth—that is, including only the linear income term plus the EME or AE dummy respectively—are retained (i.e., with all IVs significant) from the more-complicated, higher order and interaction specifications; but neither of these provides better explanatory power for contraction depth than does the DE step-function. The DE step-function (R^2=.232) is outperformed by the income group classification's LMIC step-function (R^2=.091; and similarly for adj.-R^2, AIC and BIC values). For the duration DV, only an AE-step function model is retained as having all IVs significant, indicating that AEs experienced significantly longer contractions than did the combined DE and EME reference group ($p<.001$), and with the DEs and EMEs showing no significant difference

[31] This comparison between the independent linear functions for each income group is also illustrated graphically in Figure 2A.5.

(p>.7). Yet, again the income group classification's LMIC step-function outperforms this development group AE-step function in explanatory power, albeit only barely (R^2=.151 vs. .149, and similarly for adj.-R^2, AIC and BIC).[32]

Both results are also largely robust to the re-inclusion of outliers.[33] For contraction depth, when re-including only the eight iterated outliers—that is, with basic outliers still excluded—the group averages increase only a little and explanatory power decreases only a little (R^2=.220 vs. .232). The further re-inclusion of the seven basic outliers—especially including the five basic DV outliers with particularly deep contractions—increases average contraction depth for both the LMIC and UMIC-HIC groups further, and reduces explanatory power much more (to R^2=.096), with the LMIC dummy's significance reduced a little (though still at p<.05). Thus, for the depth DV, the main results are quite robust to re-inclusion of iterated outliers, but a little less so for re-inclusion of basic outliers. For the duration DV, the results are more straightforwardly robust to outlier re-inclusion: the intercept, income coefficient and explanatory power values all remain highly significant and relatively stable when sequentially re-including each set of outliers.

Finally, multicollinearity does not appear to influence these results, with the possibility of unreliable coefficients ruled out for the models with all IV coefficients

[32] A cross-classification model was also tested, comparing average durations between LMICs, AEs and the remaining countries that are neither LMICs nor AEs, consisting of UMICs plus the few HICs that are EMEs, or equivalently EMEs that are not LMICs. As expected, there are significant differences between the LMICs and the intermediate group, and between the intermediate group and AEs; but with both of those differences significant at "only" $p_{(r)}$<.05—as compared to p<.002 for the LMIC step function or the AE step function. This cross-classification model also provides lower explanatory power than the LMIC difference, AE difference or linear income models. The relevance of these results is discussed in the concluding section.

[33] See Table 2A.4 for regression results showing the re-inclusion of outliers.

deemed statistically significant, and the possibility of false negatives mostly ruled out for specifications in which at least one coefficient estimate is deemed insignificant. All VIFs for the specifications in Table 2.1 and for depth model [5] in Table 2.2 are less than two, indicating no issue with multicollinearity and reliable coefficient estimates for those specifications. In Table 2.2, the VIFs for IVs in depth models [6] and [7] all do exceed four, reflecting the mathematical relationship between these related IVs.[34] However, the potential effects of multicollinearity are deemed irrelevant here because these specifications all have AIC and BIC values higher-than those of depth model [2], which is again thereby preferred. Regarding specifications including at least one coefficient estimate found statistically insignificant, many of the more complex specifications have IVs with very high VIFs, flagging potential false negatives due to multicollinearity. However, all such specifications for the depth DV and all but a handful for the duration DV also have AIC and BIC values greater than those of the corresponding model [2], again rendering the potential effects of potential multicollinearity moot (e.g., including duration models [5]–[7] in Table 2.2). Table 2.3 lists the four duration DV models showing any VIFs greater than four, for which the AIC and/or BIC are lower than that of the preferred model [2]—along with models [1] (linear on income) and [2] (LMIC step-function) for comparison.[35] The possibility that these specifications do represent false negatives due to

[34] In model [6] for the duration DV: $VIF_{log[GDP/c]}$=7.6, VIF_{HIC}=1,142.4, and $VIF_{log[GDP/c]\times HIC}$=1,238.2; and in model [7]: $VIF_{log[GDP/c]}$=$VIF_{log^2[GDP/c]}$=1,049.0 (equal because there are only two IVs).

[35] In Table 2.3, duration model [8] represents a linear relationship on income with an HIC shift, model [9] represents a quadratic relationship on income, and models [10] and [11] represent quadratic relationships with vertical shifts for LMICs and UMICs respectively.

Table 2.3. Multicollinearity Considerations

DV	Contraction Duration					
Model	[1]	[2]	[8]	[9]	[10]	[11]
log[GDP/c]	**2.79*** **		**4.07** **	**-4.77**	**-41.70**	**-38.55**
	(.001)		(.041)	(.846)	(.202)	(.212)
			4.5	*1024.2*	*1851.0*	*1657.6*
$\log^2$[GDP/c]				**0.90**	**5.08†**	**4.99†**
				(.758)	(.182)	(.177)
				1024.2	*1778.2*	*1682.8*
LMIC		**-1.91*** **			**-1.79***	
		(.002)			(.093)	
					3.4	
UMIC						**1.16***
						(.079)
						1.9
HIC			**-0.86**			
			(.367)			
			4.5			
Constant	**-8.37** **	**3.82** **	**-13.43**	**7.45**	**88.76**	**76.44**
	(.015)	(<.001)	(.041)	(.885)	(.206)	(.233)
N	63	63	63	63	63	63
R^2	.181	.151	.192	.182	.221	.224
Adj.R^2	.168	.137	.165	.155	.181	.185
AIC	254.8	257.0	255.9	256.7	255.6	255.3
BIC	261.2	263.5	264.5	265.2	266.4	266.1

*p-values in parentheses; ***: p<.01; **: p<.05; *: p<.1; †: p<.2; VIFs in italics*

multicollinearity cannot be definitively ruled-out; nonetheless, they are rejected here as challenging the preferred specification, including because the reduction in AIC values relative to model [2] is quite small, while all BIC values remain larger.[36]

[36] Because of the nature of multicollinearity—especially the potential for inaccurate coefficient estimates and inflated standard errors—within- versus between-group analysis and graphical examination are both unreliable here. Nevertheless, it should be noted that none of these models improve (in AIC or BIC terms) on the linear income specification (model [1]), itself rejected only on the basis of within- versus between-group analysis. Likewise, the very small coefficient for the quadratic term in model [9] is suggestive

2.5 Conclusion

Broadly speaking, this chapter partly undermines the notion of an AE nature to the GFC. The analysis first replicates the finding from the differential impact literature, of a continuous, linear relationship between higher income (logged per capita GDP) and worse GFC outcomes, measured alternatively as the depth or duration of the GFC-associated output contraction. Numerous alternative models were also considered, based on combinations of the continuous income function, in linear, quadratic and cubic forms, and dummy IVs representing two alternative country classifications: the World Bank's Group classification by income group, into LMICs (including Kyrgyzstan, the single LIC for which adequate data was available), UMICs, and HICs; and a development classification, distinguishing between AEs, EMEs and DEs. It has been rigorously demonstrated that the simple linear income-outcome model, as well as several other candidate models involving continuous functions on income, all spuriously reflect a much simpler relationship: that LMICs fared better than did the UMICs or HICs, which experienced quite similar average contraction depths and durations. In particular—on average, ceteris paribus, and as illustrated in Figures 2.3 and 2.4 LMICs' output contracted by 2.0 per cent over 1.9 quarters (nearly 6 months), which is significantly shallower and shorter—by 3.9 percentage

of overfitting, as graphical examination of the quadratic model shows only a very slight additional curve over the sample's range of income, remaining quite close to the linear model. In considering improvements in adjusted-R^2 values between nested models, models [8] and [9] also do not improve on model [1], while models [10] and [11] improve on it only modestly (Δadj.R^2 of .013 and .015 respectively—i.e., providing only a 1.3 pp to 1.5 pp improvement in predictive power); yet, model [10] is also nested in model [2], and provides a non-trivial increase (Δadj.R^2 of .048, almost a 5 pp improvement in predictive capacity).

points and 1.9 quarters (p<.002 with iterated or basic outliers excluded)—than the UMIC-HIC average of 5.9 per cent over 3.8 quarters (most of year), and with no significant difference between the UMIC and HIC averages.[37] One important implication of this LMIC-difference result is that any analysis that is conducted on samples excluding LMICs—that is, focused on UMICs and/or HICs, or even EMEs and/or AEs—may overlook or fail to identify important causal factors that drive overall differential impact.

While this LMIC difference is central, one somewhat ambiguous difference was also discernable for the duration DV within the non-LMICs. Though the UMIC and HIC average durations were not significantly different (difference of .07 quarters, p>.17, when controlling for the LMIC difference), the difference between non-LMIC EMEs and AEs is significant (p<.05), with AEs experiencing contractions 1.1 quarters longer than non-LMIC EMEs. The difference between these results hinges on whether four non-AEs—the Czech Republic, Malta, Slovakia, and Slovenia—are better considered as HICs or as EMEs. Yet, as the group definitions under consideration here are somewhat arbitrary, and are not considered to be causally explanatory, resolution of this ambiguity is not crucial. Other causal factors (to be explored in the next chapter) are expected to help explain the differential impact, and may help clarify why these countries, experienced shorter contractions more consistent with other EMEs, in spite of their high income status.

The clearest difference remains that between the LMICs and other countries,

[37] The fact that average contraction duration for the UMIC-HIC group is almost exactly double that of the LMICs appears to be a coincidence.

though that difference is also not strict. It is worth noting the unusual LMICs in Figure 2.3: Georgia (GE) and Thailand (TH), with contractions deeper than those of other LMICs; Kyrgyzstan (KG) and the Philippines (PH), as outliers on income; and Ukraine (UA) as an outlier on the depth DV. Save for Ukraine as an extreme case, these LMICs all experienced contractions more in line with the worse-half of the UMIC-HIC group. Similarly, one might be tempted to group with the LMICs some of the UMICs (e.g., the string from South Africa (ZN) through Poland (PO) in Figure 2.3) and even some HICs (e.g., Israel (IL), Australia (AU), and possibly New Zealand (NZ)) that experienced quite short contraction durations. Other such "visual clusters" may catch the eye, but the question remains as to why they cluster in these ways? Why did Georgia and Thailand behave differently from other LMICs? And why did South Africa, Poland, Australia and Israel experience such mild contractions, more similar to the LMICs in this sample than to the other UMICs or HICs? These questions will be pursued in the next chapter.

Appendix 2A: Additional Tables and Figures

Table 2A.1. Full Sample by World Bank Income Group

LIC (n_{LIC}=1)		
Kyrgyzstan	DE	KG

LMICs (n_{LMIC}=17)		
Bolivia	EME	BO
China	EME	CN
Colombia	EME	CO
Ecuador	EME	EC
Egypt	EME	EG
Georgia	EME	GE
Guatemala	DE	GT
India	EME	IN
Indonesia	EME	ID
Jordan	DE	JO
Macedonia	DE	MK
Morocco	DE	MA
Peru	EME	PE
Philippines	EME	PH
Thailand	EME	TH
Tunisia	DE	TN
Ukraine	EME	UE

UMICs (n_{UMIC}=22)		
Argentina	EME	AR
Belarus	EME	BY
Belize	DE	BZ
Botswana	DE	BW
Brazil	EME	BR
Bulgaria	EME	BU
Chile	EME	CE
Costa Rica	EME	CR
Croatia	EME	HR
Jamaica	DE	JM
Latvia	EME	LV
Lithuania	EME	LT
Malaysia	EME	MY
Mauritius	DE	MU
Mexico (OECD)	EME	MX
Poland (OECD)	EME	PO
Romania	EME	RO
Russia	EME	RU
Serbia	DE	RS
South Africa	EME	ZN
Turkey (OECD)	EME	TR
Uruguay	EME	UY

HICs, OECD ($n_{HIC.OECD}$=27)		
Australia	AE	AU
Austria	AE	AT
Belgium	AE	BE
Canada	AE	CA
Czech Rep.	EME	CZ
Denmark	AE	DK
Finland	AE	FI
France	AE	FR
Germany	AE	DE
Greece	AE	GR
Hungary	EME	HU
Iceland	AE	IS
Ireland	AE	IE
Italy	AE	IT
Japan	AE	JP
Korea, South	AE	KR
Luxembourg	AE	LU
Netherlands	AE	NE
New Zealand	AE	NZ
Norway	AE	NO
Portugal	AE	PR
Slovakia	EME	SK
Spain	AE	ES
Sweden	AE	SE
Switzerland	AE	CH
United Kingdom	AE	UK
United States	AE	US

HICs, non-OECD ($n_{HIC.nonOECD}$=9)					
Brunei	AE	BN	**Malta**	EME	MT
Cyprus	AE	CY	**Singapore**	AE	SG
Estonia	EME	EE	**Taiwan**	AE	TW
Hong Kong	AE	HK	**Slovenia**	EME	SI
Israel	AE	IL			

(n_{DE}=11; n_{EME}=35; n_{AE}=30)

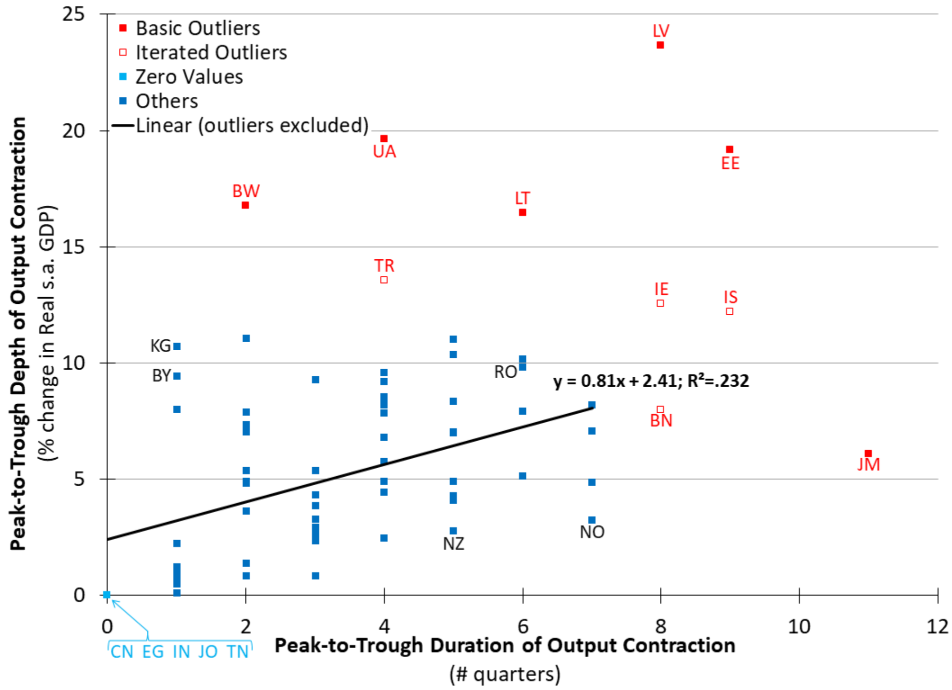
Table 2A.2. Country Codes (alphabetically)

AR	Argentina	**FR**	France	**MY**	Malaysia
AT	Austria	**GE**	Georgia	**NE**	Netherlands
AU	Australia	**GR**	Greece	**NO**	Norway
BE	Belgium	**GT**	Guatemala	**NZ**	New Zealand
BN	Brunei	**HR**	Croatia	**PE**	Peru
BO	Bolivia	**HU**	Hungary	**PH**	Philippines
BR	Brazil	**ID**	Indonesia	**PO**	Poland
BU	Bulgaria	**IE**	Ireland	**PR**	Portugal
BW	Botswana	**IL**	Israel	**RO**	Romania
BY	Belarus	**IN**	India	**RS**	Serbia
BZ	Belize	**IS**	Iceland	**RU**	Russia
CA	Canada	**IT**	Italy	**SE**	Sweden
CE	Chile	**HK**	Hong Kong	**SG**	Singapore
CH	Switzerland	**JM**	Jamaica	**SI**	Slovenia
CN	China	**JO**	Jordan	**SK**	Slovakia
CO	Colombia	**JP**	Japan	**TH**	Thailand
CR	Costa Rica	**JR**	Korea, South	**TN**	Tunisia
CY	Cyprus	**KG**	Kyrgyzstan	**TR**	Turkey
CZ	Czech Rep.	**LT**	Lithuania	**TW**	Taiwan
DE	Germany	**LU**	Luxembourg	**UA**	Ukraine
DK	Denmark	**LV**	Latvia	**UK**	United Kingdom
EC	Ecuador	**MA**	Morocco	**US**	United States
EE	Estonia	**MK**	Macedonia, FYR	**UY**	Uruguay
EG	Egypt	**MT**	Malta	**ZN**	South Africa
ES	Spain	**MU**	Mauritius		
FI	Finland	**MX**	Mexico		

Table 2A.3. Countries Excluded from the Sample (by World Bank Income Group)

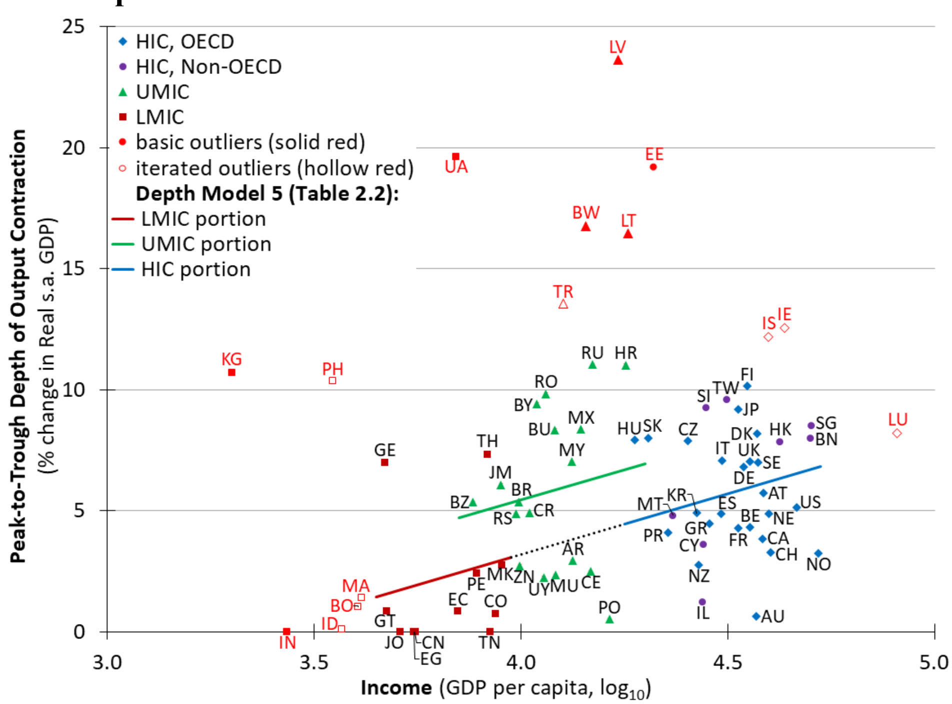
Group	Countries
HICs (N=28)	Andorra; Antigua and Barbuda; Aruba; Bahamas, The; Bahrain; Barbados; Bermuda; Cayman Islands; Equatorial Guinea; Faroe Islands; French Polynesia; Greenland; Guam; Isle of Man; Kuwait; Liechtenstein; Macau; New Caledonia; Monaco; Northern Mariana Islands; Oman; Puerto Rico; Qatar; United Arab Emirates; Virgin Islands; San Marino; Saudi Arabia; Trinidad and Tobago
UMICs (N=18)	American Samoa; Cuba; Dominica; Fiji; Gabon; Grenada; Kazakhstan; Lebanon; Libya; Montenegro; Palau; Panama; Saint Kitts and Nevis; Venezuela; Saint Lucia; Saint Vincent and the Grenadines; Seychelles; Suriname
LMICs (N=38)	Albania; Algeria; Angola; Armenia; Azerbaijan; Bhutan; Bosnia and Herzegovina; Cameroon; Cape Verde; Congo, Republic of the; Djibouti; Dominican Republic; El Salvador; Guyana; Honduras; Iran; Iraq; Kiribati; Lesotho; Maldives; Marshall Islands; Namibia; Nicaragua; Micronesia, Federated States of; Moldova; Mongolia; Paraguay; Turkmenistan; Tuvalu; Vanuatu; West Bank; Samoa; Sri Lanka; Sudan; Swaziland; Syria; Timor-Leste; Tonga
LICs (N=48)	Afghanistan; Bangladesh; Benin; Burkina Faso; Burma; Burundi; Cambodia; Central African Republic; Chad; Comoros; Congo, Democratic Republic of the; Cote d'Ivoire; Eritrea; Ethiopia; Gambia, The; Ghana; Guinea; Guinea-Bissau; Haiti; Kenya; Korea, North; Laos; Liberia; Madagascar; Malawi; Mali; Mauritania; Mozambique; Nepal; Niger; Nigeria; Pakistan; Papua New Guinea; Rwanda; Uganda; Uzbekistan; Vietnam; Yemen; Zambia; Zimbabwe; Sao Tome and Principe; Senegal; Sierra Leone; Solomon Islands; Somalia; Tajikistan; Tanzania; Togo
Not Classified by World Bank	Anguilla; British Virgin Islands; Christmas Island; Cocos (Keeling) Islands; Cook Islands; European Union; Falkland Islands (Islas Malvinas); Gaza Strip; Gibraltar; Guernsey; Holy See (Vatican City); Jersey; Kosovo; Mayotte; Nauru; Netherlands Antilles; Niue; Montserrat; Norfolk Island; Saint Helena; Turks and Caicos Islands; Wallis and Futuna; Western Sahara; Pitcairn Islands; Saint Pierre and Miquelon; Svalbard; Tokelau

Figure 2A.1. GFC Output Contraction DVs: Depth vs. Duration



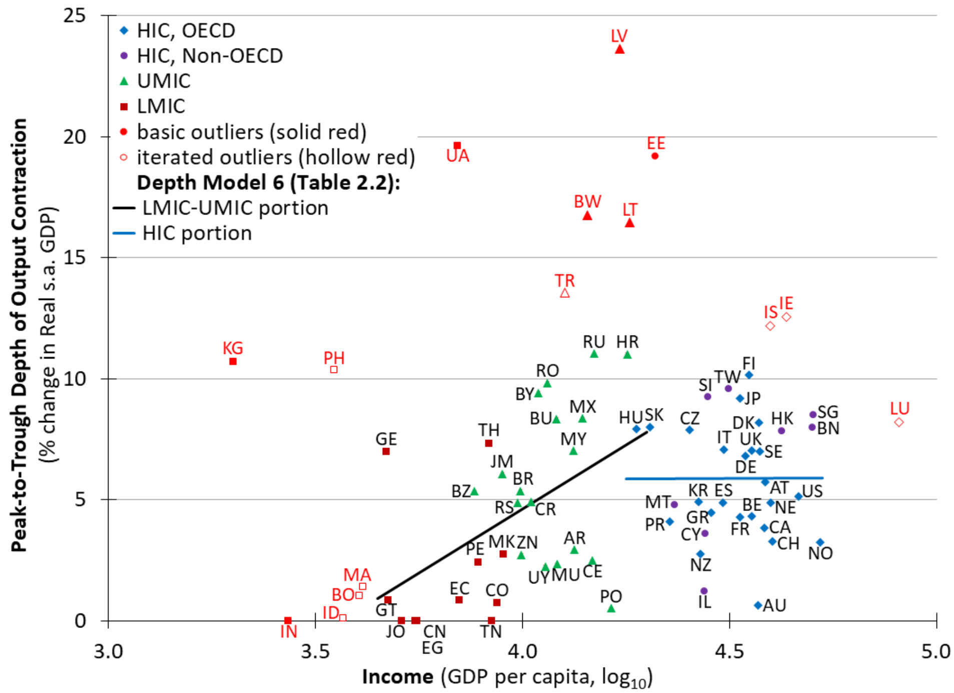
Source: IFS, author's calculations.

Figure 2A.2. Depth DV vs. Income: Linear model with UMIC-shift



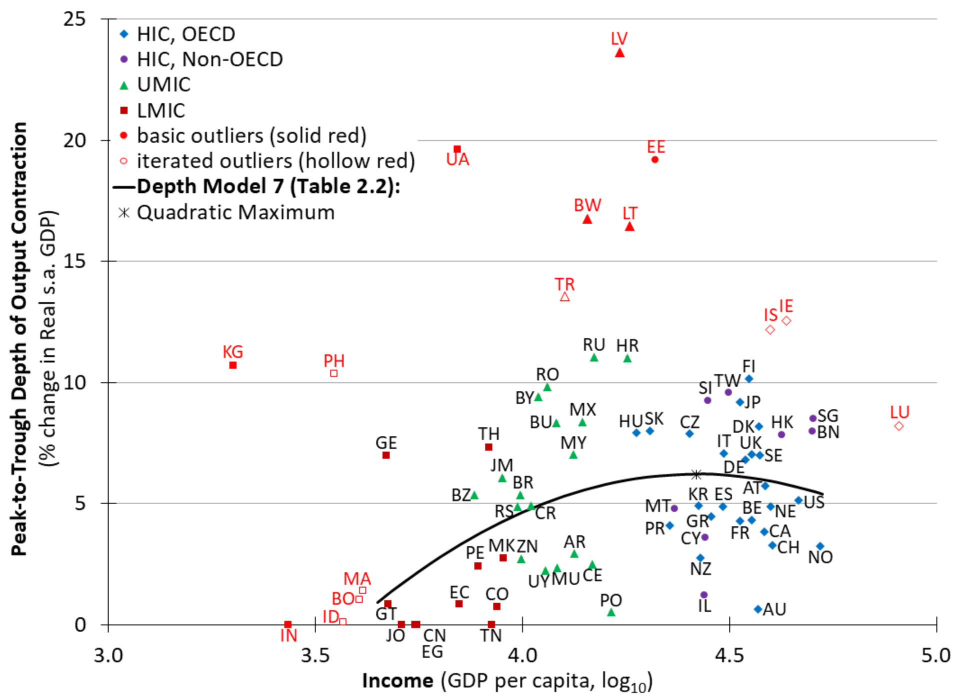
Source: IFS, author's calculations.

Figure 2A.3. Depth DV vs. Income: Linear model with distinct HIC-linear



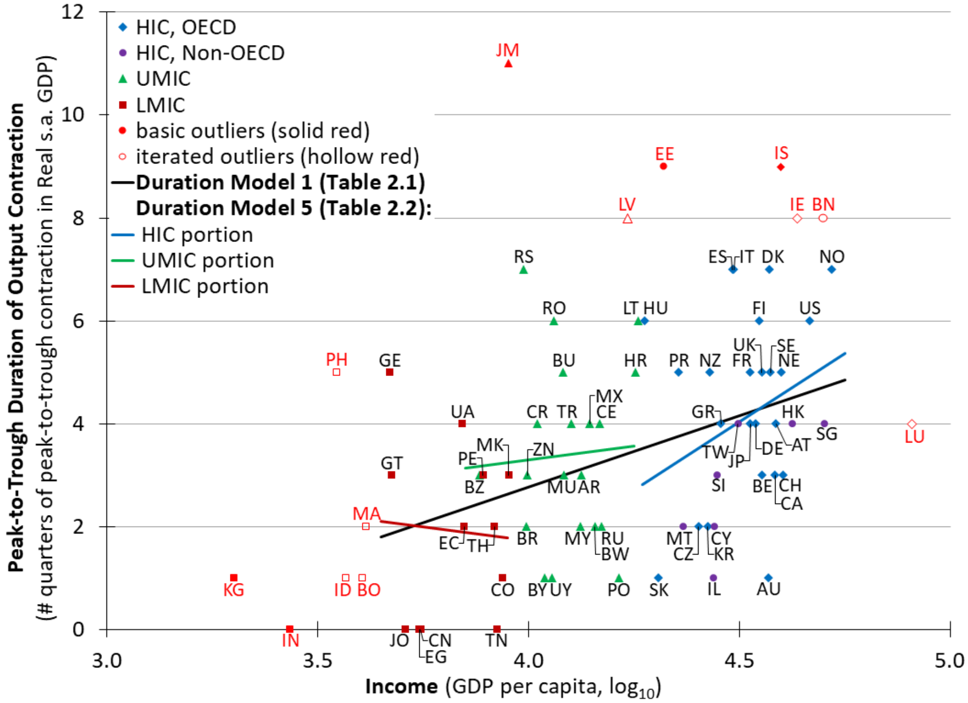
Source: IFS, author's calculations.

Figure 2A.4. Depth DV vs. Income: Simple quadratic model



Source: IFS, author's calculations.

Figure 2A.5. Duration DV vs. Income: Distinct linear models for each group



Source: IFS, author's calculations.

Table 2A.4. Outlier Robustness of Final Models

Model Outliers Excluded	8 Iterated	9 Basic	10 None	8 Iterated	9 Basic	10 None
LMIC	**-3.87***** (<.001)	**-3.97***** (<.001)	**-3.55***** (.007)	**-1.91***** (.002)	**-1.91***** (.002)	**-1.91***** (.002)
Constant	**5.87***** (<.001)	**6.30***** (<.001)	**7.18***** (<.001)	**3.82***** (<.001)	**3.82***** (<.001)	**3.82***** (<.001)
N	61	69	76	63	63	63
R^2	.232	.220	.096	.151	.168	.196
Adj.R^2	.219	.208	.083	.137	.156	.185
AIC	300.5	357.5	455.1	257.0	257.0	257.0
BIC	306.8	364.2	462.1	263.5	263.5	263.5

*p-values in parentheses; ***: p<.01; **: p<.05; *: p<.1; †: p<.2 (two-tailed tests)*

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Chapter 3: Explaining the "AE Nature" of the GFC

3.1 Introduction

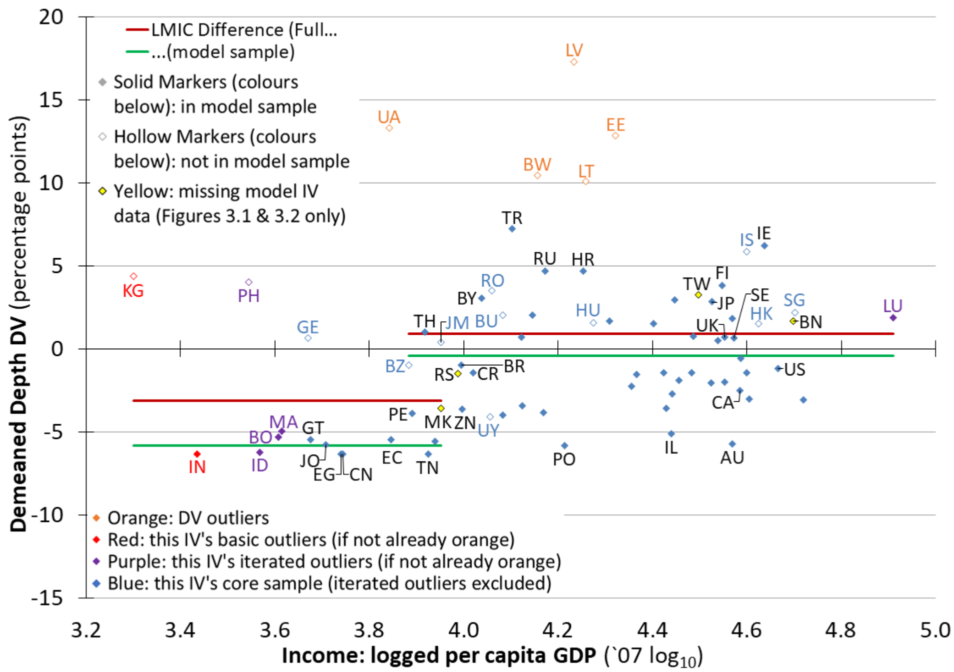
The "differential impact" literature seeks pre-crisis factors associated with cross-country variation in the output contractions related to the Global Financial Crisis (GFC) of 2008–2009. As discussed in the previous chapter, several papers note that Advanced Economies (AEs) fared worse than other countries, observed empirically in a significant relationship between higher income (pre-crisis logged per capita GDP) and worse outcomes (measured variously in different papers). This apparent "AE Nature" conflicts with the intuitive expectation that higher income countries have more resources and policy capability than poorer countries, which should provide resilience. The AE Nature may, however, be consistent with the alternative view that AEs may have been more vulnerable due to explanatory factors correlated with higher income but not directly related to it (Rose and Spiegel 2009). Most papers in the literature include an income term as a control variable to explain country economic performance during the crisis. Although several researchers interpret the negative relationship between income and better performance as "highlighting" (Lane and Milesi-Ferretti 2011) or "reflecting" (Claessens et al. 2010) the AE Nature, the existing literature neither problematizes this observation, nor seeks alternative factors to explain this unexpected relationship with country income.

The results of the previous chapter show that the lower-middle-income countries (LMICs) fared significantly better than the combined group of their lower-middle-income and high-income counterparts (UMICs and HICs respectively), and that there is no significant difference between the UMICs and HICs in terms of economic performance during the crisis. For the full sample, the average LMIC contraction was 3.9 percentage points shallower and nearly 6 months (1.9 quarters) shorter than that for the UMICs and HICs. In addition, the results indicate that there is no robust continuous relationship between income per capita and either the depth or duration of the post crisis recession for any of these country groupings. In other words, wealthier rich countries did not have systematically worse recessions than somewhat poorer but still high- or upper-middle-income, countries. Instead, a discrete difference is apparent between LMICs and other countries, but with further variation clearly unaccounted for within the different groups (see Figures 3.1 and 3.2).

This chapter turns from characterizing the income-outcome relationship to finding factors that help explain different depths and durations of the "Great Recession" experienced by different countries. The regression approach of the differential impact literature is used here as well, seeking to identify the independent variables (IVs) from the pre-crisis period that best explain the dependent variables (DVs) measuring the depth and duration of the post-crisis output contraction. Of particular interest is whether income is conditionally correlated with the DVs in this more expansive and complex model.

The basic approach to explaining the observed income relationship first identifies the models that best explain variation in each DV, while excluding the income-related terms considered in the Chapter 2; it then tests whether any of those income terms retain

Figure 3.1. Demeaned Depth DV vs. Income (showing LMIC difference)

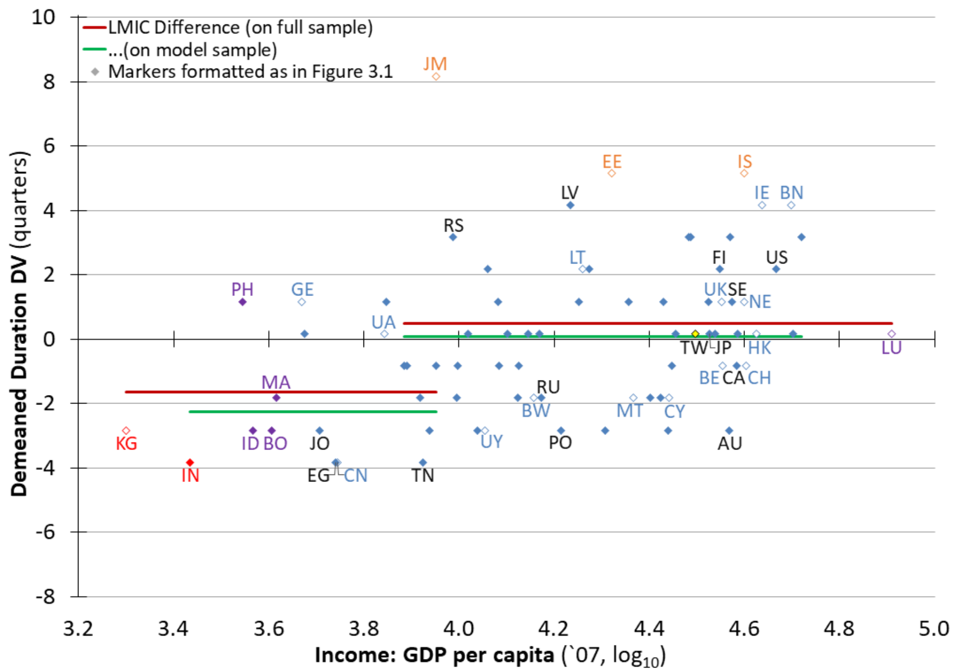


Source: IFS, author's calculations.

or lose significance when added to those models. In this way, this chapter seeks to answer the following research question: Can the LMIC differences identified in Chapter 2 be "explained away" by an empirically identified and theoretically plausible model? In doing so, this chapter also seeks to answer the broader research question of why countries experienced different depths and durations of output contraction during the GFC.

The previous chapter provided an overview of the differential impact literature, considering general and specific methodological features (such as DV and sample choice, robustness testing, etc.), and reviewed the unproblematized AE Nature of the crisis. This chapter's literature review examines the existing methodological variation in model selection int the existing literature, identifying areas for methodological improvement, and

Figure 3.2. Demeaned Duration DV vs. Income (showing LMIC difference)



Source: IFS, author's calculations.

reviews the range of results found in the literature. The methodology section then outlines the IVs under consideration here—drawn from and expanding on those considered in the literature—and describes in detail the process used to identify the models best accounting for DV variation. These details underpin the methodological contributions this chapter makes to the literature: the comprehensive testing of IVs identified in the existing literature, so as to reduce the potential for omitted variable bias and to help reconcile the somewhat inconsistent results of existing studies; and the development and use of a more explicit and thorough process for testing those numerous IVs, improving results while accounting for potentially confounding methodological issues identified in the original literature.

3.2 Literature Review

Very generally, the differential impact literature undertakes multiple regression analysis, identifying significant relationships between IVs representing potential explanations for GFC outcome and DVs representing those outcomes.[1] After selecting DVs, samples, and a (sometimes broad) set of IVs reflecting the particular research focus and data limitations, regressions test combinations of those IVs, identifying and reporting one or more specifications, and providing some robustness analysis and discussion. Statistical significance is the primary determinant of IV inclusion, with the magnitude of the effect (or "economic significance") considered when interpreting results. Different papers, however, follow quite different approaches in selecting the IV specifications that are tested and reported on. This section will first review and deconstruct the specification selection processes used in this literature, with an eye to developing a stronger selection process for this Chapter, and will then report on the results emphasized in the literature, given the selection processes used. But before turning to the literature's different approaches to specification selection, a brief note on outlier handling in the literature.

The potential for outlier observations to confound regression results through either

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[1] Rose and Spiegel (2009, 2010) provide the only studies that do not simply apply Ordinary Least Squares regression—or approaches building thereon, such as Bayesian Model Averaging (see below)—to continuous DVs measuring aspects of the GFC-related output contraction. (Others do, however, consider other DVs not directly related to output.) Rose and Spiegel instead apply Multiple Indicators Multiple Causes (MIMIC) analysis, which can be understood as a form of multiple regression analysis identifying relationships between IVs (MIMIC's "multiple causes") and an unobservable "latent DV" related to several observable indicators of GFC impact (MIMIC's "multiple indicators"). While Rose and Spiegel (2011) update their MIMIC results, that paper turns to the use of OLS regression with average growth 2008–2009 as the main DV (while also considering various DVs used in the differential impact literature).

false-positives or false negatives is common in the differential impact literature.[2] Several studies appear to have not considered the potential influence from outliers or other sample variations at all (Rose and Spiegel 2009a, 2009b; Berglöf et al. 2009; Claessens et al. 2010; Cecchetti, King and Yetman 2011; Frankel and Saravelos 2012; Tsangarides 2012; Dwyer and Tan 2014; Chen et al. 2017; Allegret and Allegret 2019). Others test their results for robustness to some limited sample variation, finding their results generally robust, but not investigating further (Lane and Milesi-Ferretti 2011; Giannone, Lenza, and Reichlin 2011; Blanchard, Faruqee, and Das 2010; Llaudes, Salman, and Chivakul 2010; Rose and Spiegel 2011; Bussière et al. 2015; Hausmann-Guil, van Wincoop and Zhang 2016; Bashar and Bashar 2020). In one example providing more detail, Ólafsson and Pétursson (2010) test the robustness of significant results to the removal of each individual observation, not simply those identified as outliers. They find that Luxembourg drives the result between financial openness and their duration DV, but with other results robust for their depth and duration of output contraction DVs (21). In addition to ignoring the possibility that a small group of outliers (rather than just one observation) drives a particular result, their process exemplifies a problem with much outlier analysis: in testing only whether significant results on the whole sample remain significant with some observations removed, only false

[2] Recall from Chapter 2: Outliers are observations with relatively extreme (high or low) values on the DV or any of the IVs in a specification. Outliers can "falsely" influence regression results by generating either a significant result (a false positive) or an insignificant negative result (false negative) that is otherwise not present when excluding those outliers. The sensitivity of results to the exclusion of only a few observations is taken to reflect something unusual—e.g., idiosyncratic, or simply not yet adequately controlled for—about those observations, rather than that their inclusion reveals the "true" relationship.

positives can be identified. The identification of false negatives requires finding coefficient estimates that are significant only with one or a few observations removed.

3.2.1 Specification Selection Processes

Many papers in the existing differential impact literature start with a straightforward approach, testing each IV "individually"—that is, without other test IVs included in the specification, though often with one or more control IVs present in all specifications. Income (logged per capita GDP) is usually one of the included control variables (e.g., Claessens et al. 2010). Without testing individually significant IVs simultaneously, two potentially confounding methodological issues arise. First, when included simultaneously, two individually-significant IVs can show three basic outcomes: (a) they both retain significance, in which case their underlying causal roles are presumed to be largely independent, with both contributing to a better model of the DV; (b) one "dominates" the other, retaining significance while rendering the other insignificant, possibly indicating that both represent a single underlying causal mechanism, the one more closely so than the other; or (c) both lose some or all significance, "competing" for explanatory power, again possibly indicating related roles. In cases (b) and (c) the better model will include only one of the two IVs, with the choice immediately clear in case (b): the insignificant IV is not robust to the inclusion of the significant IV.[3] Further

[3] During model selection, priority is given to statistical significance over economic significance. Statistical significance indicates whether an effect is discernable; e.g., whether the coefficient estimate is different from zero, given the data at hand. If it is not statistically significantly different from zero—including when controlling for other IVs—then the estimated magnitude of effect should not be considered.

consideration is required in case (c), for example by examining which provides a greater increase in explanatory power when included without the other.

The second methodological issue is that an IV that is statistically insignificant individually might represent a "false negative", becoming significant once controlling for other significant terms—for example, due to the overall "noise reduction" from controlling for other IVs, or due to genuine "conditional significance", with the significance of one IV depending directly on controlling that of another (e.g., as in Simpson's paradox). While some papers do simultaneously test sets of IVs found significant individually (Rose and Spiegel 2009, 2010; Berglöf et al. 2009; Berkmen et al. 2012), none also systematically re-test IVs that were previously found individually insignificant in a statistical sense.[4] These issues illustrate the need to not only test IVs individually, but simultaneously—and to do so whether or not they are significant individually. The challenge, however, is how to avoid these issues without examining the overwhelming number of regression results representing all possible combinations of the numerous IVs under consideration.[5]

A second approach to model selection simultaneously includes all of a relatively small number of IVs under consideration in a single model (e.g., Lane and Milesi-Ferretti 2011). However, as discussed—re outcome (c) above—IVs can confound one another,

[4] In specifications combining several individually-significant IVs simultaneously, Rose and Spiegel (2009, 2010) do re-test some individually insignificant IVs, but do not do so systematically. Berglöf et al. (2009) also test some IVs not previously reported on with their simultaneous specifications.

[5] Cecchetti, King and Yetman (2011) partly address this problem by employing a stepwise forward search. However, that search was only undertaken on 28 IVs, which exclude several explanatory factors identified as important in studies (sometimes in pre-publication forms) that they themselves cite (2011, 4, footnote 2), including: Berkmen et al. (2009), Blanchard, Faruqee, and Das 2010, Giannone, Lenza, and Reichlin 2010, Lane and Milesi-Ferretti 2010, Rose 2012, Rose and Spiegel 2009, 2010.

their simultaneous inclusion rendering each less- or in-significant. It is possible, then, that some of the insignificant IVs reported in Lane and Milesi-Ferretti’s results represent such confounding pairs. In particular, their trade openness ([exports + imports]/GDP, 2007) and financial openness (log[(foreign assets + foreign liabilities)/GDP], 2007) IVs—which are both borderline statistically significant ($.2<p_r<.1$) in most specifications—may be correlated enough to warrant testing each with the other removed.[6] More generally, it is important not only to test IVs simultaneously, but also to remove extraneous insignificant terms (including insignificant control IVs) from any specification—though this requires identifying which of the insignificant terms are in fact “extraneous”.

A third model selection approach focuses more closely on IVs representing hypothetical causal relationships of particular importance and/or interest. Some of these studies do so after selecting a “base model” through individual and/or simultaneous testing, e.g.: Berkmen et al. (2012), focusing on the role of commodities exports; Giannone, Lenza, and Reichlin (2011), considering the role of liberalization; and Blanchard, Faruqee, and Das (2010) and Llaudes, Salman, and Chivakul (2010), looking at the role of foreign exchange reserves (FXR), scaled against short-term financing requirements (e.g. related to short-term debt and/or the current account deficit). Others begin with a baseline model of control IVs drawn from the results of earlier literature: Rose (2012), focusing on financial integration and bilateral financial ties in Asian economies; Tsangarides (2012), focussing

[6] Lane and Milesi-Ferretti do note that the simultaneous inclusion of the current account and net foreign assets terms was not possible due to their confounding effects. It thus seems less likely that they would have overlooked this possibility for trade and financial openness, but they do not discuss this explicitly.

on exchange rate regimes and regime switching; Bussière et al. (2015), consider FXR scaled in several ways; Hausmann-Guil, van Wincoop and Zhang (2016), considering discontinuities related to financial and/or trade integration; Allegret and Allegret (2019), regarding FXR scaled specifically to the M2 measure of the monetary supply (FXR/M2); and Bashar and Bashar (2020), considering countries ‘resource richness’ (as oil rents, natural gas rents, coal rents, and mineral rents).

In their focus on the role of “liberalization” in influencing GFC outcome, Giannone, Lenza, and Reichlin (2011) exemplify the dangers of focusing too narrowly on a particular hypothesized causal relationship, without first pursuing the overall best explanatory model.[7] They first identify a baseline specification consisting of indicators from the Fraser Institute’s Economic Freedom of the World (EFW) ratings for credit market regulation (CMR), labour market regulation (LMR) and business regulation (BR), as well as control IV’s for income (log[GDP/c]), population (logged), and a “boom growth” term (average output growth 2002–2006). In that main specification, the CMR, LMR and income terms are significant (at $p<.01$, .01 and .05 respectively), while population, boom growth and BR are insignificant (each at $p>.2$). Subsequent analysis then tests this baseline specification for robustness, individually adding twenty-two IVs from six categories: openness (to trade and finance), financial size, banking system size, stock market size, and “macroeconomics and banks”. While the significant CMR result is robust throughout, the LMR term is

[7] “Liberalization” implies a process of change from a less- to a more-liberal state, such that better measures of (economic) “liberalization” would reflect changes in the variables that Giannone, Lenza, and Reichlin consider. As operationalized, their study perhaps better examines (economic) “liberality”.

dominated by several IVs, and the BR term actually attains significance only when controlling for other IVs, suggesting avenues for improving the model. In particular, Giannone, Lenza, and Reichlin's LMR term is dominated by terms for the current account (as per cent of GDP in 2006) and for the level of private credit (private credit by money banks and other financial institutions as a percentage of GDP in 2005), while the BR term is also rendered significant by the inclusion of that private credit term. While this issue does not negate the importance of Giannone, Lenza, and Reichlin's main result—that the CMR term is significant and robust, at least so far as their testing could detect—it does highlight that Giannone, Lenza, and Reichlin are focused on testing that particular measure of liberalization, instead of seeking to explain differential impact more generally. Seeking the best baseline model possible would then provide a stronger test of robustness for the "liberalization" related IVs, or other IVs and relationships of particular interest.[8]

Few studies in the literature do explicitly seek a best model. While Ólafsson and Pétursson (2010) seek to explain cross-country variation in post-crisis experience, they provide little detail about how they arrived at their "preferred specifications":

> *...with the large number of potential explanatory variables included in this study and limited guidance from theory on exactly what factors to include, we necessarily had to undertake* ***some experimentation*** *before arriving at the preferred baseline specifications presented. Thus, all the potential variables were tested but only those found to be statistically significant at conventional levels are retained. (15, emphasis added)*

They do not explicitly discuss any systematic testing of IVs not included in their preferred specifications, thus while their approach may have identified the best model, this cannot

[8] Giannone, Lenza, and Reichlin (2011) also use Bayesian Model Averaging (BMA) as part of their robustness testing, which will be discussed further below.

be discerned from the results and discussion provided.

Providing "an update" on their previous results (i.e., in Rose and Spiegel 2009, 2010), Rose and Spiegel (2011, 315) undertake a more systematic approach. They "search for simple quantitative models of macroeconomic and financial indicators of the 'Great Recession' of 2008–09", focusing on "nine causes of the crisis [i.e., IVs] that researchers have been able to link successfully to the intensity of the crisis". They first test those nine IVs individually across various sub-samples and contraction-related DVs based on annual-level data, with income (log[GDP/c], 2006) as a control throughout. They then choose a baseline specification including income and three IVs found robustly significant: current account (CA-to-GDP, 2006), credit boom (2000–2006), and EFW's credit market regulation (CMR).[9] This model selection process is threatened by potential biases already discussed, including: omitted variable bias in considering only IVs found significant in other studies; and overlooking false negatives in considering only IVs found significant individually. However, to "test the validity" of the "judgment" relied upon in identifying that baseline specification, Rose and Spiegel use an automated mechanical general-to-specific stepwise specification search; only the CA, CMR and income terms—and to a lesser extent the credit boom term—"survive" that test (319; and their Table 4b).[10] The

[9] Rose and Spiegel's (2011) baseline model includes two IVs found significant previously (2009, 2010), but which are insignificant in the new baseline: share of trade with the U.S. (2006), and stock market capitalization growth (2003–2006). These potentially confounding IVs should be removed from the model.

[10] The extent to which Rose and Spiegel's (2011) mechanical specification search helps avoid the problems of false negatives and contingent IV significance assumes that the search was applied to Rose and Spiegel's entire dataset, and including far more than just those IVs reported on "individually" in the first part of their paper.

‘general-to-specific’ nature of their search suggests that it began not with their entire dataset of IVs, but with a specification including only the IVs already found significant “individually”, thereafter sequentially eliminating each least-significant IV. Thus, while this search helps eliminate the potential problem of false negatives due the inclusion of confounding insignificant IVs, it still does not address the problems of false negatives and contingent IV significance present in the first part of their paper.

A fourth broad approach to model selection uses Bayesian Model Averaging (BMA), to explicitly address the issue of “model uncertainty”—that is, the lack of theoretical guidance on specification selection, and the plausibility of numerous IVs and combinations thereof. BMA is an automated process testing numerous regression specifications from a “model space” of different combinations of many candidate IVs. Because the model space grows exponentially with the number of candidate IVs—i.e., with 2^k possible combinations of k IVs—BMA processes also often employ Monte Carlo simulations, sampling the model space rather than explicitly testing all possible specifications. Technically the BMA process does not identify a single ‘best’ model, but rather describes an average of all the models sampled. For each IV, the BMA process generates an overall coefficient estimate, averaging the coefficient estimates across the sampled specifications. It also generates a “Posterior Inclusion Probability” (PIP) value for each IV, with higher values indicating that “irrespective of which other explanatory variables are included, the regressor has strong[er] explanatory power” (Giannone, Lenza, and Reichlin 2011, 125). PIPs greater than 0.5 are generally accepted as providing significant explanatory power. However, despite the apparent strength of BMA in addressing the problem of "model uncertainty", the existing studies do not provide conclusive evidence concerning the differential impact of the GFC, for a variety of reasons, some operational and some more directly related to the limitations of BMA.

Three papers—Dwyer and Tan (2014), Ho (2015), Chen et al. (2017)—use BMA to explicitly test and extend the results of Rose and Spiegel (2009, 2010, and/or 2011). Each uses Rose and Spiegel's own dataset, thereby facing limitations inherent in that data (e.g., re omitted variable bias) and in selecting IVs from a model space smaller than the entire dataset. For example—before proceeding with other non-BMA-based analysis—Dwyer and Tan (2014) use BMA on a model space of 77 IVs from Rose and Spiegel's (2009 and 2010) database. With incidence measured as 2008–09 economic growth, they confirm that "almost no indicators are empirically robust in terms of predicting crisis incidence" (87). Here the greatest challenge to the results is from omitted IVs not available in the database used, but included later in the database from Rose and Spiegel (2011).

In contrast, but also using output growth 2008–2009 as DV, Ho (2015) applies BMA in several alternate forms to a model space of 51 IVs selected from Rose and Spiegel's (2011) dataset. Ho further introduces "simultaneous Bayesian variable selection and outlier identification" (SVO) on 33 of those IVs to address potential outlier influence. Ho's explicit goal is to show that Rose and Spiegel's (2011) negative results—the few IVs identified as significantly predicting GFC outcome—are largely the result of their methodology, and to demonstrate that BMA and SVO are able to identify more potentially relevant IVs. Ho's goal is thus not to better understand the differential impact of the crisis, save regarding differences with respect to Rose and Spiegel, and the results are presented with little consideration or interpretation of their meaning and implications. Chen et al. (2017) likewise seek test and improve on Rose and Spiegel's (2011) results—as well as on Ho's, actually using Ho's database (itself derived from Rose and Spiegel's). Chen et al. use BMA to address the uncertainty in selecting individual IVs, and also add a "Bayesian hierarchical formulation" to address the prior uncertainty in selecting groups of IVs; but they do not appear to address potential outlier influence (e.g., as per Ho's use of SVO).

One particular concern in Ho's results—also present for Chen et al.—is the simultaneous identification of quite similar IVs as significant in particular BMA results. For example, throughout Ho's BMA results both trade- and exports-exposures to Rose and Spiegel's (2010) "small crisis countries" (SCCs)—i.e., economically small countries (with low GDP) that experienced "dramatic" contractions: Iceland, Ireland, Ukraine, and the Baltics—are found to have high posterior inclusion probabilities (PIPs). It seems theoretically unlikely such IVs would both be significant when included simultaneously, as they are likely highly correlated, and reflect the same underlying causal mechanism, and would thereby "compete" for explanatory power in a non-averaged specification. Similarly, IVs for income, Freedom House's civil liberties and political rights scores, and the World Bank's Worldwide Governance Indicator (WGI) for regulatory quality are all identified as relevant in various BMA results, but are all likely to be at least somewhat correlated and to compete for explanatory power; indeed (as already discussed), Giannone, Lenza, and Reichlin (2011) showed that the WGI term dominates income.[11]

Another concern with Ho's and Chen et al.'s results is the procedural identification of significant IVs that require further consideration. The income term is the example of central focus in this dissertation, with worse GFC-outcomes correlated to higher income, but raising the question of why this is so. But, in another example, Ho's and Chen et al.'s results on exports- and trade-exposure to the SCCs results ignores Rose and Spiegel's (2010) note about potential endogeneity issues regarding those terms:

> *Much of this is not of particular interest, because there is considerable intra-Baltic trade, and the Baltics are all included in the regressions, unlike the regressions that link other countries to, for example, the United States and do not include the United States as an observation (because the United States cannot export to the United States). (355, footnote 21)*

By simply listing the results, and not further considering their meaning, Ho's and Chen et al.'s focus remains strictly methodological: obtaining different (and maybe even better) results compared to Rose and Spiegel, but without necessarily improving understanding of why countries experience differential impact.

Giannone, Lenza, and Reichlin (2011) also use BMA, specifically to extend their own robustness testing, from adding numerous IVs to their baseline specification

[11] Feldkircher (2012) also undertakes BMA analysis, further introducing interaction terms. The only interaction term found relevant (i.e., with a PIP>.50, specifically .949) is that between a pre-crisis credit boom IV (change over 2000–2006 in domestic credit provided by banking sector in per cent of GDP,) and an IV for AE bank claims (2006 consolidated claims of foreign BIS-reporting banks from 18 AEs, in per cent of GDP). Because many pre-GFC domestic credit booms were fuelled by foreign bank inflows, it seems likely that the credit boom and AE bank claims are well-correlated, and so should be also tested directly against one another in non-BMA regressions specifications. The inclusion of their interaction term further complicates the matter, with the interaction term necessarily correlated with both parent terms: 3-way multicollinearity could produce spurious results, even in a non-BMA specification. However, as the remainder of this dissertation does not follow a BMA framework, the full dissection of BMA and the use of interaction terms therein is deemed beyond the scope of this chapter.

individually (as discussed above), to testing these IVs simultaneously (albeit dropping two IVs with limited observations to preserve sample size: 125, footnote 5). However, their use of BMA mirrors one of the limitations of this study already discussed above. Giannone, Lenza, and Reichlin interpret the inclusion of the CMR (PIP=.59) and LMR (PIP=.54) terms in a list of the top-five PIPs for their IVs as "further indication of the importance of these variables in explaining the variation across countries in 2008–09 growth rates" (126).[12] However, they seem to overlook that the current account term (as per cent of GDP 2006) and the private credit term (level of private credit by money banks and other financial institutions as a percentage of GDP 2005), both have higher PIPs (.94 and .57 respectively) than does LMR (.54). As discussed earlier, these are also two of the IVs that dominated LMR when added individually in robustness testing, and with the inclusion of private credit also rendering BR significant. So, again, their narrow focus on the liberalization terms before undertaking a more exhaustive model search (even using BMA) prevents them from identifying a clearly stronger model, and also prevents hem from both rejecting the LMR term as not *robustly* significant and considering the BR term further (subject to further robustness testing). More generally, though, this outcome suggests that a BMA PIP value greater than 0.5 does not necessarily imply that a given IV will not be dominated by another IV (likely with a higher PIP). By remaining within a strictly probabilistic framing, BMA

[12] Note: In Giannone, Lenza, and Reichlin's Table 5 (listing BMA results for IVs with the top-5 PIPs), the average growth 2002–2005 IV has the second highest PIP=.85, and income is not included (126); but in the text they refer to income (and not average growth) as in the top-5 PIPs (126), indicating that one or the other is a typo. Because of income's significance in other results, and with average growth's insignificance otherwise fairly robust, I assume that the typo is in the table, and that income has PIP=.85.

thus does not strictly correct for potential false positives due to IV omission.[13]

Some studies also consider the question of why the countries of emerging Europe experienced worse contractions the crisis, as indicated by a significantly negative binary dummy IV identifying those countries, as originally noted—but not further analysed—by Rose and Spiegel (2009). Berglöf et al. (2009) provide the main example, attacking this problem directly. Using interaction terms between an emerging Europe dummy and terms representing financial integration and the role of foreign bank ownership (FBO), they first argue that those factors played out differently in emerging Europe than elsewhere (i.e., for their global sample). However, their initial interaction specifications exclude the emerging Europe dummy term itself, as an un-interacted “parent” of the interaction terms. This exclusion constrains their model in a way that “pushes” all explanatory power relating to any emerging Europe difference into the interaction terms, whether or not this reflects the true relationship or produces a spurious result. Berglöf et al. also do not explicitly control for sample change between the results in which they first show the emerging Europe dummy to be significant (with a global sample: N=176) and then insignificant (with only Emerging Market Economies (EMEs): N=59), attributing all of that change to specification difference (now without any interaction terms), where sample difference may play an important role. So, Berglöf et al. do examine the question of why a particular “empirical regularity” appears, by testing IVs for financial integration and FBO that are likely “closer”

[13] One solution to this problem could use BMA as a first step in model selection, then testing all IVs with PIPs over 0.5 simultaneously, and eliminating insignificant IVs via a general-to-specific step-wise process. This approach was not considered before model selection was undertaken for this chapter.

to underlying causal mechanisms than is the IV highlighting the regularity to be explained (the emerging Europe dummy). However, their particular analysis requires further consideration before their conclusions can be accepted. They also do not discuss the possible influence of outliers in the emerging Europe difference: the extreme outcomes for the Baltics and Ukraine may well drive the result, such that the question may become why they, rather than all of emerging Europe, fared so poorly.[14]

To summarize, several issues (and remedies) have been identified, to be taken into account in seeking to identify the "best" specification helping to explain GFC outcomes:

- **Omitted Variable Bias:** overlooking possible explanatory factors, particularly the relevant possibilities identified in the literature.
    - Remedied (partly) by testing a broad range of IVs, including (at least) those considered in the literature, and not just those found significant in those studies.
- **Confounding Significances between IVs:** insignificant IVs may confound other IVs; correlated IVs may confound one another.
    - Remedied by removing insignificant IVs, and by selecting between competing IVs based on dominance and explanatory power.
- **Contingent Significances:** individually insignificant IVs may represent false negatives, with the "true positive" visible only after including other significant IVs.
    - Remedied by re-testing all previously insignificant IVs, added to candidate models that include only significant IVs.

[14] Cuaresma and Feldkircher (2012, within a BMA framework) and Fraga and Rocha (2014, non-BMA) also examine the emerging European difference. However, their more complex use of interaction terms does not permit the direct evaluation of whether or not their models actually fully explain that difference. Because the emerging Europe dummy itself—as a non-interaction "parent" for interaction terms—now reflects the intercept for an independent linear relationship, it no longer represents any meaningful *difference* for those countries. Actual evaluation of an emerging European difference would require examination of the DV residuals of a particular model (and not just on an average model under BMA), as is illustrated below, in the analysis section of this chapter.

- **Outlier Influence:** extreme values on IVs or the DV can generate false negatives as well as false positives.
    - Remedied by performing model search with outliers excluded.
- **Credibly Causal Role:** some significant IVs may not reflect plausibly causal roles, spuriously capturing effects better attributed to other possibly-correlated IVs—e.g., the income and emerging Europe IVs hypothesized as not directly causal.
    - Remedied by testing IVs representing more credibly theoretical causal mechanisms in the deliberate absence of the less-theoretically-credible IVs.

These issues are addressed by the methodology used in this chapter, discussed after reviewing the substantive results reported in the differential impact literature.

3.2.2 Results in the Literature

Given the model selection processes described above, Table 3.1 summarizes the results from the literature, outlining the samples and DVs used, and the IVs identified statistically significant in the main results. This section reviews those results, first focusing on “vertical” (“depth-like”) impact DVs—based on annual-level growth data, changes in expected or forecast growth, or quarterly-based measures of contraction depth—and then looking at the papers that consider “horizontal” DVs measuring contraction duration.

As discussed in Chapter 2, several papers find pre-crisis income (log[GDP/c], 2006 or 2007) related to worse “vertical” GFC outcomes (Rose and Spiegel 2009, 2010, 2011; Berglöf et al. 2009; Frankel and Saravelos 2011; Giannone, Lenza, and Reichlin 2011; Lane and Milesi-Ferretti 2011; Rose 2012; and Bashar and Bashar 2020).[15] Income is also

[15] Giannone, Lenza, and Recihlin (2011) find income significant in their preferred specification,

Table 3.1: Differential Impact Literature Select Results

	Rose & Spiegel (2009)	**Rose & Spiegel (2010)**	**Berglöf *et al.* (2009)**	
Sample	GDP/c>$4k & Pop>10M (N=107)		Emerging Europe (N≤25)	Global & EMEs (N≤176 & N=59)
Main DV(s)	MIMIC Latent DV of “crisis incidence or severity” (see note)		Acute Phase Growth (sum of 2008Q4 & 2009Q1, s.a. Q/Q output growth)	Growth Difference (2009 minus 1999–2008 avg.)
IVs* (statistically significant: robustly or in preferred specification)	−Income (2006) −Stock Market Boom (2003–2006) −Central & Eastern Europe & Central Asia dummy	−Income (2006) −Stock Market Boom (2003–2006) +U.S. share of Total Trade (2006) −Current Account Balance (2006) +Total Trade (2006)	−Credit Boom (2005–2008, bank & OFI) −Foreign Bank Ownership (2005) −Corruption Perceptions	−Income −GDP Growth (1999–2008) +Credit Level −Credit Boom (2005–2008, bank & OFI) −Bank System Leverage (2006) +Oil Rents (*or* Commodities share of Exports)
R^2 (N) for main results	R^2 not applicable in MIMIC (N=40)	(N not specified)	.57 (N=24)	.56 [.62] (N=142) [(N=59)]
Notes	Multiple Indicators of Latent DV are the 2008 changes in: GDP; national stock market index; IMF SDR exchange rate; and *Institutional Investor*’s country credit risk rating.		The claim that the final EME specification explains the emerging Europe difference identified on the global sample may confuse specification difference with sample change.	

* +/− indicates higher IV value sig. correl. with better/worse outcome (regardless of DV “direction”) *(continued…)*

included in Ho’s (2015) SVO-identified model with the highest posterior model probability (PMP), taken here as the “preferred” specification, though Ho does not explicitly make this conclusion.[16] These studies all use broad global samples, spanning the full income spectrum, and so are expected to show a negative linear income-outcome relationship,

including the EFW “trio” of CMR, LMR and BR, but (as discussed above) not when those trio are replaced with either the *EuroMoney* credit risk rating or the WGI indicator for regulatory quality.

[16] For each form of BMA (including SVO), Ho (2015) reports PIPs for each IV, highlighting those that improved on their prior inclusion probability, as well as a list of models providing the top-10 PMPs. Dealing with potential outliers, SVO is the most-sophisticated form of BMA used, and so is assumed to generate models to be preferred over other forms of BMA, with the highest PMP identifying the “best” model.

Table 3.1: Differential Impact Literature Select Results (continued)

	Lane and Milesi-Ferretti (2011)	Giannone, Lenza, and Recihlin (2011)	Berkmen et al. (2012)	
Sample	"Broad Global Sample" (N≤163)	As per Rose and Spiegel (2009, 2010) (N≤107)	EMEs (N≤40)	Developing Countries (N≤121)
Main DV(s)	Growth 2008-2009	Growth 2008-2009 (as per Lane and Milesi-Ferretti 2011)	Output Forecast Error: (Δ. actual 2009 output vs. pre-GFC *Consensus* forecast)	Output Forecast Error (Δ actual 2009 output vs. IMF forecast April 2008)
IVs* (statistically significant: robustly or in preferred specification)	−Income (2007) +Current Account Balance (2007) −Credit Boom (2004–2007, bank and OFI)	−Income (2006) −Credit Market Regulation (EFW) +Labour Market Regulation (EFW) (but not robust) × Business Regulation (EFW) (robustly insig.)	−Banking System Leverage −Hard Peg XR dummy +Primary Fiscal Gap −Short-Term External Debt	−Trade Openness −Bank Leverage −Credit Boom (2005–2007, bank) −Manufacturing share of Exports (or: +Soft-Commodities share of Exports)
R^2 (N) for main results	.44 (N=162)	.32 (N=29)	.67 (N=29)	.34 (N=86)
Notes	Also: During-GFC Trade Shock (2008–2009 trading partner growth), sig. (+) w/ DV residual from main results (R^2=.10, N=160).	*EuroMoney* Credit Risk Rating (CRR) dominates income. WGI Reg. Quality dominates CRR. EFW-trio dominates WGI Reg. Quality, but not income.	Income not considered on either sample.	Interaction analysis between EMEs and Manufacturing (or Soft-Commodities) share of Exports is problematic: EME dummy is omitted as non-interaction term.

* +/− indicates higher IV value sig. correl. with better/worse outcome (regardless of DV "direction") *(continued…)*

given the results of Chapter 2. Other papers that do not find an income term significant generally have narrower samples, excluding many LMICs that Chapter 2 identifies as driving the linear income relationship: Claessens et al. (2010) consider "most" AEs and "the major" Emerging Market Economies (EMEs) (N=58, with 10 LMICs), Ólafsson and Pétursson (2010) consider only the "upper half of the income spectrum" (N=46: 1 LMIC), and Blanchard, Faruqee, and Das (2010) consider EMEs only (N=29: 7 LMICs). Meanwhile, Llaudes, Salman, and Chivakul (2011) consider 57 EMEs including 24 LMICs

Table 3.1: Differential Impact Literature Select Results (continued)

	Claessens et al. (2010)		**Ólafsson and Pétursson (2010)**	
Sample	“Most AEs and the major EMEs” (N≤58)		“Upper Half of Income Spectrum” (N=46)	
Main DV(s)	Contraction Depth (as “Severity”) (cumul. GDP decline during contraction, or to 2009Q4)	Contraction Duration (# quarters of contraction, or to 2009Q4)	Contraction Depth (log-Δ in s.a. real GDP between peak in 2007Q1–2008Q4 and 2009Q4)	Contraction Duration (# quarters w/ q/q s.a. GDP growth <0 in 2008Q3–2009Q4)
IVs* (statistically significant: robustly or in preferred specification)	−Housing Price Boom (2000–2006) −Credit Boom (2000–2006, bank) −Current Account Balance (2006) −Trade Openness (2006)	−Income −Housing Price Boom (2000–2006) −Credit Boom (2000–2006, bank) +Current Account Balance (2006) −Outward Foreign Bank Claims (2006, log)	−Inflation Rate +XR Variability −Output Correlation −Output Volatility −Financial Leverage +Exchange Rate Regime dummy (for floating w/ inflation targeting)	−Inflation Rate +XR Variability +Trade Openness −Financial Openness −Capital Inflows (FDI-to-GDP) −Gen. Gov. Debt −Past Currency Crisis dummy (in last 30-years)
R^2 (N) of main results	≤.28 (N=45)	≤.32 (N=56)	.77 (N=46)	.49 (N=46)
Notes	IVs tested only individually w/ Income control (i.e., no simultaneous testing).		Income insig. when added to preferred depth and duration specifications.	

* +/− indicates higher IV value sig. correl. w/ better/worse outcome (regardless of DV) *(continued…)*

and 27 UMICs—as well as 2 LICs and 7 HICs—and so should be able to detect the income relationship; but they only consider an income IV in robustness testing of particular results with split samples: income is statistically significant (or insignificant) for countries with the ratio of foreign exchange reserves to short-term external debt greater than (or less than) 100 per cent. Berkmen et al. (2012) appear to have not considered income at all.

Most papers in the literature also test the expectation that the GFC impact was (at least partly) transmitted through trade linkages. Yet contradictory results indicate that greater “trade openness” or “total trade” (exports plus imports to GDP) was significantly correlated with better outcomes (Rose and Spiegel 2010; Claessens et al. 2010), worse

Table 3.1: Differential Impact Literature Select Results (continued)

	Blanchard, Faruqee, and Das (2010)	**Llaudes, Salman, and Chivakul (2010)**	**Rose and Spiegel (2011)**
Sample	EMEs (N=29)	EMEs (N=50)	As per Rose and Spiegel (2009, 2010) (N≤107)
DV(s) (output oriented)	Acute Phase Unexpected Growth (2008Q4–2009Q1 growth vs. IMF forecast April 2008)	Contraction Depth (peak-to-trough %Δ in s.a. quarterly real GDP)	Growth 2008–2009 (as per Lane and Milesi-Ferretti 2011)
IVs* (statistically significant: robustly or in preferred specification)	+During-GFC Trade Shock ("unexpected trading partner growth") −Short-Term External Debt (STED)	−IMF External Vulnerability Index (*or* each of 3 of 5 sub-components: FXR/(STED-CA); CA/GDP; External Debt-to-GDP) +During-GFC Trade Shock (contraction period AE trading partner domestic demand growth) −Inward Foreign Bank Claims	−Income (2006) +Current Account −EFW Credit Market Regulation
R^2 (N) of main results	.46 (N=29)	.44 (N=40)	.41 (N=75)
Notes	Also find no independent FXR effect (but the analysis is problematic; and see Llaudes, Salman, and Chivakul 2010).	Also find FXR role for countries with lower FXR/GDP (but the analysis is problematic).	Tests wider variety of IVs and DVs from other studies.

* +/− indicates higher IV value sig. correl. w/ better/worse outcome (regardless of DV) *(continued…)*

outcomes (Berkmen et al. 2012), or was insignificant (Lane and Milesi-Ferretti 2011; Giannone, Lenza, and Reichlin 2011).[17] Focusing more narrowly on the composition of exports, Berglöf et al. (2009) find "a role for commodities", either as oil rents (2007 value of produced oil) or the commodities share of merchandise exports, each significantly

[17] Lane and Milesi-Ferretti (2011) find trade openness "nearly" significant on their "all countries" sample (p=.144), and with major oil exporters excluded (p=.114), but then significant (at p=.083) when excluding LICs. However, it becomes insignificant again when excluding LICs and financial centres (FCs) (or excluding LICs, FCs and major oil exporters), suggesting the significance is driven by the FCs, but is "muted" by the LICs. Some FCs have very high trade openness (e.g., Hong Kong, Luxembourg), so the limited trade openness result may reflect an outlier effect, rather applying generally across most countries.

Table 3.1: Differential Impact Literature Select Results (concluded)

	Didier, Hevia and Schmukler (2012)	**Ho (2014)**	**Feldkircher (2012)**
Sample	Global (N=152≤182)	As per Rose and Spiegel (2009, 2010) (N≤107)	EMEs & AEs (N=63)
DV(s) (output oriented)	Growth Collapse (difference in real GDP growth between 2007 and 2009)	Growth 2008–2009 (as per Lane and Milesi-Ferretti 2011)	Contraction Depth (peak-to-trough %Δ in s.a. quarterly real GDP) (Also: cum. output loss & 2 measures of long-term deviation from trend output)
IVs* (statistically significant: robustly or in preferred specification)	−Credit Boom (2003–2007) −Trade Openness (2007) −LIE dummy (for non-HIC economies with IDA but not IBRD borrowing access)	−Income (2006) −Stock Market Growth (2003–2006) −Private Bank Ownership (2006) +Trade Exposure to Japan −Trade Exp. to Small Crisis Countries	+Credit Boom (2000–2006, bank) −Output Boom (2000–2006) −Ratio: how often country was above trend growth in 2000–2006 +(Credit Boom) ×(Output Boom)
R^2 (N) of main results	.706	not reported for BMA	not reported for BMA
Notes	Income dominated by LIE dummy. CA & FXR terms (/GDP) dominated by Trade Openness.	Uses BMA & SVO to illustrate limits of Rose and Spiegel’s (2011) process.	But IVs with high BMA PIPs for Contraction Depth DV model are ‘not efficiently estimated’

* +/− indicates higher IV value sig. correl. w/ better/worse outcome (regardless of DV)

predicting better outcomes (providing a “stabilizing effect on outcome”: 1003). Berkmen et al. (2012) similarly find the soft-commodities share of exports significantly related to better outcomes, and the manufacturing share of exports is significantly related to worse outcomes when replacing the soft-commodities term. Yet neither Berglöf et al. nor Berkmen et al. test which of those trade-composition terms provides a better fit—for example, examining whether there were distinct shocks specific to oil, soft-commodities, manufactured goods, or combinations thereof.[18,19,20]

In contrast, Ólafsson and Pétursson (2010) find no significant role for trade linkages, with IVs for trade openness or the manufacturing share of exports, or using UNCTAD’s measures of trade diversification or trade concentration. They do, however, identify a role for output correlation with the rest of the world (correlation between the cyclical component of quarterly GDP and gross world product over 1985–2007) and exchange rate variability (standard deviation of quarterly nominal effective exchange rate (NEER) changes over 1994–2007), aspects of international linkages not unrelated to trade, but which are not considered elsewhere in the literature.

Some papers also identify the current account balance (as ratio-to-GDP) as significantly related to “vertical” GFC outcomes, with lower pre-crisis balances (i.e., lower surpluses or larger deficits) correlating with worse contractions (Rose and Spiegel 2009,

[18] Berkmen et al. (2012) do consider whether the manufacturing or soft-commodities share of exports relationships are different between EMEs and other developing countries in their sample. However, the reliability of their results is not clear, as they do not include the EME dummy (in non-interaction form) in specifications including its interaction with the manufacturing or soft-commodities export share terms.

[19] Several papers also consider partner-specific trade linkages, but only Rose and Spiegel (2010) find trade exposure to the U.S. (i.e., U.S. share of total trade) significant—predicting worse outcomes in terms of their MIMIC latent DV—but which they later did not find robustly significant using standard (i.e., non-MIMIC) regression on more-typical “vertical” DVs (Rose and Spiegel 2011).

Ho’s (2015) top-PMP SVO model also includes IVs for trade exposure to Japan and trade exposure to the SCCs significantly related, with greater exposure significantly predicting better and worse outcomes respectively; however, as pointed out by Rose and Spiegel (2010) and discussed above the significance of that SCC trade exposure term is “not particularly meaningful” due to endogeneity concerns.

[20] Some papers alternatively test a trade IV measuring the actual during-GFC trade shock (Lane and Milesi-Ferretti 2011; Blanchard, Faruqee, and Das 2010, Llaudes, Salman, and Chivakul 2011)—e.g., through a trade weighted average of trading partners’ growth over the crisis period, or a similar measure. While such during-GFC IVs may introduce endogeneity issues, Blanchard, Faruqee, and Das’s results are robust to switching to pre-crisis exports-to-GDP, and Lane and Milesi-Ferretti find their version significant when regressed against the residual of the DV from their main specification of pre-crisis IVs (in which total trade was insignificant: see Footnote 17).

2010; Lane and Milesi-Ferretti 2011; Claessens et al. 2010). Giannone, Lenza, and Reichlin (2011) also find the current account term to have the top PIP (.94) according to BMA analysis of the IVs considered; but they do not incorporate it into their final preferred model, leaving the EFW labour market regulation (LMR) term in place (itself with only the fifth highest PIP of .54), even though their robustness testing shows that the current account term also dominates LMR. In contrast, Blanchard, Faruqee, and Das (2010) and Rose and Spiegel (2011) find the current account term initially significant, but dominated by a short-term external debt (STED/GDP) term, at least for their much smaller samples on which STED data is available (N=29 and N=38, respectively).

The role of credit is also central to many results, with Berglöf et al. (2009) Lane and Milesi-Ferretti (2011), Berkmen et al. (2012) and Claessens et al. (2010) all finding a credit boom term significant: greater growth in credit to the private sector from domestic banks—or from banks and other financial institutions (OFIs)—over some pre-crisis boom-period (e.g., 2000–2006, 2005–2007, or 2005–2008) correlates with worse outcomes, as the pre-crisis boom reverses itself. Berglöf et al. (2009) also find that pre-crisis (2007) level of credit-to-GDP significantly predicts better outcomes, as do Giannone, Lenza, and Reichlin (2011) in robustness testing.[21] In contrast, Rose and Spiegel (2009) find the 2006 level of credit-to-GDP insignificant, though they include it as one of several (level-based) “measures of relative domestic credit growth” (10). Rose and Spiegel (2011) then find a

[21] As with current account, credit level also dominates the EFW LMR term in Giannone, Lenza, and Recihlin’s (2011) robustness tests, and has a higher PIP (.57), but is not included in the final model.

2000–2006 credit growth term significant when included only with the income control IV, but not in their preferred specification. In addition to the credit level and growth terms, Berglöf et al. (2009)find that bank system leverage (loans-to-deposits 2006) significantly predicts worse outcomes, as do Berkmen et al. (2012) (as credit-to-deposits 2007).

IVs found significant in other papers include: consumer price index (CPI) inflation (Ólafsson and Pétursson 2010); exchange rate regime dummies (Berkmen et al. 2012; Ólafsson and Pétursson 2010); a dummy for emerging European countries (Rose and Spiegel 2009; Berglöf et al. 2009); EFW credit market regulation (CMR) (Giannone, Lenza, and Reichlin 2011; Rose and Spiegel 2011);[22] foreign bank ownership (FBO: foreign owned share of total banking system assets in 2005: Berglöf et al. 2009); "inward" foreign bank claims (total claims on the country by foreign banks, as ratio to GDP in 2007: Llaudes, Salman, and Chivakul 2010);[23] and pre-crisis "room" for a fiscal response (primary fiscal gap: Berkmen et al. 2012); as well as actual during-crisis fiscal response (2008–2009 change in cyclically adjusted primary fiscal balance: Blanchard, Faruqee, and Das 2010). Additionally, Ho's (2015) highest-PMP SVO model includes terms for private bank ownership (share of bank deposits held in privately owned banks), and stock market booms (stock market capitalization growth 2003–2006), which was found significant by

[22] Giannone, Lenza, and Recihlin (2011) also test the sub-components of the EFW CMR indicator, finding the "(private) ownership of banks" and "foreign bank competition" indicators significant, but the "interest rate controls/negative interest rates" and "private sector credit" indicators insignificant.

[23] The modifier "inward" is added here to Llaudes, Salman, and Chivakul's (2010) "foreign bank claims" IV name to distinguish from Claessens et al.'s (2010) "outward" version of "foreign bank claims," focused on domestic banks' claims on foreigners, discussed below.

Rose and Spiegel (2009, 2010), but insignificant in their (2011) preferred specification.[24]

For these models on DVs representing various "vertical" measures of GFC outcome, the preferred models provide a wide range of explanatory power, across quite different final model samples (reduced from initial broad sample coverage by data paucity). For example, Berglöf et al. (2009) use six IVs to explain 56 per cent (R^2=.56) of the variation in their "growth difference" DV (2009 growth minus the 1999–2008 avg.) on a "global" sample, reduced by missing data from 176 to 142 countries. In contrast, Lane and Milesi-Ferretti's (2011) preferred model explains 44 per cent (R^2=.44) of cross-country variation in their 2008–2009 average growth DV, using only three pre-crisis IVs on a final

[24] Other results of possible interest, but which I interpret as broadly negative:

Housing Price Boom: Rose and Spiegel (2011) find Claessens et al.'s (2010) individually significant housing price boom term (change in real house prices between 2000 and 2006) insignificant when added to their preferred specification (and with data paucity reducing sample size from N=75 to 43).

Foreign Exchange Reserves (FXR): Blanchard, Faruqee, and Das (2010) conclude that the significance of a log[FXR/STED] term represents variability in the short-term external debt (STED) denominator, with no independent role for FXR. Llaudes, Salman, and Chivakul (2011) challenge this, claiming a distinct significant role for FXR for countries with lower FXR/GDP, but I have three major reservations about the methodology used to reach their conclusions: (1) extending Blanchard, Faruqee, and Das's decomposition of log[FXR/STED] into log[FXR/GDP] and log[STED/GDP] terms to the transition from log[FXR/(STED−CA)] to log[FXR/GDP], log[STED/GDP] and log[CA/GDP] terms does not follow from the property of logarithms that log[a/b] = log[a]−log[b]; (2) the approach of splitting samples would be better operationalized using dummy IVs and interaction terms; and (3) they may conflate a genuine logarithmic diminishing returns effect with their interpretation of significant FXR results for lower FXR countries and insignificant results for higher FXR countries.

External Vulnerability Index (EVI): Llaudes, Salman, and Chivakul (2011) also find an IMF EVI significant, but which is not publicly available for testing.

Pre-Crisis GDP Growth: Berglöf et al. (2009) find a term for pre-crisis average GDP growth over 1999–2008 to significantly predict worse outcomes, though their DV is the difference between growth in 2009 and that same 1999–2008 average growth value. Using only 2009 growth as DV, Lane and Milesi-Ferretti (2011) find no such significant relationship for that same "trend growth" IV, while a 2005–2008 average "boom growth" IV is significant (at $.1>p>.05$) on their full sample, but not on any of their four subsamples. Giannone, Lenza, and Reichlin (2011) also include 2002–2006 average growth as a control IV throughout all regressions on their 2009 growth DV, but the term is robustly insignificant (where reported).

sample of 161 countries.[25] With that same DV, Rose and Spiegel (2011) likewise obtain 41 per cent explanatory power (R^2=.41) on 75 countries (with income>$4k and population>1M) with only three IVs. For those measuring contraction depth on a quarterly level, Ólafsson and Pétursson (2010) achieve the highest 77 per cent explanatory power (R^2=.77), over 46 countries from "the upper half of the income spectrum", with 6 IVs.[26]

Of the two papers in the literature that consider DVs representing the "horizontal" duration of the GFC-related contraction, Claessens et al. (2010) find the income term significantly correlated with longer contractions—robust to which test-IV is included individually with it—while Ólafsson and Pétursson (2010) find the income term insignificant when added to their preferred specification. This apparent discrepancy is, however, likely the result of sample differences. Claessens et al.'s sample of N=58 EMEs (including "most" AEs and "the major" EMEs) includes 10 LMICs, as well as 15 UMICs, and 33 HICs, showing enough variation to detect the LMIC-difference identified in Chapter 2 (albeit as an income relationship). In contrast, Ólafsson and Pétursson's sample of N=46 countries from the "upper half of income spectrum" includes only one LMIC (Thailand), along with 10 UMICs and 33 HICs; so, a linear income relationship (or the

[25] Lane and Milesi-Ferretti also identify a during-GFC trade shock IV explaining 10 per cent of the main model's residual DV variability, for total explanatory power of around 50 per cent (49.6% = 44% plus 10% of the unexplained 56% residual), though at the loss of one more observation (N=160).

[26] In addition: Llaudes, Salman, and Chivakul (2011) reach only R^2=.44 over 40 EMEs, with three IVs (one of which measures the during-GFC trade shock, so raises concerns about endogeneity). Claessens et al. (2010) see a maximum of only R^2=.28 on 45 AEs and EMEs, in the specification testing only their significant housing boom IV (cumulative change in real house prices between 2000 and 2006) with an insignificant income control term). Claessens et al. (2010) also obtain very similar results with their "decline in growth" (2008–2009 vs. 2003–2007) DV as for their "contraction severity" DV, with the same IVs significant or insignificant (with the income control term insignificant), reaching R^2=.44 with N=45.

LMIC difference identified in Chapter 2) would not have been discernable even if tested alone with the duration DV. It is the sample, and not the specification, that renders the income term insignificant for Ólafsson and Pétursson’s duration DV.

Other IVs found significant with those two papers’ duration DVs do not overlap at all. Claessens et al. find contraction duration significantly correlated with pre-crisis current account, credit boom and housing price boom terms (all also significant with their contraction depth DV), as well as with “outward” foreign bank claims (i.e., domestic banks’ claims on non-residents in 2006, logged). With each IV tested individually (with the income control term), explanatory power still reaches 32 per cent (R^2=.32) for the foreign bank claims IV, on 56 EME observations. Meanwhile, Ólafsson and Pétursson’s preferred contraction duration model includes IVs for the inflation rate and exchange rate variability (both also in their contraction depth model), as well as for trade openness, financial openness, FDI inflows, general government debt, and past currency crises (a dummy identifying countries that experienced a currency crisis within the last 30 years). With those seven IVs, Ólafsson and Pétursson’s model explains around half of DV variation (R^2=.49) on a sample of 46 countries from the “upper half of income spectrum”.

Given the differing results and methodological details in the literature, along with addressing the question of what explains the LMIC-difference identified in Chapter 2, this chapter seeks to better explain the depth and duration of GFC-related contractions, through stronger and more-transparent methodology described next.

3.3 Methodology

3.3.1 DVs and Sample

As detailed in Chapter 2, this chapter measures GFC outcomes through quarterly peak-to-trough depth (percentage change) and duration (number of quarters) of the contraction in seasonally adjusted real GDP related to the GFC (i.e., in roughly 2007–2009, but with two countries' troughs occurring in 2010Q1 and 2010Q2). The choice of these DVs restricts the sample to countries with adequately quarterly output data available for seasonal adjustment (N=76). The sample is further restricted by varying data availability on the IVs, typically retaining N≥68 for most IVs prior to outlier exclusion. As discussed in Chapter 2, this sample largely expands on the samples used in papers in the differential impact literature with DVs based on quarterly-level output data, in particular improving on their coverage across the income spectrum. This sample does, however, narrow considerably the samples used by papers considering DVs based on annual-level output data, with the exclusion of almost all low-income countries (LICs). Though unfortunate, the smaller sample is preferred given the superiority of quarterly-based contraction depths and durations as measures of the GFC impact relative to annual-based measures.

The depth and duration DVs are measured relative to the peak and trough of the GFC-related output contraction, and can only take on non-negative values. For countries experiencing no contraction (China, Egypt, India and Tunisia) the DV is recorded as zero, despite the possibility of quite different output dynamics during the crisis (e.g., degrees of slowing or acceleration).[27] With non-negative DVs, Ordinary Least Squares (OLS) regression can produce biased coefficients, so alternate techniques are required. For the depth DV's non-negative ratio level of measurement, Tobit regression with a left-censor at zero is appropriate. The duration DV's non-negative integer level of measurement, indicates the use of Poisson or negative binomial regression. The choice between Poisson or negative binomial is then determined through empirical testing on the equality between variance and mean. In the present case, the mean of the duration DV was not statistically different from its variance, so Poisson regression is appropriate.

However, where OLS and Tobit models are linear, Poisson and negative binomial regression use exponential models, fitting a linear function of the IVs to the natural logarithm of the DV. The linear Tobit model thus implicitly assumes that negative DV values are meaningful, with the DV representing the observable portion of a latent variable for which the negative values can only be observed as zero values. This structure is consistent with the idea that countries experiencing no actual contractions still experienced different output dynamics during the crisis, but which are not distinguishable in non-negative operationalizations of the depth and duration DVs. The Tobit model can thus predict negative values, representing relative performance between countries predicted to suffer no contraction. In contrast, the exponential model of Poisson regression predicts only positive (i.e., non-negative and non-zero) values, asymptotically approaching zero for

[27] Note that an update to output data since Chapters 1 and 2 were completed indicates that Jordan actually experienced a contraction, lasting one quarter, with depth of 0.57 per cent of peak GDP.

extreme IVs values in one direction (high or low depending on the sign of the coefficient), and producing very high (exponentially increasing) predicted values for extreme IV values at the other end. The use of Tobit for depth and Poisson for duration, are thus not fully consistent with each other, one predicting negative contraction depths, the other unable to predict negative contraction durations.[28] Thus, despite the duration DV's integer measurement level—arguably requiring the use of Poisson regression—the primary focus here is given to the Tobit results, using the more relevant linear relationship, but with alternative results also reported demonstrating robustness to the use of Poisson regression.

3.3.2 IVs Considered

With no well-developed theory providing a framework to deductively identify factors expected to explain varying GFC outcomes, different papers in the literature test a variety of IVs, justifying inclusion with informal discussion of the factors' potential relevance.[29] However, the papers each test a relatively limited set of IVs, frequently numbering in the dozens, but often not considering some found significant in other papers, raising concerns about omitted variable bias and model misspecification. This chapter expands somewhat on the range of pre-crisis factors considered in the literature, with the

[28] I am unaware of an alternate form of regression using a linear (rather than exponential) model for DVs comprising non-negative integer data.

[29] Blanchard, Faruqee, and Das (2010) provide the only formal model in the differential impact literature, but only use that "model and its implications as a rough guide" (277), and consider a much narrower range of potential explanatory factors than seen in other studies.

full range of IVs outlined in Appendix 3A. This section provides a basic summary.[30]

Most of the IVs considered in the literature use pre-crisis measures only, thereby avoiding potential endogeneity or simultaneity, in which IV values measured during the crisis reflect GFC influence. Some papers (Lane and Milesi-Ferretti 2011; Blanchard, Faruqee, and Das 2010; Llaudes, Salman, and Chivakul 2010) do consider IVs representing "during-GFC" measures—for example, considering how changing trade flows during the crisis correlate with crisis outcomes—but with limited attention paid to the potential for endogeneity. This chapter focuses exclusively on pre-crisis IVs, using values from 2007 or earlier ("level" IVs), or changes in values over some period ending in or before 2007 ("growth" or "boom" IVs). This choice avoids the issue of endogeneity, but limits direct consideration of during-crisis dynamics and policy responses. These dynamics and responses can be considered indirectly by measuring pre-crisis characteristics that could influence crisis dynamics and by using measures of policy capacity (e.g., fiscal or monetary "space"), rather than IVs representing policy choices (e.g., fiscal or monetary stimulus). While the role of policy responses is an important topic, it faces the methodological hurdles associated with endogeneity and will thus not be considered in this chapter; case studies in the next chapter will consider how policy choices affected the trajectory of the crisis in

[30] Some studies in the literature were identified after the analysis presented here was completed, so that explanations tested there are not fully considered here, including: (1) additional scalings for FXR, such as FXR/M2 (Allegret and Allegret 2019), log[FXR/M2] and log[FXR/Imports] (Bussière et al. 2015); (2) measures of "resource richness" for coal, natural gas or minerals (Bashar and Bashar 2020); and (3) more-complex relationships, for example: discontinuities related to financial and/or trade integration (Hausmann-Guil, van Wincoop and Zhang 2016) or the role of exchange rate regime switching (Tsangarides 2012).

specific countries. It is hoped that this research will contribute toward understanding the pre-crisis characteristics that influenced GFC outcome, helping guide future research into during-crisis dynamics and policy responses, once controlling for pre-crisis influences.

Another important concept is the period of high growth between 2003 and 2007, representing the global “boom” prior to the GFC “bust”. Using slightly different time frames (e.g., 1999–2007, 2002–2005, 2003–2007) several papers test—but find insignificant—IVs representing boom-period growth in output (Berglöf et al. 2009; Lane and Milesi-Ferretti 2011; Giannone, Lenza, and Reichlin 2011), while others find IVs related to credit booms to be significantly correlated with worse crisis outcomes (Berglöf et al. 2009; Berkmen et al. 2012; Lane and Milesi-Ferretti 2011; Claessens et al. 2010; Llaudes, Salman, and Chivakul 2011; Rose and Spiegel 2011). To consider the broader role of economic activity during the boom-period, this chapter includes IVs both in pre-crisis (2007) “level” form, and in “boom” form as cumulative average growth rates (CAGRs) over the 2003–2007 boom-period. In addition, logged versions of the 2007 level IVs are tested, primarily to manage highly skewed distributions of some unlogged versions, which can render coefficient estimates highly sensitive in significance, magnitude, and even sign to the sequential exclusion of outliers.

This chapter further expands the IV group by including related measures not tested in other studies. Examples include other variables from databases used in the literature (e.g., the External Wealth of Nations Mark II, Financial Development and Structure, and Economic Freedom of the World databases), as well as alternate scalings of various IVs (e.g., manufacturing exports as a share of total exports, as well as scaled to GDP).

3.3.3 Specification Selection Process

Given the large number of IVs under consideration, the selection of the best model is a non-trivial task. This chapter follows a non-automated, step-wise iterated selection process, starting from "model-0" with no IVs—that is, taking the mean value of the DV as the estimate of GFC outcome for all countries—and iteratively identifying the "test-IV" that provides the "best" improvement on the previous model. A successful test-IV is then included as a "model-IV" in the next model, which in turn is used in the next iteration. At each step, the full range of test-IVs are added individually to each model, allowing for robustness testing of the previous model and identification of candidates for the next model. To avoid false positives (false significances) and false negatives (false insignificances) from outlier influence, IV selection focuses on results excluding both first-round and iterated outliers on the DV and IVs.[31]

In practice, the full range of test-IVs considered as candidate model-IVs was narrowed down quickly based on IV significance and added explanatory power. Typically, a small number of IVs showed coefficient estimates with high statistical significance (e.g., $p_{(r)}<.01$), of which a smaller number stand out as providing higher explanatory power (R^2 and adj.-R^2).[32] The test-IV providing the greatest R^2-increase is considered first,

[31] See Chapter 2 concerning the distinction between first-round and iterated outliers.

[32] Careful attention was also paid to changing sample sizes (e.g., due to the elimination of observations that were outliers on or were missing data on newly added IVs), avoiding one potential problem

recognizing that "incorrect" choices between test-IVs will be automatically identified in subsequent iterations, with the "incorrect" IV not robust to inclusion of a better choice. As such, the model selection process becomes a branching "tree search", identifying a "candidate" test-IV and further iterating the model until an earlier choice is found non-robust, or until a final model is identified.

Model-IVs are typically robust to the addition of most test-IVs, but particular attention is given where a test-IV "challenges" any of the model-IVs by rendering them less significant. Such "challenges" frequently involve test-IVs clearly related to the model-IV they affect—for example, test-IVs representing alternative scalings (e.g., a given type of exports as per cent GDP versus as share of total exports) or IVs measuring related concepts (e.g., current account and net exports). However, some test-IVs affect model-IVs with which they are not obviously related. In either case, further examination of the competing IVs is undertaken. Frequently one of the two clearly "dominates" the other, showing much higher significance when the two are included simultaneously. In less clear cases, analysis compares specifications including each competing IV individually, and (where necessary) controlling for sample difference due to missing data or outlier differences. Where a model-IV is judged not robust, a new branch of the tree, starting from where that candidate model-IV had originally been added, is started, selecting a new candidate model-IV in place of the rejected IV. The non-robust IV is not simply replaced

in using R^2 (or adj.-R^2) as a decision tool. Throughout the analysis AIC and BIC values were also considered, with (lower/higher) results always consistent with the (higher/lower) R^2 and adj.-R^2 values.

by the test-IV demonstrating its non-robustness in-case the earlier selection of that non-robust IV influenced subsequent IV selection along that branch of the tree search. The new candidate model-IV is selected as having the next highest increase in explanatory power.

The potential for heteroscedasticity to complicate the results is also considered by examining regular and heteroscedastic-robust p-values (p and p_r) throughout model process.[33] Most frequently both p-values indicate similar levels of significance, and the few IVs showing conflicting p-values (one significant, the other not) were all found to be non-robust. As such, only the regular p-values are reported in the results tables.

Similarly, potential issues arising from multicollinearity are considered (and ruled-out) by examining variance inflation factors (VIFs) for the IVs in each specification.[34] In the final specifications obtained for both the depth and duration DVs, the VIFs (not shown explicitly in the results tables) are all less than 1.2, indicating that the coefficients presented in the main results are reliable (i.e., are not “unreliable positives” due to multicollinearity). Likewise, false negatives due to multicollinearity are ruled out by examining the VIFs with each other test-IV added to the preferred model. Of those specifications, all but ten for the depth model and all but twelve for the duration model have all VIFs less than 3.0 (an even more conservative VIF threshold than considered in Chapter 2). The exceptions all show VIFs greater than 3.0 (and often greater than 4.0) for the added test-IV and for only one

[33] As in Chapter 2, the particular form of H-correction used for the p_r-values here is Davidson and MacKinnon’s (1993) “HC2”, as implemented as the default in Barreto and Howland’s (2005) OLSReg Function Excel Add-In.

[34] See Chapter 2 for details of VIF calculation and rules of thumb for identification of potential multicollinearity, and consideration of “false negatives” and “unreliable positives” due to multicollinearity.

model-IV, which is always clearly related to the test-IV—for example, as linear vs. logged forms, as total trade vs. just exports versions, or as bank-only instead of bank and OFI versions of the corresponding model-IV. Because of their close relationships—representing slightly different theoretical possibilities—only one of each pair should be included in the final specification, and in each case the model-IV clearly dominates the added test-IV (as already determined through the model selection process).[35]

Through this labour-intensive iterative tree search, a single IV specification was identified for each DV. The selection process was originally undertaken using OLS regression for both DVs to facilitate the generation of test statistics to test model comparability (such as adjusted R^2 values) and were re-estimated using Tobit estimation for the depth DV and both Tobit and Poisson estimations for the duration DV.[36]

[35] Specifically, when added to the depth model, the following test-IVs have VIFs greater than 3.0: (a) related to the logged manufacturing exports to GDP IV model-IV: manufacturing exports to GDP (linear), total manufacturing trade (imports plus exports) to GDP (linear or logged), manufacturing exports to total exports (linear); (b) related to the boom in FDI assets to GDP model-IV: boom in total FDI assets and liabilities to GDP, boom in FDI assets to total foreign assets; (c) related to the boom in bank and OFI credit to GDP model-IV: boom in bank credit to GDP, boom in bank (or bank and OFI) assets to GDP; or (d) related to the boom in total general government expenditures model-IV: logged general government structural balance to GDP (but for which missing data reduces sample size to N=11, rendering it unusable).

Likewise, when added to the duration model, the following test-IVs have VIFs greater than 3.0, and are "related" to: (a) the logged ratio of debt liabilities to GDP model-IV: debt liabilities to GDP (linear), total foreign debt assets and liabilities to GDP (linear or logged), total foreign liabilities to GDP (linear or logged), total foreign assets and liabilities to GDP (linear or logged); or (b) the boom IV for bank assets: the boom IV for bank and OFI assets, the boom IV for private sector credit issued by banks (or by banks and OFIs), the boom IV for credit issued to the private sector by banks (or by banks and OFIs), and the boom IV for deposits at banks (or at banks and OFIs).

[36] The OLS model search was undertaken in Microsoft Excel (Professional Plus 2010), with regression results obtained via the OLSReg function, part of Barreto and Howland's (2005) OLS Regression Excel Add-In, with minor modifications by the author providing alternate output formatting. The use of Excel provided better control of output formatting than is available in many common statistical packages, e.g., showing numerous specification results across the columns of a worksheet, colour coded to highlight p-value ranges, permitting rapid scanning and identification of significant results for each model with many

3.4 Results

3.4.1 The Depth DV

Table 3.2 presents the main results for the depth DV. The IV specification obtained through the model selection process is shown for the model sample ([1]), as well as on the sample with only DV outliers excluded ([2]), and on the full sample ([3]). This main specification includes six IVs representing countries’ pre-crisis values for: credit boom; manufacturing exports; boom in government expenditures; boom in foreign direct investment (FDI) assets; boom in the food, fuels and mining (FFM) products share of exports; and whether the country used a flexible exchange rate regime (XRR)—each discussed further below. Missing data on the model-IVs reduces the full sample from seventy-six to seventy-two (N=76 to 72), and outlier exclusion on DV and model-IVs reduces the sample further to fifty-five observations (N=55). The results obtained with DV and model-IV outliers excluded ([1]) are largely robust to outlier re-inclusion ([2], [3]). Where the other IVs are fully robust to outlier inclusion in terms of significance, sign and coefficient order of magnitude, the FDI assets boom and XRR terms maintain only their sign, with reduced coefficient magnitude and significance.[37]

For comparative purposes, corresponding OLS regression results are also shown

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individually added test IVs. Tobit, Poisson and Negative Binomial Regression results were generated using Stata (13.1), and imported into Excel for ease of review and analysis.

[37] The FDI assets boom result is robust to re-including all model-IV outliers save two of its own: Iceland (IS) and Hungary (HU) (see Figure 3B.3). The XRR result is robust to re-including other model-IVs’ outliers (as a dummy IV, it has no outliers of its own), with the exception of: Iceland, Hungary, Philippines (PH), Uruguay (UY), Bulgaria (BU) and Belize (BZ) (see Figure 3B.6). The model-IV outliers that confound these two results are also all depth DV residual outliers that are not outliers on the raw depth DV.

Table 3.2. Main Depth Model (with sample and regression type variations)

DV	**Contraction Depth**					
Regression Type	**Tobit Regression**			**OLS Regression**		
Sample	**Model Sample**[a]	**DV outliers excl.**	**Full Sample**	**Model Sample**[a]	**DV outliers excl.**	**Full Sample**
Model	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**
Credit Boom	**37.0***** (<.001)	**31.0***** (<.001)	**41.1***** (<.001)	**35.6***** (<.001)	**30.1***** (<.001)	**39.7***** (<.001)
Manufacturing Exports	**3.5***** (<.001)	**3.0***** (<.001)	**3.5***** (.001)	**3.4***** (<.001)	**2.9*** (.035)	**3.4** (.615)
FDI Assets Boom	**-13.9***** (<.001)	**-4.4**** (.026)	**-1.5** (.520)	**-13.4***** (<.001)	**-4.1***** (<.001)	**-1.2***** (<.001)
Government Expenditures Boom	**-68.5***** (<.001)	**-50.8***** (.001)	**-47.6**** (.012)	**-67.3***** (<.001)	**-49.2***** (.001)	**-45.2**** (.018)
Food, Fuels and Mining (FFM) Exports Boom	**33.2***** (<.001)	**18.1***** (.004)	**24.5***** (.001)	**33.5***** (<.001)	**18.2***** (.003)	**24.5***** (.001)
Flexible Exchange Rate Regime	**-1.5***** (.007)	**-0.2** (.700)	**-0.7** (.380)	**-1.5***** (.008)	**-0.3** (.687)	**-0.7** (.386)
$n_{XRR.Flex}$[(b)]	*28*[(c)]	*36*[(d)]	*37*[(e)]	*28*[(c)]	*36*[(d)]	*37*[(e)]
Constant	**6.7***** (<.001)	**5.9***** (<.001)	**6.0***** (<.001)	**6.6***** (<.001)	**6.0***** (<.001)	**6.1***** (<.001)
N	55	67	72	55	67	72
Pseudo R^2	.248	.147	.147			
Back Calc R^2	.748	.558	.594			
OLS R^2				.748	.559	.594
OLS Adj.R^2				.716	.514	.556

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on any model-IV; (ii) first round outliers on the depth DV; and/or (iii) first round outliers on any model-IV.

(b) $n_{XRR.Flex}$ number of countries in each sample with Flexible XRRs.

(c) $n_{XRR.Flex}$=28: countries with Flexible XRRs that are not outliers on the depth DV or any model-IV = [the full 39 (below)] − {UA; GE, HU, IS, JM, KG, RO, RS, SG, TW, UY}.

(d) $n_{XRR.Flex}$=38: countries with Flexible XRRs that are not outliers on the depth DV = [the full 39] − {UA}.

(e) $n_{XRR.Flex}$=39: all countries with Flexible XRRs
(note: no countries with Flexible XRRs are missing data on any model-IVs)
= {AU, BR, CA, CE, CH, CO, CZ, EG, GE, GT, HU, ID, IL, IN, IS, JM, JP, KG, KR, MU, MX, MY, NO, NZ, PE, PH, PO, RO, RS, SE, SG, TH, TR, TW, UA, UK, US, UY, ZN}.

([4]–[6]). The OLS regression's R^2 value (e.g., .748: [4]) can be interpreted in absolute terms, as representing the proportion of DV variation (74.8%) that is accounted for by the model; but the Tobit model’s pseudo-R^2 statistic has no such intuitive interpretation and is best used to compare relative explanatory power between two Tobit models. As such, a “back-calculated R^2” has been included for Tobit (and later Poisson) results, calculated as the square of the Pearson correlation coefficient between the model’s predicted DV values and the observed values. Throughout the results these back-calculated R^2 values for the Tobit Regression are very close to the R^2 values for the corresponding OLS regressions, reflecting the close similarity between these two regression approaches, each involving a linear model with quite similar IV coefficients and intercepts, and differing only on how four cases with DV values of zero are handled. Tentatively interpreting the back-calculated R^2 value in absolute terms, the depth model then still accounts for about three-quarters of DV variation (R^2=.748: [1]). In subsequent results tables, the complete OLS results are not reported explicitly, but the R^2 and Adjusted-R^2 values are provided for the OLS regressions corresponding to the Tobit regression results reported. Unless otherwise specified “R^2” in the text will refer to the back-calculated R^2 values.

Twelve observations are poorly explained by the model—that is, are outliers on the depth DV residual, with a Z-score magnitude greater than two ($|Z_{Dep}|>2.0$), taken relative to the “model sample” excluding DV and IV outliers.[38] Those that experienced actual contractions much deeper than predicted by the model include four of the five outliers on

[38] Throughout this chapter DV residual Z-scores (Z_{Dep} and Z_{Dur}) are calculated with respect to the model sample (i.e., excluding DV and model-IV outliers). As such, an observation’s Z-score represents the number of standard deviations from the mean, using the mean and standard deviation for that model sample. In contrast, DV and IV Z-scores used to identify outliers on the raw DV or on the IVs are calculated with respect to the full sample (excluding only those observations missing data on that variable).

the raw depth DV—Estonia (Z_{Dep}=3.8), Latvia (8.6), Lithuania (5.1), and Ukraine (8.8)—as well as Hungary (6.6), Iceland (6.2), Uruguay (4.5) and the Philippines (3.1). Those with contractions shallower than predicted are: Bulgaria (-3.6), Belize (-3.5), Tunisia (-2.7), and Kyrgyzstan (-2.002, just barely an outlier). The remaining observations all have Z-scores between -1.8 and +1.9, including the IV or DV outliers that are nevertheless well-explained by the model, including Botswana (-1.8), which is the last of the raw depth DV outliers discussed above, and five more outliers on one or more of the IVs (Georgia: 1.2; Hong Kong: 0.8; Jamaica: 1.2; Romania: 0.4; and Singapore: -1.4). The outliers on the depth DV residual will be considered in the discussion below, as “deviant cases”, for which further explanation may be required regarding depth DV outcomes.

3.4.1.1 Credit Boom IV

The credit boom IV measures growth over the pre-crisis boom-period (CAGR 2003–2007) in the ratio of credit-to-GDP, for credit issued by domestic banks and OFIs to the domestic private sector. The credit boom IV’s coefficient of 37.0 ($p_{(r)}<10^{-8}$), indicates that (ceteris paribus) a one percentage point (pp) faster boom-period credit expansion corresponds with a 0.37 pp deeper contraction. (Figure 3B.1 in Appendix B illustrates this partial relationship). The corresponding standardized coefficient ($\beta = b \times s_x / s_y = 37.0 \times 0.0579/3.55 = 0.602$) indicates that a one standard deviation larger value for the credit boom IV corresponds to a 0.6 standard deviation deeper contraction.

Empirically, the credit boom result indicates that, in the context of the global credit boom over 2003–2007, countries that experienced a larger domestic credit boom suffered deeper contractions, consistent with effects of a GFC-related credit crunch. An alternate hypothesis to the credit crunch interpretation is that the GFC-contraction simply "undid" the pre-crisis expansion in output; however, the depth of the output contraction does not correlate significantly with the boom-period expansion in output itself: an output boom IV (2003–2007 CAGR in GDP) is insignificant, whether tested on its own, or either in-place-of or in-addition-to the credit boom IV. It is also not the case that countries that grew more as a result of their credit expansion experienced even deeper contractions: operationalized as the interaction between the credit boom and output boom terms—that is, with greater credit boom values influencing the output-boom-to-contraction-depth relationship—as that interaction term was also found insignificant.

The credit boom term also dominates its "bank-only" counterpart—i.e., excluding credit issued by OFIs—which also provides slightly lower explanatory power (R^2=.722 instead of .748 in [1]). IVs measuring the corresponding pre-crisis level of credit (the ratio of credit-to-GDP in 2007 for credit to the private sector, from banks with or without OFIs) are also insignificant when added to the model, indicating that deeper contractions were more closely related to the growth of credit during the boom-period than to the overall level of credit in the economy. Similarly, leverage IVs measuring the ratio of credit-to-deposits in the banking system (with or without OFIs), as well as the boom-period growths therein, are insignificant, indicating that contraction depth effects are not more closely related to bank system overleveraging than to the size of the credit boom itself. The model is further robust to adding any of the Economic Freedom of the World (EFW) indicators, most of which are insignificant or provide minimal additional explanatory power. In particular, and counter to Giannone, Lenza, and Reichlin (2011) and Rose and Spiegel (2011), the EFW credit market regulation rating is insignificant when added to the model.

One straightforward expectation of the empirically observed relationship between credit boom and the depth of the output contraction is that with the onset of the GFC-associated global credit crunch, domestic credit itself would be reduced roughly in proportion to the amount it expanded in the boom-period lead-up to the crisis, with consequent effects on output. As a simple test, correlations were calculated between the credit boom IV—as well as the credit level IV—and during-crisis 2008 and 2009 changes in credit, measured as changes in credit scaled to 2006 GDP.[39] However, the results are not consistent with the expectation described above, in that larger pre-crisis credit booms correlate moderately with higher credit growth during the crisis (R=.47 for 2008, and .30 for 2009). During-crisis growth in credit is, instead, negatively correlated with countries' pre-crisis 2007 level of credit (R=-.34 for 2008; -.41 for 2009), which is not significantly correlated with the depth of the output contraction. Thus, while the specific causal mechanisms underpinning the relationship remain unclear, output contraction depth correlates specifically with the pre-crisis expansion of credit.[40]

[39] The 2008 and 2009 changes are calculated for ratios scaled to 2006 GDP—rather than to same-year 2008 and 2009 GDPs, respectively—so as to control for changes in the denominator resulting from the GFC itself. Using 2006 values in the denominator provides a constant scale against which to measure the changes, while still controlling for the relative size of the economy.

[40] One alternative interpretation is that in countries with larger credit expansions, output itself became more *reliant* on that credit, with deeper output contractions occurring during the credit contraction.

3.4.1.2 Manufacturing Exports IV

The manufacturing exports IV is calculated as the base-10 logarithm of the ratio of manufacturing exports to GDP (in 2007).[41] The coefficient of 3.5 ($p_{(r)}<10^{-5}$) indicates that (ceteris paribus) countries for which manufacturing exports are ten times larger, relative to the size of their economy, experienced GFC contractions that were on average 3.5 pp deeper (Figure 3B.2). The corresponding standardized coefficient ($\beta = 0.411$, $s_x = 0.471$) indicates that a one standard deviation larger value for the manufacturing exports IV corresponds to a 0.41 standard deviation deeper contraction.

This composition of trade effect—with countries exporting more manufacturing commodities hit harder by the GFC—is consistent with the idea of decreased global demand for manufactures due to decreased investment and/or consumption during the crisis. To further test this interpretation, correlations were calculated between the manufacturing exports IV and 2008 and 2009 changes in manufacturing exports to 2006 GDP.[42] The IV is moderately negatively correlated with the 2008 change in manufacturing exports (R=-.35), but is very weakly correlated with the 2009 change (R=.05), consistent

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Focusing on credit also provides a high-level explanation subsuming explanations related to the more precise use of credit—whether for consumption or for investment, or underpinning housing, stock market or other asset booms—which may have differed across countries, and for which (for housing prices in particular) data coverage is limited. Another explanation is that the output dependence on pre-crisis credit expansion may be related to the nature of the "exotic" assets underpinning the credit expansion (globally) during the boom-period. Future research could examine these possibilities more closely.

[41] Using the logged rather than linear form of the manufacturing exports-to-GDP IV was necessary due to the highly skewed nature of the linear version.

[42] See Footnote 39.

with a reduction in foreign demand for manufactures occurring primarily in 2008.[43] With these cross-country correlations only possible at the annual level, future research could permit more granular (quarterly or monthly) analysis of particular countries, providing more detail concerning the timing and process of the apparent demand shock.

The manufacturing exports term is robust to the addition of all other test-IVs, including its own boom-period growth version and alternate components of trade: manufactures; agricultural products (with food and non-food sub-categories considered separately); fuels and mining products (FMP); other merchandise; and services; as well as a combined food, fuels and mining (FFM) category. These alternative measures of trade composition are also generally insignificant when added to this model as either linear or logged 2007 levels; where they do show significance, they provide very little increased explanatory power ($\Delta R^2 < .02$). The manufacturing exports level result is also robust to including test-IVs representing boom-period changes in the composition of trade, with the model-IV for FFM share of exports boom dominating all others, as discussed below.

3.4.1.3 FDI Assets Boom IV

The FDI assets boom IV measures the boom-period growth (CAGR 2003–2007) in the ratio of foreign direct investment (FDI) assets-to-GDP—that is, the average rate at which domestic investors acquired FDI interests abroad during the pre-crisis boom. The

43 Figure 3B.7 shows the large decrease in the global export of manufactures, consistent with the interpretation of a reduction in global demand for manufactures. Annual average manufacturing exports drops between 2008 and 2009, reflecting the annual-level granularity of that global level data, but which is not inconsistent with the primary reduction in demand occurring in 2008.

coefficient value of -13.9 ($p_{(r)}<10^{-5}$) indicates that a 1 pp greater rate of increase in FDI assets over the pre-crisis boom-period corresponds with a 0.14 pp shallower output contraction during the crisis (Figure 3B.3). The corresponding standardized coefficient (β = -0.413, s_x = 0.105) indicates that a one standard deviation increase in the credit boom IV corresponds to a 0.41 standard deviation shallower contraction.

The model remains robust to the inclusion of other related IVs, including IVs for: the corresponding boom in FDI liabilities; boom-period growths in total foreign assets and/or liabilities, and in the assets and liabilities other asset classes (portfolio equity, debt, and derivatives, the last of which suffers from data paucity); as well as the levels of foreign assets and liabilities and each type thereof, scaled as a ratio to GDP (and each logged due to high skew in their linear forms). While some of these test-IVs show borderline evidence of significance, they all provide very little increased explanatory power ($\Delta R^2<.02$).

This FDI assets boom result is consistent with the idea that FDI provides a more stable source of returns, and that short-term returns play a less important role in the original acquisition and retention of FDI. Where returns from shorter term portfolio equity and debt assets are more volatile, and were more likely disrupted during the crisis, the choice to acquire and retain FDI is less likely to be influenced by shorter-term stock and dividend fluctuations. Where, in a short-term strategy, portfolio equity and debt would be sold into a falling market to minimize further losses, FDI would be retained with little impact on expected revenue. The FDI was likely acquired to hold for the longer term, rather than to sell quickly to maximize profit or minimize loss. It is, however, intriguing that it is the boom-period growth in FDI assets, rather than the pre-crisis level of FDI assets that appears to provide resilience. Questions here include whether something specific about the type of FDI acquired during the boom-period—for example, horizontal, vertical or conglomerate, greenfield, or mergers and acquisitions, or focused in particular sectors—distinguishes it from FDI accumulated prior to that period that produces this distinction.

3.4.1.4 Government Expenditures Boom IV

The government expenditures boom IV measures the boom-period growth (CAGR 2003–2007) in the ratio of general government total expenditures-to-GDP. At -68.5 ($p_{(r)}<10^{-4}$), the government expenditures boom coefficient indicates that (ceteris paribus) countries with government expenditures-to-GDP ratios that grew 1 pp faster over the pre-crisis boom-period experienced output contractions that were, on average, 0.68 pp shallower (Figure 3B.4). The corresponding standardized coefficient ($\beta = -0.354$, $s_x = 0.018$) indicates that a one standard deviation increase in the credit boom IV corresponds to about a 0.35 standard deviation shallower contraction.

Other measures related to government spending and debt are all insignificant or provide negligible additional explanatory power when added to the depth model, including: the 2007 ratio of government expenditures-to-GDP; levels and boom-period growths for government gross debt, net debt or structural balance; and EFW’s “size of government” aggregate and its sub-components, including the government consumption rating.[44]

[44] The government net debt and structural balance data are only available for relatively small subset

The resilience associated with larger government expenditures boom is consistent with a straight-forward fiscal stimulative effect, in which the correlation represents a direct but lagged effect from the boom-period increase in expenditures, only taking full effect during the GFC period itself (2008–2009). Alternatively, the correlation might indicate that larger boom-period increases predict greater expenditures during the crisis, for example in the form of automatic fiscal stabilizers or discretionary fiscal responses. However, simple correlations indicate that countries experiencing larger government expenditures booms actually tended to have slightly lower government expenditures growths in 2008 or 2009, though those correlations are fairly weak (R_{2008}=-.10, R_{2009}=-.16). These negative (and weak) correlations are inconsistent with the hypothesis that government expenditures growth during the boom predicts greater growth during the crisis, so the alternative hypothesis of a direct lagged effect is (tentatively) retained. Future research could again help further clarify the causal relationship here.

3.4.1.5 FFM Share of Exports Boom IV

The food, fuels and mining (FFM) share of exports boom IV measures the boom-period growth (CAGR 2003–2007) in the ratio of FFM exports to total exports. The coefficient of 33.2 ($p_{(r)}<10^{-5}$) indicates that (ceteris paribus) countries that saw a 1.0 pp higher average boom-period change in the composition of exports, towards more FFM

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of the full sample, making these negative results somewhat less reliable. The Government structural balance level and boom IVs were the only of these to show any significance (p_I<.1 and p_I<.01 respectively), but with each providing little additional explanatory power when compared to the depth model restricted to the corresponding reduced samples.

products, experienced (on average) 0.33 pp deeper contractions during the GFC (Figure 3B.5). The result is independent of the base composition of exports, as this FFM share of exports boom term is robust to removal of the manufacturing exports IV. The standardized coefficient (β = -0.427, s_x = 0.0457) indicates that a one standard deviation increase in the credit boom IV corresponds to about a 0.43 standard deviation shallower contraction.

Empirically, then, a higher boom-period increase in the exports share of FFM products corresponds with larger output contractions during the crisis. Related IVs are all insignificant when added to the depth model, including the pre-crisis level of FFM exports (as a share of total exports or scaled to GDP) and the pre-crisis boom in the ratio of FFM exports-to-GDP, as well as IVs for booms in other types of exports. The FFM share of exports boom term also dominates the manufacturing exports boom term, and a “primary products boom” term, adding non-food agricultural products to the FFM category.

While all types of exports increased globally in the 2003–2007 period (Figure 3B.7), exports of fuels expanded more than others, such that the share of FFM in total global exports increased (Figure 3B.8), while the share for manufactures decreased, and the shares for other exports (raw agricultural products, other merchandise, and services) remained largely stable. While exports of food and of mining products (i.e., ores and minerals) each increased in absolute terms, they increased much less relative to fuels.

During the pre-crisis boom-period commodities prices also boomed, especially for oil (Figure 3B.9). Following a lull in 2006, oil prices spiked further through 2007 and early

2008, before plummeting in July 2008—that is, shortly before the September collapse of Lehman Brothers and the 2008Q4–2009Q1 "acute phase" of the crisis. Oil prices bottomed out in January 2009, rebounding to pre-2007 levels by July 2009, and increasing somewhat thereafter. Following only a moderate increase until 2006, food prices also show a significant increase in 2007 and into 2008, with a sharp drop again starting in July 2008, and bottoming-out and recovery starting in early 2009. The output contraction thus appears related not only to specific changes in demand for FFM exports, but also to price changes occurring just before the acute-phase of the GFC starts.

The model results are thus consistent with the theory that with the boom-period increases in prices for oil and other commodities, marginally profitable producers initiated or expanded production. The price spike and crash in 2008 would then affect these producers, and the countries in which they operated, more than those that were already profitable prior to the boom. Consequently, a country's greater FFM share of exports boom values is associated with deeper output contractions. Correlations between the FFM share of exports boom IV and during-crisis (2008 or 2009) changes in related exports measures, are largely consistent with this interpretation, though the use of correlations between variables based on annual data somewhat masks the mid-year timing of the initial shocks and the recovery of prices in the first half of 2009. The FFM share of exports boom IV is negatively and moderately correlated only with the 2009 change in the FFM exports scaled to 2006 GDP (R=-.37), but is relatively uncorrelated with the 2008 change (R=.05), consistent with the oil and food price shocks occurring in late-2008: the average 2008 level is higher than that for 2007, and thus the 2008 change largely reflects the oil and food prices existing before August, while the 2009 change reflects the subsequent sharp drop and lower average level in 2009.[45]

Future research could help clarify the causal mechanisms at play in this FFM exports boom result, confirming (or refuting) specific details relating to prices and the role of marginal producers in these outcomes, and teasing apart the possibly different roles played by foods, fuels, and mining products, and even different types of each.

3.4.1.6 Flexible Exchange Rate Regime dummy IV

The flexible XRR dummy IV is based on XRRs as reported in the IMF's 2007 *Annual Report on Exchange Arrangements and Exchange Restrictions* (AREAER). The flexible XRR dummy takes the value "one" for countries classified as "managed floating with no pre-determined path" or "independently floating" (n=39 out of 76 countries on the full sample, reduced to n=24 out of 55 on the model sample), but excluding members of the European Monetary Union (EMU, or "Eurozone"). The AREAER classifies members of the EMU as "independently floating", a description that does not describe well their lack of monetary policy independence. Countries with "less flexible" XRRs, and dummy value of "zero", consist of EMU members and those with AREAER classifications of "no separate legal tender", "currency board", "conventional peg", "peg within horizontal bands", "crawling peg" or "crawling band". The coefficient estimate of -1.5 ($p_{(r)}$<.01)

[45] The 2008 and 2009 changes are changes in for ratios scaled to 2006 values of Exports or GDP, so as to control for changes in those denominators resulting from the GFC itself. (See Footnote 39.)

indicates that (on average and ceteris paribus) countries with more flexible XRRs experienced contractions roughly 1.5 pp shallower than those with less flexible regimes.[46] (Figure 3B.6 illustrates the XRR difference.)

Other XRR classifications were also tested, but with none improving on this simple flexible vs. less-flexible distinction. Specifically tested were: Reinhart and Rogoff's (2004) "coarse" (de facto) and "IMF coarse" (de jure) classifications, each consisting of groups for pegged, crawling, intermediate and floating exchange rates, and classifying EMU members as pegged;[47] the IMF De Facto Classification of Exchange Rate Regimes and Monetary Policy Frameworks (April 2008), grouping countries as pegged, intermediate or floating, and with EMU members treated as floating; and a classification following Ólafsson and Pétursson's (2010) four (somewhat overlapping) "monetary and exchange rate regime" dummy IVs, for EMU members, non-EMU countries with pegged XRs, countries with floating XRs and inflation targeting monetary regimes, and countries with floating exchange rates (with or without inflation targeting).[48]

These results are consistent with the theoretical expectation that, when facing external demand shocks, countries with fixed exchange rates will face a larger reduction in

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[46] As the flexible XRR IV is a binary dummy, its standardized coefficient is not meaningful.

[47] Reinhart and Rogoff's "coarse" classification also includes "freely falling" XRs and "dual market in which parallel market data is missing", which do not apply to any country in the sample considered here.

[48] Ólafsson and Pétursson's (2010) "floating with inflation targeting" and "floating" XR dummies overlap closely: the latter adds only the U.S., Japan and Taiwan to the former, thus providing only limited distinction. They include Taiwan in their "floating" (with or without IT) group, but it is not included in the AREAER. My reading of the Central Bank of the Republic of Taiwan website indicates that there were explicit inflation targets from 2003. However, this point is moot, as Taiwan is excluded from my sample due to missing data on other IVs.

output than similar countries with floating exchange rates. Though different classifications provide more granularity, no significant distinction was found empirically between those with different kinds of either more- or less-flexible regimes. In particular, EMU countries fared no better or worse than countries using other less-flexible regimes. Each EMU country's currency is unable to adjust independently, perhaps particularly relative to those of its main trading partners, other EMU members.

3.4.1.7 Income Relationship and LMIC Depth Difference

Centrally for this chapter, the main depth model explains away the previously observed "AE nature" of the crisis, whether observed as a linear income relationship or as the LMIC step-function identified from Chapter 2 (and illustrated in Figure 3.1). Table 3.3 demonstrates this result for the LMIC difference, while controlling for sample change between the LMIC-difference result (model [1] in Table 3.3) and the main depth DV model result in this chapter (repeated as [3] in Table 3.3). When the LMIC dummy is added to the main model, its magnitude and significance are notably reduced (model [4] in Table 3.3), with these changes reflecting specification difference (comparing [4] against [2]), rather than any sample difference (comparing [2] against [1]).[49] These results do still indicate that LMIC countries experienced, on average, a contraction that was 1.7 pp lower than other

[49] In Chapter 2, the LMIC dummy included Kyrgyzstan, the only LIC in the sample. Here it is not included in the LMIC dummy (i.e., in Table 3.3 column [1]), but is also not in the model sample (i.e., in Table 3.3 columns [2-5]). While Kyrgyzstan saw a deeper (raw) contraction than most LMICs (Figure 3.1), its contraction was shallower than predicted by the depth model (Z_{Dep}=–2.002: Figure 3.3). Kyrgyzstan's exclusion thus makes it "easier" for the LMIC dummy to attain significance (i.e., in Table 3.3's model [1], versus the result from Chapter 2). Reporting the LMIC dummy results without Kyrgyzstan in Table 3.3 thus provides a more conservative test for whether the LMIC difference is explained away by the duration model.

Table 3.3. Contraction Depth-Income Relationship: LMIC Difference

DV:	**Contraction Depth**				**DV Residual from [3]**
Regression Type:	**Tobit**				**OLS**
Sample:	**Full Sample**	**Model Sample**$^{(a)}$			
Model	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
LMIC dummy	**-4.7***** (.001)	**-5.4***** (<.001)		**-1.7**** (.020)	**-0.8**† (.159)
n_{LMIC} $^{(b)}$	*17*$^{(c)}$	*13*$^{(d)}$		*13*$^{(d)}$	*13*$^{(d)}$
Credit Boom			**37.0***** (<.001)	**33.2***** (<.001)	
Manufacturing Exports			**3.5***** (<.001)	**3.0***** (<.001)	
FDI Assets Boom			**-13.9***** (<.001)	**-12.6***** (<.001)	
Gov. Expend. Boom			**-68.5***** (<.001)	**-58.2***** (<.001)	
FFM Exports Boom			**33.2***** (<.001)	**28.0***** (<.001)	
Flexible XR dummy$^{(e)}$			**-1.5***** (.007)	**-1.4***** (.008)	
Constant	**7.2***** (<.001)	**5.9***** (<.001)	**6.7***** (<.001)	**6.9***** (<.001)	**0.3** (.331)
N	76	55	55	55	55
Pseudo R^2	.026	.087	.248	.268	
Back Calc R^2	.117	.329	.748	.763	
OLS R^2	.117	.329	.748	.765	.037
OLS Adj.R^2	.105	.316	.716	.730	.019

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on any model-IV; (ii) first round outliers on the depth DV; and/or (iii) first round outliers on any model-IV.

(b) n_{LMIC} represents the numbers of countries in each sample that are LMICs.

(c) n_{LMIC}=17: all LMICs = {BO, CN, CO, EC, EG, GE, GT, ID, IN, JO, MA, MK, PE, PH, TH, TN, UA}.

(d) n_{LMIC}=13: LMICs not missing data on model-IVs and not outliers on depth DV or any model-IV = [the full 17] − {MK; UA ; GE, PH}.

(e) $n_{XRR.Flex}$=28: number of countries in the model sample with Flexible XRRs (for details see Table 3.2).

countries in the sample. However, when the LMIC dummy is regressed against the residual of the depth DV from the main model—giving the model “first chance” at explaining DV variation, with the LMIC dummy only permitted to explain any leftover (i.e., residual) variation—the LMIC term’s coefficient magnitude is reduced further and rendered much less significant ([5]).[50] The model itself is also robust to the addition the LMIC dummy, with relatively small changes in coefficient magnitude for the other IVs (comparing [4] with [3]).[51] So, while the model does not perfectly explain away the LMIC difference—that is, rendering the LMIC dummy clearly insignificant when added to the model ([4])—it does go a long way to explaining that difference.[52]

Probing into which IVs contribute most toward explaining away the LMIC difference on the depth DV, specifications were examined including only the LMIC dummy and each model-IV individually, and then adding the LMIC to the full model, but removing each model-IV in-turn, all while controlling for sample difference by constraining each specification to the model sample (see Table 3B.3 and Table 3B.4). The individual addition of the credit boom term provides the greatest reduction in the LMIC

[50] Table 3B.1 expands on Table 3.3, showing additional steps ([1b]–[1c]) in the sample change between the full sample ([1]) and the model sample ([2]), for the specification including only the LMIC dummy. Models [6] and [7] further show that, when using the main model’s coefficient estimates to make predictions for observations beyond the model sample (i.e., for the IV and DV outliers, but which is not also possible for the observations with missing IV data), the LMICs’ residual difference remains insignificant. These results are not particularly interesting in Table 3B.1 (or in Table 3B.2 or Table 3B.7) and so are not included in Table 3.3 (or Table 3.5); but some of the corresponding models for the emerging Europe difference on the depth DV provide additional insight regarding the emerging Europe difference for the depth DV, as discussed below, and so they are included in Table 3.4 (and Table 3B.5), discussed below.

[51] While the LMIC dummy’s variance inflation factor (VIF) is higher than any others in model [6] of Table 3.3, at only 1.4 it remains quite low. This observation suggests that the model’s success at explaining away the LMIC difference is not simply the result of the model selection process identifying IVs that predict LMIC status well, thereby spuriously predicting the LMIC difference. This observation likewise holds for both the income IV (in Table 3B.2) and for the emerging Europe dummy (in Table 3.4), as well as for the LMIC and income IVs with the duration DV (Table 3.6 and Table 3B.5).

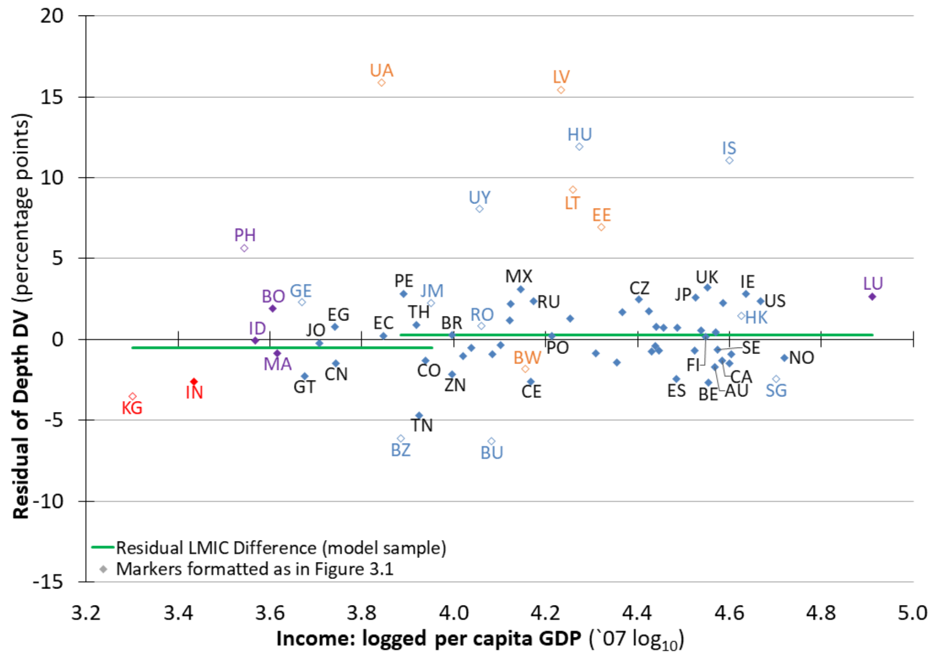
[52] Very similar results are also obtained using the log[GDP/c] Income term instead of the LMIC dummy IV (Table 3B.2), with the Income term showing greatly reduced coefficient magnitude and significance when added to the main model ([7]), due to specification difference (i.e., compared to [6]) and not sample difference ([2–6]). The continuous Income relationship is even more clearly explained away than the LMIC difference when allowing the model-IVs “first shot” at explaining DV variability ([8–10]).

dummy's coefficient magnitude. The manufacturing exports term provides the second largest reduction, and government expenditures boom a more distant third, and other terms produce very little change. Yet, the LMIC dummy remains strongly significant with each IV added individually, indicating that none of the IVs fully explains away the difference by itself. Similarly, the LMIC dummy regains the largest amount of coefficient magnitude and significance when the credit boom term is removed. Here, however, individual removal of the remaining terms (save the flexible XRR dummy) provides similar, smaller LMIC "improvements"—that is, showing no pattern consistent with the larger contributions for the manufactured exports and government expenditures boom IVs added individually. Exclusion of the XRR dummy produces very little change in the LMIC term.

Thus, the credit boom term appears to provide the largest single contribution toward explaining why LMICs experienced shallower contractions during the GFC, with LMICs tending toward smaller credit booms and correspondingly deeper output contractions (though only modestly so: R=-.18 between the LMIC dummy and the credit boom term). Other model-IVs also contribute somewhat, with LMICs tending toward lower levels of manufactured exports (R=-.33), larger government expenditure booms (-.23), and smaller FFM exports booms (-.29), all of which help predict shallower contractions. Choice of XRR and size of the FDI assets boom are both minimally correlated with LMIC status (R=.06 and .02 respectively), contributing very little to explaining the LMIC difference.

Figure 3.3 plots the model's depth DV (full) residuals against income, illustrating the slightly positive but insignificant residual LMIC difference ([7] in Table 3.3) as green

Figure 3.3. Depth DV Residual vs. Income (showing residual LMIC difference)



Source: IFS, author's calculations.

LMIC difference lines. For direct comparison, Figure 3.1 shows the LMIC difference for the raw depth DV on the model sample ([5] in Table 3.3 illustrated in corresponding green lines.[53] Comparing Figures 3.1 and 3.3 shows the general vertical narrowing of the distribution and the LMIC differences, illustrating the high explanatory power of the model, with IV variation accounting for three-quarters of the variation in the depth DV for the model sample (R^2=.748). The main exceptions to that narrowing remain the DV residual outliers: the cluster of very poorly-explained peripheral European countries—Estonia (EE), Hungary (HU), Iceland (IS), Latvia (LV) and Lithuania (LT)—plus Uruguay

[53] Figure 3.1 also highlights (in yellow) the four observations excluded from the model sample specifically due to *missing data* on one-or-more model-IVs. Two of those are LMICs, but make a negligible difference to the LMIC difference result (i.e., comparing [4] vs. [2] in Table 3.3).

(UY) and the Philippines (PH), which all experienced contractions deeper than predicted; as well as Kyrgyzstan (KG), Tunisia (TN), Belize (BZ) and Bulgaria (BU) with contractions moderately shallower than predicted.

3.4.1.8 Emerging Europe Depth Difference

Beyond the income relationship question, an emerging Europe difference was also considered, following Berglöf et al. (2009), who—along with Rose and Spiegel (2009) and Ho (2015)—showed that emerging Europe experienced worse crisis outcomes.[54] Berglöf et al. provide a model ostensibly explaining the difference, but without explicitly controlling for sample difference, their conclusions remain unclear. Here, on the full sample ([1] in Table 3.4: N=76), the emerging Europe dummy—representing nineteen countries (n_{EmEur}=19)—is very significant ($p_{(r)}<10^{-3}$), reproducing the base issue.[55] The emerging European countries experience contractions averaging 5.8 pp deeper than those of other countries. However, that difference includes the experiences of four outliers on the raw depth DV: Estonia, Latvia, Lithuania and Ukraine. With just those DV outliers excluded ([2]: N=71), the emerging Europe dummy remains significant ($p_{(r)}<10^{-3}$), and contractions for the remaining fifteen emerging European countries ($\underline{n}_{EmEur}$=15) average

[54] The emerging Europe grouping used here consists of (n_{EmEur}=19): Belarus (BY), Bulgaria (BU), Croatia (HR), Czech Republic (CZ), Estonia (EE), Georgia (GE), Hungary (HU), Kyrgyzstan (KG), Latvia (LV), Lithuania (LT), Macedonia FYR (MK), Poland (PO), Romania (RO), Russia (RU), Serbia (RS), Slovakia (SK), Slovenia (SI), Turkey (TR), and Ukraine (UA). Berglöf et al. (2009) "use the term "emerging Europe" broadly to denote Turkey and the transition economies of Central, Southeastern and Eastern Europe including the Caucasus region… [as well as] a few Central Asian economies" (p985, f.n. 2), but without explicitly listing the group's membership.

[55] Note that Table 3B.5 expands on Table 3.4, as Table 3B.1 does for Table 3.3 (see Footnote 50).

Table 3.4. Contraction Depth-Income Relationship: Emerging Europe Difference

DV	Contraction Depth					DV Residual from [4]		
Regression Type	**Tobit**					**OLS**		
Sample	**Full Sample**	**Exclude DV outliers**	**Model Sample(a)**				**Reincl. IV outliers**	**Reincl. IV&DV outliers**
Model	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**	**[8]**
Emerging Eur. dummy	**5.8***** (<.001)	**3.5***** (.001)	**4.8***** (<.001)		**1.0** (.290)	**0.5** (.490)	**0.3** (.733)	**3.0***** (.007)
n_{EmEur}(b)	*19(c)*	*15(d)*	*9(e)*		*9(e)*	*9(e)*	*13(f)*	*17(g)*
Credit Boom				**37.0***** (<.001)	**33.8***** (<.001)			
Manufacturing Exports				**3.5***** (<.001)	**3.4***** (<.001)			
FDI Assets Boom				**-13.9***** (<.001)	**-14.4***** (<.001)			
Gov. Expend. Boom				**-68.5***** (<.001)	**-61.0***** (<.001)			
FFM Exports Boom				**33.2***** (<.001)	**32.3***** (<.001)			
Flexible XR dummy(h)				**-1.5***** (.007)	**-1.4***** (.010)			
Constant	**4.8***** (<.001)	**4.6***** (<.001)	**4.0***** (<.001)	**6.7***** (<.001)	**6.6** (<.001)	**0.01** (.973)	**0.4** (.377)	**0.3** (.526)
N	76	71	55	55	55	55	67	72
Pseudo R^2	.048	.031	.045	.248	.252			
Back Calc R^2	.251	.154	.222	.748	.754			
OLS R^2	.251	.154	.222	.748	.754	.009	.002	.098
OLS Adj.R^2	.241	.142	.208	.716	.717	-.010	-.014	.085

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) first round outliers on the depth DV; (ii) missing data on any model-IV; and/or (iii) first round outliers on any model-IV.

(b) n_{EmEur} represents the numbers of Emerging European countries in each sample.

(c) n_{EmEur}=19: Emerging Europe
= {BU, BY, CZ, EE, GE, HR, HU, KG, LT, LV, MK, PO, RO, RS, RU, SI, SK, TR, UA}.

(d) n_{EmEur}=15: Emerging Europe, but not outliers on the DV = [the full 19] − {EE, LT, LV, UA}.

(e) n_{EmEur}=9: Emerging Europe, not missing data on model-IVs and not outliers on the DV or model-IVs
= [the full 19] − {MK, RS; EE, LT, LV, UA; GE, HU, KG, RO} = {BU, BY, CZ, HR, PO, RU, SI, SK, TR}.

(f) n_{EmEur}=13: Em. Eur., not missing model-IV data, not outl. on DV = [full 19] − {MK, RS; EE, LT, LV, UA}.

(g) n_{EmEur}=17: Emerging Europe, but not missing data on model-IVs = [full 19] − {MK, RS}.

(h) $n_{XRR.Flex}$=28: number of countries in the model sample with Flexible XRRs (for details Table 3.2).

3.5 pp deeper than for other countries—notably shallower than when including the DV outliers, but still statistically and economically significant. This difference remains significant when further constraining to the model sample ([2]: N=55), including the loss of six more emerging European countries (n_{EmEur}=9), but with effect size increasing to 4.8 pp ($p_{(r)}<10^{-3}$), largely representing the exclusion of countries missing data on some model-IVs.[56] Overall, then, with respect to statistical and economic significance, the emerging European difference is robust to sample change. On that same sample, when then adding in the IVs of the main model, the emerging Europe dummy becomes clearly insignificant ([5]: $p_{(r)}>.2$) with greatly reduced effect size (0.99 pp), such that the difference of those nine remaining emerging European countries is explained away by the model. The model itself is also robust to adding the emerging Europe dummy ([5] vs. [4]). With the exception of Hungary (Z_{Dep}=6.6), the emerging European countries excluded only as model-IV outliers—not as DV outliers or due to missing model-IV data—are well-predicted by the main model or experienced only mildly shallower-than-predicted outlier contractions (Kyrgyzstan: Z_{Dep}=-2.002).

However, despite the dummy's corresponding insignificance when regressed against the depth DV residual on the model sample ([5]), and on the sample with model-IV outliers re-included ([6]), the dummy regains significance on the sample with DV outliers also re-included ([7]), driven by the four raw DV outliers (Estonia, Latvia, Lithuania, and Ukraine) as well as Hungary. The emerging European difference on the full sample ([1])

[56] Serbia is missing data on the FFM share of exports boom IV, and Macedonia FYR is missing data on the FDI assets boom IV. Bulgaria and Romania are outliers on the credit boom IV, while Georgia is an outlier on the government expenditures boom IV, and Kyrgyzstan is an outlier on the FDI assets boom IV (as well as a second-round outlier on the credit boom IV).

thus appears to comprise (at least) two components: one relating to vulnerabilities well-captured in the main model, and which explain away the difference for most (12 out of 19) of the emerging European countries; and another (or others) relating to the unexplained residual difference of five more emerging European countries (the Baltics, Ukraine and Hungary) and perhaps also Iceland (not identified as part of emerging Europe, but showing residual DV outlier status like the other five, and clearly part of “peripheral” Europe).[57,58] Thus, in addition to explaining away the “AE Nature” of the GFC, the IVs of the depth model—and not the associated sample difference—also explain away the broad difference observed for much of emerging Europe, though with further explanation required for those five or six poorly-explained cases.

3.4.2 The Duration DV

Table 3.5 presents the main results for the duration DV. The IV specification obtained through the model selection process is shown with Tobit regression on the model sample [1], as well as on the sample with only DV outliers excluded [2], and on the full sample [3]. The preferred IV specification comprises only two IVs, representing countries' pre-crisis values for the pre-crisis level of foreign debt liabilities (logged) and the boom-

[57] The remaining two emerging European countries (Serbia and Macedonia FYR) are neither well-explained nor poorly-explained by the model, because they are missing model-IV data.

[58] The vulnerability for emerging European countries appears particularly related to the credit boom IV. Among the seventeen (iterated) outliers on the credit boom IV, only four are not explicitly considered part of emerging Europe: Iceland (IS), Ireland (IE), Spain (ES) and Jamaica (JM). And only four emerging European countries are not credit boom outliers: Slovakia (SK), Poland (PO), the Czech Republic (CZ), and Croatia (HR). (However, Croatia does have the second highest non-outlier value, after Greece (GR), which is not considered part of emerging Europe.)

period growth in bank assets, each discussed further below. Missing model-IV data (for Taiwan) reduces the full sample to seventy-five countries (N=75), and excluded outliers reduces the sample further to fifty-five observations (N=55, though a different 55 than for the depth DV model). The preferred sample excludes not only first-round outliers on the DV and model-IVs, but also the iterated outliers on the foreign debt liabilities IV, as will be discussed below. The results on these different samples show the model to be largely robust to outlier re-inclusion, though with somewhat altered coefficient values and significances (but maintaining $p_{(r)}<.05$ throughout).

Corresponding OLS and Poisson regression results are also presented for the model sample and full sample ([4]-[7]), showing the robustness of this model to the use of alternate regression techniques.[59] The Tobit and Poisson results each include back-calculated R^2 values (as discussed with respect to the depth DV results). With only two IVs found significant and robust, this model accounts for slightly less than half of duration DV variability (R^2=.464), which is nearly identical whether using Tobit ([1]) or OLS ([5]), though slightly higher with Poisson ([7]: R^2=.494).

Nine observations are relatively poorly explained by the model—that is, are outliers on the duration DV residual, with Z-score magnitude greater than 2.0 ($|Z_{Dur}|>2.0$), taken relative to the model sample.[60] The DV residual outliers with actual contractions deeper than predicted by the model are Brunei (BN: Z_{Dur}=6.5), itself an outlier on both IVs, and

[59] OLS and Poisson results for the sample with DV outliers excluded ([2] in Table 3.5 for Tobit regression) show robustness to change in regression technique, but are omitted to limit the results presented.

[60] See Footnote 38.

Table 3.5. Main Duration Model (with sample and regression type variations)

DV	Contraction Duration						
Regression Type	Tobit			OLS		Poisson	
Sample	Model Sample[(a)]	DV outliers excluded	Full Sample	Model Sample[(a)]	Full Sample	Model Sample[(a)]	Full Sample
Model	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Foreign Debt Liabilities	**3.9** (<.001)	**1.6** (.003)	**1.8** (.002)	**3.7** (<.001)	**1.7** (.003)	**1.1** (<.001)	**0.4** (<.001)
Bank Assets Boom	**10.8** (.003)	**7.9** (.010)	**9.0** (.007)	**10.4** (.003)	**8.6** (.008)	**3.0** (.006)	**2.3** (.001)
Constant	**4.2** (<.001)	**3.5** (<.001)	**3.7** (<.001)	**4.2** (<.001)	**3.8** (<.001)	**1.4**	**1.3** (<.001)
N	55	55	55	55	55	55	55
Pseudo R^2	.141	.053	.053			.133	.071
Back Calc R^2	.464	.212	.212			.494	.232
OLS R^2				.464	.212		
OLS Adj.R^2				.444	.190		

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2
(a) The Model Sample excludes observations that are: (i) missing data on either of the model-IVs; (ii) (first round) outliers on the duration DV; (iii) first round outliers on either model-IV; and/or (iv) iterated outliers on the foreign debt liabilities IV.

Jamaica (JM: 5.2) and Estonia (EE: 2.3), which are two of the three outliers on the raw duration DV. The outliers with contractions shallower than predicted are Luxembourg (LU: Z_{Dur}=-4.2), Kyrgyzstan (KG: -3.2), Malta (MT: -3.1), Cyprus (CY: -2.9), Australia (AU: -2.21), and Switzerland (CH: -2.18); of these, four are excluded from the model sample as first-round (LU) or iterated (MT, CY and CH) outliers on the foreign debt liabilities IV, while Kyrgyzstan is an outlier on the bank assets boom term, and Australia is not an outlier on either IV. The remaining observations all have duration DV residual Z-scores between -1.98 and +1.77, within the ±2.0 standard deviation cut-off for outliers. These "relatively well-explained" observations include Iceland (IS: Z_{Dur}=-0.26), which is the third outlier on the raw duration DV, as well as the other observations excluded from the model sample as IV outliers (including some of the iterated outliers on the debt IV).

3.4.2.1 Foreign Debt Liabilities IV

The foreign debt liabilities IV is calculated as the base-10 logarithm of the ratio-to-GDP of total private and public sector debt owed to foreigners (in 2007).[61] The coefficient of 3.9 ($p_{(r)}<10^{-4}$) indicates that (ceteris paribus) countries owing ten times more debt to foreigners relative to the size of their economy (i.e., with an IV value one logarithmic unit higher) experienced GFC contractions that averaged nearly four quarters (i.e., almost a year) longer. The foreign debt liabilities IV is robust to the addition of all other test-IVs, including its own boom-period growth version and the log-level and boom-period growth versions for other classes of foreign liabilities (e.g., FDI and portfolio equity) and corresponding foreign assets (Figure 3B.10).[62] The standardized coefficient ($\beta = b \times s_x / s_y = 3.87 \times 0.314 / 2.10 = 0.579$) indicates that a one standard deviation larger value for foreign debt liabilities IV corresponds to a 0.58 standard deviation longer contraction.

The main result—i.e., that countries owing more foreign debt experienced correspondingly longer contraction durations—is consistent with the intuitive notion of increased vulnerability associated with increased debt, for example due to the withdrawal of more liquid forms of international capital (especially debt) during the crisis. Facing the

[61] Note that use of the base–10 logarithm (rather than the natural logarithm) allows more intuitive interpretation of regression coefficient results, and that the two variables—$\log_{10}(x)$ and $\ln(x)$—are identically correlated ($R \equiv 1$), thereby providing isomorphic regression results with identical p-values and R^2 values (though nominally different coefficient values).

[62] The foreign debt liabilities IV result is also robust to including IVs for the derivatives classes of assets and liabilities, for which many observations are "zero", possibly reflecting missing data or true zeros—the abundance of which might require more specialized analytic techniques.

credit crunch and increased need for liquidity, international lenders presumably called-in their foreign debt assets, affecting countries that borrowed more heavily during the boom-period to a greater degree. However, recalling that the depth model includes no significant terms specifically related to debt liabilities, it remains unclear precisely why such vulnerability would manifest specifically in longer but not deeper contractions.

Some of the foreign debt liabilities IV’s high-end iterated outliers—Netherlands (NE), Hong Kong (HK), United Kingdom (UK), Belgium (BE), Switzerland (CH), Cyprus (CY) and Malta (MT)—cluster in a somewhat distinct group, experiencing moderately shallower contractions than the model predicts (i.e., all lying below the partial residual line in Figure 3B.10). The model itself is, however, largely robust to the re-inclusion of the iterated outliers, with coefficient significance, sign and order-of-magnitude preserved (model [2] vs. [1] in Table 3.5). Additionally, while only three iterated outliers are poorly-explained in model [1] ($|Z_{Dur}| \geq 2.0$ for CY, MT, CH), they are all well-explained in model [2]. Nonetheless, model [1] is preferred, as model [2] is not fully robust to the inclusion of all other test-IVs. In particular, model [2] is robust to the addition of all but five test IVs, each of which dominates the foreign debt liabilities term (with their own first-round outliers excluded, or with their iterated outliers also excluded). However, with the foreign debt liabilities term’s iterated outliers excluded, it dominates each of these terms, and is thus interpreted as reflecting a “truer” relationship for the “core sample” of non-outliers.

Of note, these high-end foreign debt liabilities outliers (iterated as well as first-round) relate closely to the countries identified by Lane and Milesi-Ferretti (2011) as "highly financially open"—that is, with a financial openness ratio (the sum of total foreign assets plus total foreign liabilities to GDP) greater than 800 per cent in 2007.[63] Their group further includes Bahrain, which is not in the sample here, and Singapore (SG), which is in this sample with foreign debt liabilities slightly below the iterated outliers cut-off, but remaining quite close to that cluster of high-end iterated outliers (see Figure 3B.10). In this chapter, the main results for model [1]—excluding all iterated outliers on the foreign debt liabilities IV—are all robust to excluding only the "highly financially open" countries (i.e., excluding the high-end foreign debt liabilities outliers plus Singapore, but re-including China (CN) and Botswana (BW) as low-end outliers).

Future research can help unpack the causal mechanism underpinning the foreign debt liabilities relationship, and why higher debt correlates with longer but not deeper contractions. Future research could also explore why the high-end iterated outliers on this IV appear to behave somewhat differently than countries with even slightly lower values. Do these countries play a particular role in the international financial system that alters the way debt liabilities affected them during the crisis, or is there a distinct mechanism not already reflected in the model or in the test-IVs that helps explain their performance?

3.4.2.2 Bank Assets Boom IV

The bank assets boom IV is calculated as the boom-period growth (CAGR 2003–

[63] Lane and Milesi-Ferretti (2011) include these "highly financially open" countries in a group of "financial centers", along with "a selected group of [eight] small countries that are international banking centers or with significant offshore activity" (14). Of those, only Belize (BZ) and Mauritius (MU) are in the sample here; but they do not "visually cluster" with the "highly financial open" group (see Figure 3B.10).

2007) in total assets held by deposit money banks as a share of GDP—that is, the average rate at which the assets side of the domestic banking system's balance sheet expanded during the pre-crisis boom. This IV is closely related to the depth model's credit boom IV, but broadens from credit to all assets, while narrowing from banks and OFIs to just banks. The coefficient value of 10.8 ($p_{(r)}<10^{-5}$) indicates that a 10 pp/year faster rate of increase in bank assets during the pre-crisis boom corresponds with roughly a one quarter longer output contraction during the crisis (Figure 3B.11). The corresponding standardized coefficient ($\beta = 0.330$, $s_x = 0.0644$) indicates that a one standard deviation larger value for the bank assets boom IV corresponds to a 0.33 standard deviation longer contraction.

The bank assets boom result and the model more generally are robust to the inclusion of all other test-IVs, including several closely-related to this IV. It dominates the corresponding bank credit boom IV (i.e., for credit issued to the domestic private sector by domestic banks), suggesting that the vulnerability captured in this term is more closely associated with the expansion in the broader range of bank assets.[64] Likewise, those two bank boom IVs each dominate the corresponding terms for booms in assets or credit issued by banks and OFIs, suggesting that the role of OFIs with respect to duration-oriented vulnerability is not fully consistent with that role for banks: if the causal mechanisms were consistent, it would be expected that the bank and OFI assets boom IV would reinforce and

[64] Cross country variation in banks' choices (including as influenced by differential regulatory constraints, or by countries' differing banking cultures) between traditional originate-and-hold and newer originate-and-distribute approaches to mortgage-backed securities and their complex derivatives could underpin the greater vulnerability seen here to the bank assets boom, as distinct from that related to the related credit boom. Future research could examine this hypothesis, but is beyond the scope of this chapter.

improve on the bank version, even modestly. Further, in dominating the IV representing the booms in deposits and in "liquid liabilities" (i.e., the M3 monetary aggregate), this vulnerability appears more directly related to bank assets than to their liabilities or to the broader money supply. Finally, IVs measuring the boom-period increase in "leverage"—that is, the ratio of credit extended to the domestic private sector by domestic banks scaled to total deposits at banks (or at banks and OFIs)—are likewise dominated by the bank assets boom IV, indicating that "overleveraging" did not play a distinct role.

Empirically, the bank assets boom result indicates that banking systems that took more advantage of the boom-period to expand their total assets (relative to the size of the economy) tended to experience longer contractions. This relationship is consistent with the basic vulnerability related to the credit boom, with bank credit—and thus assets—expanding simultaneously. However, the domination of other IVs by the bank assets boom term suggests that the mechanism producing the vulnerability is related more to expansion in the overall assets side of the banking system, rather than just to the credit portion thereof. The credit boom process may have driven much of the boom-period expansion in banking system assets, but with differences in balance sheet practices between countries producing a differential outcome relating to assets in particular. Further research could help test these hypotheses, exploring the boom-period expansion of bank credit and other assets in more detail, and considering the differential role of national and bank-specific policies and practices in influencing the expansion of assets, as well as looking more closely at how the boom in assets at banks, but not at OFIs, appears to have led to longer contraction durations.

3.4.2.3 Income Relationship and LMIC Duration Difference

Even though the duration model has only moderate explanatory power (R^2=.464), it too explains away the previously observed income-related relationships on the duration DV. Figure 3.2 illustrates the LMIC step-function relationship for the duration DV.

When added to the main model ([4] in Table 3.6), the LMIC dummy's coefficient magnitude is reduced by almost two-thirds (-0.8 vs. -2.3) and is rendered statistically insignificant ($p_{(r)}$≥.15), reflecting IV specification difference (i.e., comparing [4] against [3]) rather than any sample difference (comparing [3] against [1]).[65] Further, when the LMIC dummy is regressed against the duration DV residual from the main model, the LMIC term's coefficient magnitude is reduced further and rendered even more clearly insignificant ([5]).[66] The model itself is robust to the addition the LMIC dummy (comparing [4] with [3]). The duration model explains away the LMIC difference even more clearly than does the depth model.[67]

To examine which model-IV contributes more toward explaining the duration DV's LMIC difference, specifications were examined including only the LMIC dummy and each of the model-IVs individually, and adding the LMIC to the full model, while controlling

[65] Note that in the Chapter 2, the LMIC dummy included Kyrgyzstan (the only LIC in the sample). Here it has been excluded from the LMIC dummy (i.e., in Table 3.6), but is also excluded altogether from the model sample (i.e., in columns [1 and 5–7] in Table 3.6). Reporting only the LMIC result, and not also a similar LMIC/LIC result simply reduces the number of regression tables presented.

[66] Note that Table 3B.6 expands on Table 3.6, as Table 3B.1 does for Table 3.3 (see Footnote 50).

[67] Very similar results are also obtained using the log[GDP/c] income term instead of the LMIC dummy IV (Table 3B.7). Note that the raw duration DV shows no emerging Europe difference so there is no table for the duration DV corresponding to Table 3.4 for the depth DV.

Table 3.6. Contraction Duration-Income Relationship: LMIC Difference

DV	Contraction Duration				DV Residual from [3]
Regression Type	Tobit				OLS
Sample	Full Sample	Model Sample(a)			
Model	[1]	[2]	[3]	[4]	[5]
LMIC dummy	**-2.4***** (<.001) *17(c)*	**-2.3***** (.001) *14(d)*		**-0.8†** (.150) *14(d)*	**-0.4** (.349) *14(d)*
n_{LMIC}(b)					
Foreign Debt Liabilities			**3.9***** (<.001)	**3.4***** (<.001)	
Bank Assets Boom			**10.8***** (.003)	**9.6***** (.008)	
Constant	**4.3***** (<.001)	**4.0***** (<.001)	**4.2***** (<.001)	**4.3***** (<.001)	**0.2** (.517)
N	76	55	55	55	55
Pseudo R^2	.037	.053	.141	.150	
Back Calc R^2	.133	.184	.464	.478	
OLS R^2	.133	.184	.464	.479	.017
OLS Adj.R^2	.122	.169	.444	.448	-.002

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on either of the model-IVs; (ii) (first round) outliers on the duration DV; (iii) first round outliers on either model-IV; and/or (iv) iterated outliers on the foreign debt liabilities IV.

(b) n_{LMIC} represents the numbers of countries in each sample that are LMICs.

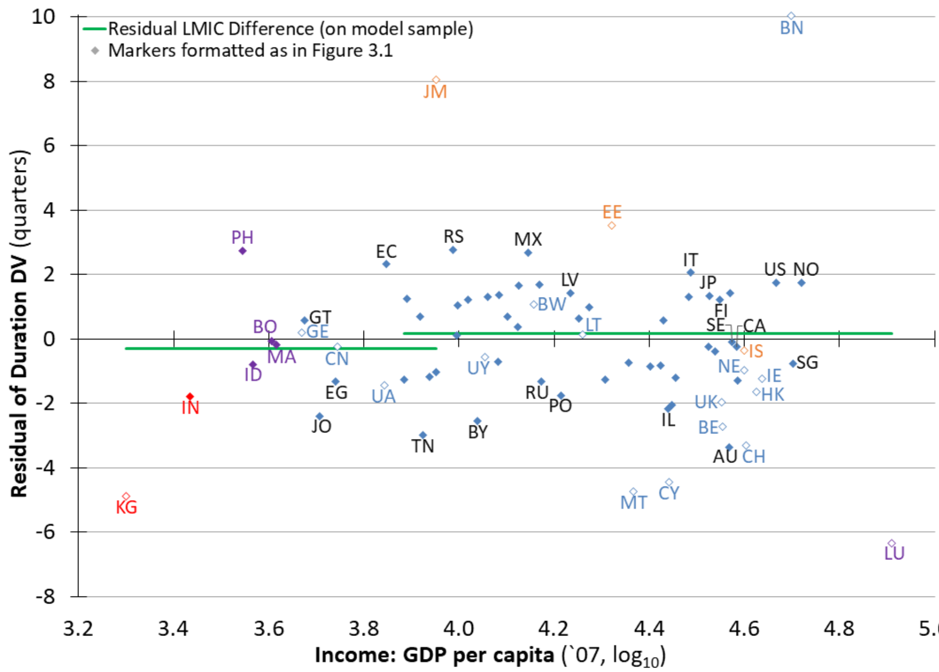
(c) n_{LMIC}=17: all LMICs (note: no LMICs are missing data on model-IVs; no LMICs are duration DV outliers) = {BO, CN, CO, EC, EG, GE, GT, ID, IN, JO, MA, MK, PE, PH, TH, TN, UA}.

(d) n_{LMIC}=14: LMICs that are not first round outliers on either IV or iterated outliers on the foreign debt liabilities IV = [all 17 LMICs] − {GE, UK; CN}.

for sample difference by constraining each specification to the model sample.[68] Adding foreign debt liabilities to the LMIC-only model reduces the LMIC dummy's coefficient estimate and significance more so than does adding the bank assets boom term. Likewise, removing the debt term increases the LMIC term's coefficient and significance more so than does removing the bank assets boom from the model including all three. But while the

[68] See Table 3B.8. With only two IVs, the individual addition of each to the LMIC dummy (corresponding to Table 3B.3 for the depth DV) is equivalent to the individual removal of each from the full model with the LMIC dummy (corresponding to Table 3B.4 for the depth DV).

Figure 3.4. Duration DV Residual vs. Income (showing residual LMIC difference)



Source: IFS, author's calculations.

foreign debt term appears to provide most of the power explaining away the LMIC difference on the duration DV, its inclusion does not render the LMIC term insignificant, with the bank assets boom also contributing to the explanation. LMICs tended to owe lower levels of foreign debt (with a correlation of R=-.39) and to have experienced smaller booms in their banks' assets (R=-.23), both of which help predict shorter contractions.

Figure 3.4 plots the model's duration DV residuals against income, illustrating the slightly negative but insignificant residual LMIC difference (of [7]) as green lines. For direct comparison, the significant LMIC difference for the raw duration DV on the model sample (representing model [5] in Table 3.6) is illustrated as the corresponding green lines in Figure 3.2. That figure also highlights (in yellow) the single observation excluded from the model sample due to missing data (Taiwan, missing its bank assets boom IV datum), which affects the LMIC difference only negligibly ([2] vs. [3] in Table 3.6). Comparing Figures 3.2 and 3.4 reveals general vertical narrowing of the distribution for the model sample—and of the LMIC differences—illustrating the moderate explanatory power of the model, with IV variation accounting for nearly half of the variation in the depth DV over the model sample (R^2=.46). The main exceptions to that narrowing include: the more extreme DV residual outlier cases of Brunei (BN), Jamaica (JM) and Luxembourg (LU), along with Kyrgyzstan (KG) and some of the high-end iterated outliers on the foreign debt liabilities IV: Malta (MT), Cyprus (CY) and Switzerland (CH). Further investigation of these cases is worth pursuing, to help understand why they are not well-explained by the model, considering, for example: whether the causal mechanisms underpinning the relationships captured by the model-IVs operate differently for the financial centres; or whether a distinct mechanism (idiosyncratic or generalizable) is at play, but which is not represented adequately in the test-IVs considered in this chapter’s model selection process.

3.5 Discussion

Following a short comparison between these results and those found in the differential impact literature and consideration of additional negative and non-results, three methodological critiques will be discussed, followed by policy implications.

3.5.1 Comparison with Results from the Literature

Broadly speaking this chapter’s results are consistent-with, but improve- and extend-on those in the literature. Not only does this analysis provide a more detailed explanation of the income-outcome or LMIC-difference relationship for each DV, it also systematically tests and identifies as significant IVs representing pre-crisis boom-period changes that—aside from the credit boom term—are not widely considered in other studies.

For the depth DV model, the high explanatory power (R^2=.75) nearly matches Ólafsson and Pétursson's (2010: R^2=.77) on a similar DV, with the same number of IVs (6), but with a somewhat larger sample (N=55 vs. 46) spanning LMICs to HICs, rather than just their "upper half of the income spectrum" focus. The model selection process here is also more rigorous and transparent than is Ólafsson and Pétursson's. Their "some experimentation" (15) produces a preferred IV specification quite distinct from those in the existing literature, while the process here also explicitly tests for robustness to each of Ólafsson and Pétursson's preferred IVs.

While the sample size of the depth model does not match those of the existing studies—which base their DVs on annual-level output data—and excludes LICs in particular, the main depth DV results are qualitatively consistent with those most robust in the literature, confirming that the magnitude of the pre-crisis credit boom is especially important in predicting worse outcomes, and identifying not just one, but two trade channels that influence GFC-period contractions. The two trade channel effects help clarify the various "composition of trade" results obtained by Berglöf et al. (2009) and Berkmen et al. (2012), while also being more specific than the literature's various (and contradictory) results on measures of total trade. The exchange rate regime result is also consistent with both theory and the few papers that obtained positive results (Ólafsson and Pétursson; Berkmen et al. on their EME sample), while improving on those that found negative results (Lane and Milesi-Ferretti; Berkmen et al., on their developing countries sample; Blanchard, Faruqee, and Das), by controlling more rigorously for other factors influencing contraction depth. The government expenditures boom and FDI assets boom IVs then add to previous results, but in ways largely consistent with theory.

The results for the duration DV model also improve on those from the existing two studies. As for the depth model, the duration model achieves similar explanatory power (R^2=.46) to Ólafsson and Pétursson (2010: R^2=.49), using a very similar DV, and with a somewhat larger sample (N=55 vs. 46) again spanning LMICs through HICs, rather than just the upper half of the income spectrum; but the model obtained here does so using only two IVs, with the selection process ensuring that the results dominate each of Ólafsson and Pétursson's six preferred IVs. The process likewise ensures that the depth model dominates most of the IVs identified as individually significant by Claessens et al. (2010).[69]

3.5.2 Negative Results and Non-Results

In addition to the main positive results, the rejection of many other test-IVs considered during model selection provides a large set of negative results identifying

[69] The main exception is Claessens et al.'s housing price boom (2000–2006) IV. Housing price IVs (level or boom), as well as IVs for STED were excluded from consideration here due to limited cross-country coverage (N=43 and 38 respectively, and excluding many LMICs or HICs, also respectively). The exclusion of STED data also pre-empted consideration of different scalings for foreign exchange reserves, e.g.: log[FXR/STED] following Blanchard, Faruqee, and Das (2010); or log[FXR/(STED–CA)] following Llaudes, Salman, and Chivakul (2010). Further consideration could be given to all these variables.

country characteristics and conditions that did not influence the depths and durations of the GFC-associated peak-to-trough contractions in output. Additionally, due to the methodological choice to consider only pre-crisis IVs—avoiding the endogeneity issues associated with during-crisis measures—any effects related to during-crisis policy response, or to more-complicated during-crisis dynamics, could not be considered directly. These negative results and non-results are outlined and discussed here.

Beyond those aspects already reflected in the depth and duration models, other aspects of countries' pre-crisis conditions and characteristics (whether measured in pre-crisis level, log-level or boom-period growth forms) were not found to systematically, significantly and robustly improve the models' performances, when controlling for the features included in the models. Aspects of countries' international trade linkages for which no contribution was discernable, include: overall trade flows, such as the sizes (relative to GDP) of exports or imports, the overall trade balance (net exports, and relatedly the current account balance), or general trade openness (measured as total exports plus imports); corresponding trade flows occurring with specific major economy trading partners (U.S., China, Japan, Germany, Eurozone, European Union, or the AEs taken together); and the product or services composition of different trade flows. Rather, the "trade channels" for GFC impact on output appear focused narrowly on shocks associated with the exports of manufactured goods, and of FFM products.

Aspects of international financial linkages that similarly made no significant difference include: overall financial flows (total foreign assets, total foreign liabilities), the balance therein (net foreign assets), or overall financial openness (total foreign assets and liabilities); corresponding flows for particular asset classes (FDI, portfolio equity, debt and derivatives) other than the two included in the models; foreign banks’ ownership, claims and lending in the domestic system; and remittance flows.

Regarding exchange rates, beyond the reduced contraction depth associated with a generally more-flexible exchange rate, no systematic vulnerability or resilience was detected associated with: high or low exchange rate variability; high or low CPI inflation; or from the adequacy (or lack thereof) of foreign exchange reserves, or changes therein.

Aspects of the domestic financial system that provided no further significant role include: bank system leverage (with or without OFIs); banking system concentration or efficiency (e.g., measured via bank overhead, return-on-assets, return-on-equity, cost-to-income ratio, or Z-score); and characteristics of the domestic stock and bond markets (especially including a measure of stock market boom). Additionally, no role was discerned for institutional characteristics using the Economic Freedom of the World, Worldwide Governance Indicators, Polity IV or Freedom House measures.

However, it should also be noted that the positive results likely reflect the most proximate influences on GFC outcome, with part of the deeper question then becoming why countries differed on those proximate influential factors. Those deeper explanations may link to some of the test-IVs rejected in the model selection process, particularly those with which they are correlated—for example, with banking system concentration or efficiency potentially influencing the magnitude of the credit boom; or with institutional characteristics influencing a variety of the model-IVs.

It should also be noted that the high explanatory power of the depth model in particular (R^2=.75) still leaves significant residual explanatory space in which during-crisis dynamics and policy responses might play a role. The strict pre-crisis nature of the IVs considered avoids technical issues associated with endogeneity and simultaneity—the concern that during-crisis IVs may reflect effect in addition to cause—but at the cost of precluding direct consideration of such during-crisis influences. This does not imply that monetary policy, fiscal policy, or during-crisis changes in other types of policy (exchange rate policy or financial regulation), or the occurrence of banking or currency crises, had no effect on GFC outcome. Rather, it suggests either a somewhat limited role for such effects specifically in influencing the depth of the contraction phase during the crisis, or that the crisis policy responses were constrained by, conditioned on, or foreshadowed by the pre-crisis characteristics identified here.

Monetary Policy may well have played a significant role, with at least some lag in implementation effect, but possibly with relatively small effect size. For example, monetary policy could have been overwhelmed by the sheer magnitude of the shocks, and in some cases less-effective due to liquidity trap and zero lower bound effects. The U.S. Federal Reserve’s first round of Quantitative Easing, starting in November 2008 and peaking in June 2010, points toward the limited “monetary space” available for conventional monetary policy and the multi-month timeframe for full implementation of unconventional policy (though the U.S. contraction did find its trough in 2009Q2). The major role of the Federal Reserve in the world economy may also confound the differential role of country-specific policy responses. Fiscal Policy, in-turn, may also have played a greater role in later output dynamics, with longer timeframes for implementation and stimulative effect consistent with little fiscal influence over the shorter timeframe of the contraction phase itself.

Meanwhile, showing relatively lower overall explanatory power (R^2=.46), the duration model leaves more room for during-crisis dynamics and policy responses to have played a role. Such influence may reflect the sensitivity of measuring the duration from peak to trough, with policy and other influences more able to affect the specific timing at which either occurred, regardless of their influence on contraction depth. Such during-crisis dynamics or responses may have hastened or delayed the onset of mild contraction prior to the main crisis effects, thereby determining the quarter of peak output without greatly affecting the subsequent contraction depth. Likewise, during-crisis effects and policy responses may have influenced whether the economy continued to contract, even slowly; or whether growth turned even slightly positive after the main contraction, again, determining the specific timing of the trough, and influencing the overall duration, with possibly little effect on overall contraction depth.

Systemic banking and/or currency crises—for example treated as distinct binary DV outcomes by Ólafsson and Pétursson (2011)—are examples of “during-crisis dynamics” not considered in this chapter. It seems reasonable to expect that the thirteen countries facing systemic banking crises during the GFC (Austria, Belgium, Denmark, Germany, Iceland, Ireland, Latvia, Luxemburg, the Netherlands, Russia, Switzerland, the U.K. and the U.S.), and the four facing currency crises (Belarus, Iceland, Korea and Ukraine; with Iceland the only "twin crisis") would experience worse real sector effects, even when controlling for effects captured the depth and duration models.[70] It is also possible, though, that the current models already capture influences that determine the occurrence of such crises, or that such influences are small relative to the magnitude of the other GFC shocks and "fit" within the residual explanatory space for either DV. While these hypotheses concerning during-crisis dynamics and policy-response warrant further attention in future research, they are beyond the scope of this study.

3.5.3 Spurious Noise-to-Noise Relationships

In advocating the use of the Bayesian model averaging approach, Ho (2015) points out that "while other conventional model selection procedures, such as stepwise regression, tend to identify pseudo-relationships between noise and noise, BMA is not plagued by this problem" (820).[71] The concern thus arises that the manual step-wise model selection process used in this chapter may have identified such spurious noise-to-noise IV-DV relationships, rather than "real" relationships. This concern is partly alleviated by the

[70] The identification of banking and currency crises here follows Laeven and Valencia (2008). Ólafsson and Pétursson (2011) also follow Laeven and Valencia, but do not include Belarus and Ukraine in their sample, so refer to only Iceland and Korea as having had currency crises.

[71] Ho (2015) demonstrates BMA's strength through Monte Carlo simulations, showing that BMA does not detect any spurious relationships between a DV and 51 IVs populated with normally-distributed random noise, but that it does detect a single IV that is correlated with the DV by construction from among 50 other IVs of random noise. (Yet, Ho does not demonstrate that step-wise regression would have either identified spurious relationships or failed to identify the actual relationship in similar situations.)

theoretical credibility of the particular results obtained. It is quite credible that the GFC outcome would vary across countries based on the domestic conditions observed empirically in these results, with worse outcomes related to larger pre-crisis credit booms and to greater exposure via trade and short-term financial linkages, with fiscal policy and flexible exchange rates playing mitigating roles.

Nevertheless, questions remain about the specific measures identified. For example: Why is it the boom, specifically in the share of food, fuels and mining in exports, rather than simply the overall level (to GDP) that matters? Or why is it the boom in bank assets—and not in bank and OFI assets, or in bank (or bank and OFI) credit—that dominates in the duration model? In each case, the specific IV identified by the model selection process might reflect spurious noise-to-noise correlation. In the case of the bank assets boom IV, it only slightly improves on the corresponding bank and OFI assets boom when included separately, and dominates it only slightly when included simultaneously. The two IVs are highly correlated (R=.96 on the model sample), with that overlapping portion explaining why each is significantly related to the duration DV, but with their non-overlapping “residual” portions showing different relationships with the portion of the duration DV not explained by the overlapping portion of the two IVs. Empirically, the bank assets boom IV’s domination of the bank and OFI version indicates that its residual portion (relative to the bank and OFI version) is better correlated with the depth DV. The question then becomes whether that better correlation might reflect a spurious noise-to-noise relationship even if the “true” relationship involves a causal mechanism that applies equally to OFIs and banks. It could similarly be the case that the FDI assets boom term spuriously provides the "cleanest" proxy for a broader class of long-term outflows (or even inflows), with the resulting significance dominating other related IVs, but without necessarily reflecting the overall true relationship.

These possibilities challenge the methodological assumption implicit in this chapter that domination of one IV by another necessarily reflects a more "true" causal relationship. This assumption intuitively holds at the larger-scale. It seems quite credible that the trade related IVs are capturing the effects of trade shocks; but it is less clear at the margin, such that the precise selection of particular IVs cannot be assumed to point directly at the precise causal mechanism at play. For this reason, future research investigating the causal mechanisms underpinning particular relationships would need to recognize that the specific IVs identified in this chapter may not directly represent the precise causal mechanisms at play, but might spuriously proxy for them better than do the other test-IVs considered here.

3.5.4 Further Model Search

Another possible concern is that the model search process is incomplete, having not identified all significant IVs, with the models thus suffering from omitted variable bias. This possibility cannot be ruled-out with certainty, especially with respect to possible causal mechanisms not at all proxied for by test-IVs considered here. Yet, several considerations help alleviate this possibility as a major concern. First, care has been taken to test a wide variety of credibly relevant IVs, including and extending-on those considered in the existing literature, reducing concerns over basic omitted variable bias—but which can never be fully eliminated.[72] Second, the model selection process ensures that IVs selected are robust to the inclusion of other test-IVs that were considered, and that the relationships identified do not reflect outlier influence, avoiding two major methodological concerns about the existing literature. Third—as discussed in the previous section, and subject to the same caveats—the model-IVs selected through this process are consistent with credible explanations for the differential impact, though with further investigation of the underlying causal mechanisms warranted to test, reinforce and refine—or to refute—this point. And fourth, the depth model thus-obtained shows relatively high explanatory power (R^2=.75), leaving limited residual explanatory scope for identifying other major causes of differential impact. In contrast, though, the duration model shows more modest power (R^2=.46), reinforcing the recognition that additional explanatory power might be obtained by considering test-IVs representing mechanisms not considered here. Both models would, of course, be improved-on by further considering during-crisis dynamics and policy responses.

3.5.5 Seemingly Unrelated Regressions

The two-DV/two-model approach used here obtains models for the depth and duration DVs independently. Implicit in this approach is the assumption that the two DVs are in-fact independent—that is, with their residuals under each model (Z_{Dep} and Z_{Dur})

[72] But recall the relationships identified in Footnote 30, which were not tested here.

uncorrelated. In contrast, models in which two or more DVs initially appear to have such independence, but which are in fact related, are called “seemingly unrelated”, and distinct models that treat them as independent are inefficient (i.e., provide biased estimators) relative to a seemingly unrelated regression (SUR) model run on both DVs simultaneously.

As discussed in Chapter 2, the choice to focus on the depth and duration of the peak-to-trough contraction in output (i.e., in seasonally adjusted quarterly real GDP) largely follows Claessens et al. (2010) and Ólafsson and Pétursson (2010). The preference was to consider changes captured at the finer quarterly granularity than is permitted by DVs based on annual output data, while also recognizing the depths and durations of countries contractions as only moderately-well correlated: less than a quarter of variation in either DV is accounted for by variation in the other: R^2=.235 on the full sample, and .222 with the DVs’ outliers excluded, but only .146 on the overlap between the two model samples (N=46). It was also recognized in Chapter 2 that these two “dimensions” of output contraction should be treated separately, rather than combined into a single measure of “recession magnitude” or “strength”—such as that proposed by Mazurek and Mielcová (2013)—which implicitly treat the experiences of countries with relatively deep but short contractions as similar to those that were relatively shallow but more prolonged. The related-but-distinct IVs obtained for the depth and duration models also suggest that different pre-crisis characteristics and conditions affected the depth and the duration of the GFC-related output contraction differently.

Nonetheless, the question remains as to whether depth and duration are independent or only seemingly unrelated. Table 3.7 provides the regression results for the models obtained in different ways: model [1] presents the main model results obtained applying Tobit regression separately on the two distinct model samples (i.e., reproducing model [1] from Tables 3.2 and 3.5, both with N=55, though a different 55 for each); model [2] presents the results obtained applying OLS regression separately on the two distinct model samples (i.e., reproducing model [4] from Table 3.2, and model [5] from Table 3.5, again both with N=55); model [3], in-turn, shows the results obtained again using OLS regression separately with each DV, but on the overlapping sample (N=46), to demonstrate changes due to the sample difference; and model [4] shows the results using OLS-based SUR, necessarily on the overlapping sample.

At the bottom of each column, Table 3.7 also reports the p-values for the Breusch-Pagan test of DV independence, testing whether the DV residuals are correlated between models ([1], each with N=55), the correlation between the DV residuals is only weakly significant (p=.083, necessarily calculated only on the overlap between the two model samples: N=46). However, if this is accepted as significant (e.g., at p<.1), a problem arises, in that methods are only available for obtaining unbiased coefficient estimates via SUR specifically using OLS regressions (e.g., using the “sureg” command in Stata), and not with Tobit (or Poisson) regressions. A choice is therefore necessary between applying SUR with OLS, and obtaining coefficients based only on the overlap between the model samples; or accepting the biased coefficients obtained via the separate Tobit models based on the larger, independent samples, but which do account for the bias associated with

Table 3.7. Seemingly Unrelated Regression (SUR) vs. Independent Models

	Regression Type:	**Tobit**	**OLS**		
	Depth & Duration models:	**Independent**			**SUR**
	Model Samples:	**Independent**		**Overlapping**	
	Model:	**[1]**	**[2]**	**[3]**	**[4]**
Depth DV	**Credit Boom**	**37.0*****	**35.6*****	**32.1*****	**32.0*****
		(<.001)	(<.001)	(<.001)	(<.001)
	Manufacturing Exports	**3.5*****	**3.4*****	**3.5*****	**3.6*****
		(<.001)	(<.001)	(<.001)	(<.001)
	FDI Assets Boom	**-13.9*****	**-13.4*****	**-13.0*****	**-11.2*****
		(<.001)	(<.001)	(<.001)	(<.001)
	Government Expenditures Boom	**-68.5*****	**-67.3*****	**-71.9*****	**-68.7*****
		(<.001)	(<.001)	(<.001)	(<.001)
	FFM Exports Boom	**33.2*****	**33.5*****	**35.4*****	**34.0*****
		(<.001)	(<.001)	(<.001)	(<.001)
	Flexible Exchange Rate Regime dummy	**-1.5*****	**-1.5*****	**-1.6*****	**-1.6*****
		(.007)	(.008)	(.008)	(.002)
	$n_{XRR.Flex}^{(a)}$	*28*	*28*	*28*	*28*
	Constant	**6.7*****	**6.6*****	**6.6*****	**6.7*****
		(<.001)	(<.001)	(<.001)	(<.001)
	N	55	55	46	46
	Pseudo R^2	.248			
	Back Calc R^2	.748			
	OLS R^2		.748	.780	.776
	OLS Adj.R^2		.716	.746	
Duration DV	**Foreign Debt Liabilities**	**3.9*****	**3.7*****	**3.8*****	**3.8*****
		(<.001)	(<.001)	(<.001)	(<.001)
	Bank Assets Boom	**10.8*****	**10.4*****	**7.6**†	**8.8****
		(.003)	(.003)	(.111)	(.049)
	Constant	**4.2*****	**4.2*****	**4.2*****	**4.1*****
		(<.001)	(<.001)	(<.001)	(<.001)
	N	55	55	46	46
	Pseudo R^2	.141			
	Back Calc R^2	.464			
	OLS R^2		.464	.440	.439
	OLS Adj.R^2		.444	.414	
Breusch-Pagan Test (p_{BP})		.083	.056	.077	.077

(a) $n_{XRR.Flex}$=28: number of countries with Flexible XRRs in the model sample for the depth DV (for details see Table 3.2). Note that countries with Flexible XRRs that would be excluded from the overlapping sample (i.e., as outliers or missing data for the duration model) are already excluded for the depth model.

measurement error from not allowing negative DV values. Further, in applying the Breusch-Pagan Test to the residuals obtained using OLS separately on the two independent model samples ([2]), the residuals' correlation is more significant (p=.056), but is reduced somewhat for residuals obtained via OLS on the overlapping sample (N=46; p=.077), and which is the same, whether using OLS separately on each DV ([3] in Table 3.7), or using OLS-based SUR simultaneously on both DVs ([4]).

Predominantly—but with one exception—the IV results across the four model pairs are quite consistent, with the coefficient significances, signs and approximate values robust to: switching from Tobit to OLS regression ([1] vs. [2]); sample difference between the two independent samples and the overlapping sample ([2] vs. [3]); and modeling the two DVs independently versus simultaneously through SUR ([3] vs. [4]). The bank assets boom IV in the duration model provides the exception, showing a notable drop in significance and coefficient magnitude resulting from sample difference ([2] vs. [3]), but with some "recovery" in both significance and magnitude when then switching to SUR ([4]). These observations appear consistent with the relationship already noted between the credit boom and bank assets boom IVs (which are correlated at R=.86 on the overlapping sample), with the overall boom and bust process affecting both contraction depth and duration, but apparently mediated somewhat differently.

While the details underpinning that intertwined relationship remain hypothetical here—and which would be well-served by further analysis—the main results of this chapter are robust to the alternate use of SUR. In particular: the Breusch-Pagan test only mildly indicates dependence between the DVs ($.1 > p_{BP} > .05$); most coefficient estimates are robust to the use of SUR; and the mild non-robustness of bank assets boom results is more attributable to sample difference than to switching to SUR. Further, and as already noted, the central result of this chapter, namely the explaining-away of the LMIC-differences observed with the raw depth and duration DVs, largely holds for the duration DV even if the bank assets boom IV is excluded from the model (model [3] in Table 3B.8). As such, the main results reported for the Tobit regressions, providing perhaps slightly biased coefficients, are retained as the central results.

3.5.6 Policy Implications

Given the limited theoretical understanding of the causal mechanisms underlying the specific correlational relationships identified in these results, any conclusions regarding policy prescriptions must at this time be regarded as tentative. Nevertheless, it seems clear that these results support the view that countries should seek to manage rapid credit expansion and the related expansion in bank assets, for example through the use of monetary policy and/or financial regulation. In a simple narrative consistent with the results obtained, countries with more expansive monetary policy and permissive regulation during the boom-period experienced greater credit booms at banks and OFIs. With those loans then generally re-deposited at banks or OFIs—presumably mostly within the domestic financial system—even further lending is possible, with the money multiplier process directly linking credit expansion to deposits expansion, and to bank assets expansion (subject to reserve requirements, other financial regulations, and perhaps other influences). Yet cross-country variation exists in the relationship between the expansions in bank and OFI credit and in bank assets—and thus in their different roles influencing contraction depth and duration—variation that may be policy tractable. Assuming the credit boom is primary (i.e., largely drives the bank assets boom), reducing the expansion of credit through monetary policy or interrupting the classical money multiplier process (for example by increasing reserve or equity requirements) would be expected to help reduce both the depth and duration of contractions resulting from the future "bust" of the credit boom. However, deeper understanding of the actual causal mechanisms underlying each relationship—between the bank and OFI credit boom and contraction depth, and between the bank assets boom and contraction duration—can help ensure that no hidden trade-offs exist between the two, and perhaps clarify the relative policy-influence of using monetary policy, specific regulatory approaches, or other options, to manage credit booms. Further, examining the relationship between bank assets boom and contraction duration—and recognizing it as at least somewhat distinct from the relationship between credit boom and contraction depth—may provide insight about shortening the duration of crisis induced contraction via policies reducing the (presumedly credit-boom-induced) expansion in bank assets.[73]

Fiscally, countries with greater boom-period expansions in government spending

[73] Future research could also consider whether particular forms of bank assets were more relevant during this crisis, including the greater accumulation of mortgage-backed securities and their more-complex derivatives, and contrasting the traditional originate-to-hold and newer originate-to-distribute models. If the bank assets boom result is largely driven by the hold-distribute difference, then regulation could require banks "hold" a non-trivial portion of the securities and derivatives that they originate.

had shallower (but not shorter or longer) crises. This result is consistent with the view of fiscal stimulus as strong-but-slow, providing a relatively high multiplier but with a lag in effect. One possible narrative here is that governments that “just happened” to expand spending in the period leading up to the crisis experienced benefits when the crisis occurred. Another has governments increasing expenditures as a result of either the greater availability of credit (globally), or due to the boom-period increase in output and thus the tax base, but with the lagged stimulative effect “just happening” to take effect as the crisis struck. A third less-likely possibility involves countries anticipating the onset of the crisis—or at least of a domestic recession—and undertaking proactive stimulus in the face of an expected contraction. The perceived unlikeliness of this last possibility highlights the intuitive limits of using fiscal policy proactively, as it would require accurate forecasting of crisis or recession onset, which is not currently a credible possibility.

The overall empirical result for the government expenditures boom IV is, however, in tension with the more standard countercyclical prescription for fiscal policy, with stimulus recommended during the slump and austerity during the expansion. Because of the apparent lagged effect—including due to the slow legislative process required to enact spending and due to subsequent implementation processes—fiscal stimulus will generally not provide a quick response in times of crisis. Such a quick response is better provided by monetary policy, highlighting the desirability of using the expansion phase to reconsolidate monetary space, tightening monetary policy both to reduce overexpansion in credit (“leaning against the wind”) and to move the monetary policy interest rate away from the zero lower bound. In the Keynesian view, large fiscal stimulus is required primarily to "jump start" a depressed and not merely sluggish economy facing dramatically reduced domestic demand, and not to manage shorter-term economic cycles, a job better left to monetary policy. Yet the government expenditures boom result obtained here raises the question of whether some fiscal expansion during the output expansion phase can deliberately help offset later contractions, whether due to crisis or more normal business cycle fluctuations. Deeper understanding of the causal mechanisms actually underpinning the empirical result may help answer this question.

The trade linkage results also require deeper understanding before any clear policy recommendations can be made. At first blush, it seems quite unlikely that countries would attempt to manipulate the fundamental composition of their exports structure simply to avoid the effects of relatively rare crises. Yet policy choices affecting the composition of trade at the margin, or which could influence the changing composition of trade, particularly during global booms, might be more realistic. For example, choosing against policies that further expand the production of booming classes of exported goods—such as oil and other food, fuels and mining (FFM) products, during the pre-GFC boom—seem a wise policy decision from a long-term perspective, though short-term political-economic forces driving the boom may be difficult to counter. A closer look is also necessary, at the relationship between the credit boom itself and the corresponding booms in FFM prices and exports, considering whether these vulnerabilities are: (a) all fundamentally related—for example, with the credit boom driving the FFM boom, through expansion in commodities prices and the corresponding expansion in investment into previously uncompetitive sources for these commodities; (b) somewhat more distinct processes that “just happened” to create problems around the same time; or (c) were unrelated (or even related) vulnerabilities that were “triggered” more-or-less simultaneously. If they are related, then policies focused on restraining the credit boom may be sufficient to constrain such expansion. If they are related, then policies focused on restraining the credit boom may be sufficient to constrain such expansion.

Regarding international financial linkages, the tentative policy prescription from these results is to encourage greater international financing via longer-term investment. Greater reliance on FDI appears to support the simultaneous goals of reducing contraction depths in the source countries (due to increased accumulation of FDI assets), and reducing contraction durations in recipient countries (due to reduced reliance on debt liabilities). Yet, additional analysis is still needed to consider whether it is something about the specific FDI actually accumulated during the pre-GFC boom-period that promoted shallower contractions. Additionally, these during-crisis benefits may face trade-offs related to the utility of shorter- versus longer-term investment during non-crisis periods. Nevertheless, while the general benefits of allocative efficiency from the (relatively) free flow of capital are of concern, such efficiency may be questionable in the euphoric context of a global credit bubble, as during the pre-GFC boom-period.

In each of these cases trade-offs will exist, for example between policy goals focused on mitigating the effects of relatively rare financial crises, and those focused on promoting positive economic objectives (e.g., faster growth) during "normal times". The choice of exchange rate regime is a prime example, with fixed regimes providing forms of stability—and indeed competitive advantage—during non-crisis periods, but with the results here showing that more-flexible regimes experienced shallower contractions during the crisis. This outcome is consistent with the theoretical expectation that flexible exchange rates act as "shock absorbers" relative to less flexible rates, reducing the effect that shocks to external demand place on domestic output. Policy recommendations concerning exchange rate regime would then need to be made with an eye toward balancing the expected benefits of currency stability during normal times, and worse output effects in the face of demand shocks. Further, fixed regimes—especially, but not exclusively—need to consider the potential for speculative attacks and potential currency crises, though few countries appear to have experienced those forms of crisis during the GFC, possibly due to adequate accumulation of foreign exchange reserves since the Asian financial crisis (1997–1998). As such, blanket policy recommendations based on specific empirical results are simply not wise. Rather, these results should be used to inform more-detailed policy analyses, considering the trade-offs inherent between particular policy goals, set within a larger policy strategy.

Finally, it should be explicitly noted that drawing policy recommendations from these results assumes that similar mechanisms and situations will be at play in future crisis, as during the GFC—that is, that the GFC provides a representative case in the larger set of crises. As shown by Rose and Spiegel (2011), their results for the GFC-related output contraction do not apply identically to the contractions of 1991–1992 and 2001–2002. Deeper understanding of the casual mechanisms at play is needed not only to help clarify policy recommendations in relation to “GFC-like” situations, but also understand the uniqueness of the GFC and whether, how and when any of the underlying causal mechanisms and subsequent policy implications apply more generally.

3.6 Conclusion

This chapter undertakes a thorough model search, identifying IVs representing countries’ pre-crisis characteristics and conditions that credibly explain much of the cross-country variation in the peak-to-trough depth and duration of the output contractions associated with the Global Financial Crisis. The search process was designed to address methodological issues present in the existing differential impact literature, including the potential for extraneous IVs to confound results, and the potential for the identification of false positives and the overlooking of false negatives, each potentially resulting from outlier influence or contingent significances. Omitted variable bias was also reduced by including as many IVs considered in the differential impact literature as possible—restricted primarily by data availability—and adding additional related variables. Further, in addition to IVs measuring the pre-crisis level of economic indicators, IVs representing the boom-period change (CAGR 2003–2007) in indicators were also tested, adding to the few such variables considered in the literature.

The resulting models (summarized in Table 3.8) show countries to be vulnerable to

Table 3.8. Summary of Results

<table>
<tr><th colspan="2">IV Category</th><th>Depth Model
(+: higher value
→ deeper contraction)</th><th>Duration Model
(+: higher value
→ longer contraction)</th></tr>
<tr><td rowspan="2">Domestic Situation</td><td>Financial</td><td>+ Bank and OFI Credit Boom
(2003–2007 CAGR in %GDP)</td><td>+ Bank Assets Boom
(2003–2007 CAGR in %GDP)</td></tr>
<tr><td>Fiscal</td><td>− Government Expenditures Boom
(2003–2007 CAGR in ratio-to-GDP)</td><td></td></tr>
<tr><td rowspan="4">International Linkages</td><td rowspan="2">Trade</td><td>+ Manufacturing Exports
(logged 2007 %GDP)</td><td></td></tr>
<tr><td>+ FFM Exports Boom
(2003–2007 CAGR in share of exports)</td><td></td></tr>
<tr><td>Financial</td><td>− FDI Assets Boom
(2003–2007 CAGR in %GDP)</td><td>+ Foreign Debt Liabilities
(logged 2007 %GDP)</td></tr>
<tr><td>Exchange Rate</td><td>− Flexible Exchange Rate Regime
(binary dummy)</td><td></td></tr>
</table>

both domestic economic conditions and to international trade and financial linkages: larger domestic credit booms, higher levels of manufacturing exports, and greater boom-period shifts in exports composition towards more food, fuels and mining products each correspond with deeper contractions; meanwhile, larger booms in bank assets and higher amounts of debt owed to foreign lenders correspond with longer contractions. Sources of resilience were also identified, with greater boom-period increases in government expenditures and accumulations of FDI interests abroad both corresponding to shallower contractions, which were also observed for countries with flexible exchange rate regimes.

These models each largely explain the income relationship described as the "AE Nature" of the crisis, observed in the existing differential impact literature as significant and positive relationships between income (logged per capita GDP) and various measures of GFC impact on output, but better characterized (as seen in Chapter 2) as an "LMIC difference". The depth model also explains well the deeper contractions experienced by countries in emerging Europe, though six “peripheral” European countries—Ukraine, the Baltics, and Hungary, as well as Iceland (not typically identified as “emerging European”)—experienced much deeper contractions than predicted by the model. While the explanatory factors identified reflect credible theoretical relationships, future research would help better understand the causal mechanisms underlying these correlational relationships, and to further examine the (few) countries poorly-explained by the models obtained here—the latter of which will be pursued via case studies in the next chapter.

Appendix 3A: Data Sources and Independent Variables

Data Sources

- **BIS:** Bank for International Settlements *WebStats* database
- **Claessens and van Horen**'s (2012) *Foreign Bank Ownership* (FBO) dataset
- **DOTS:** IMF Direction of Trade Statistics database
- **EFW:** The Fraser Institute's *Economic Freedom of the World* ratings (2012)
- **EWN:** Lane and Milesi-Ferretti's *External Wealth of Nations, Mark II* dataset (2009 update)
- **FDS:** Beck et al.'s *Financial Development and Structure* dataset (July 2017 revision)[74]
- **Freedom House** (2016)
- **GFD:** Global Financial Development database (World Bank)
- **IFS:** IMF International Financial Statistics database
- **IMF's De Facto Classification of Exchange Rate Regimes and Monetary Policy Frameworks** (April 2008)
- **JEDH:** Joint External Debt Hub database (BIS, IMF, OECD, World Bank)
- **MTC:** WTO *Merchandise Trade by Commodities* database
- **Polity IV:** 2014 update (p4v2014)
- **Reinhart and Rogoff's Exchange Rate Regime classifications (2003, 2008)**
- **TCS:** WTO Trade in Commercial Services database
- **TMT:** WTO *Total Merchandise Trade* database
- **UNCTAD:** *UNCTADStat* database (re trade concentration and diversification)
- **WDI:** World Bank *World Development Indicators* database
- **WEO:** IMF World Economic Outlook (April 2012)
- **WGI:** World Bank *Worldwide Governance Indicators* dataset (2012 update)

[74] Note that offshore bank deposits data in the April 2013 revision of the FDS dataset was problematic: it does not correlate well with the same variable taken from the previous two revisions (November 2010, September 2012), or the subsequent two (November 2013, July 2017).

Independent Variables

The following list outlines the IVs considered in this Chapter, which were tested in 2007 level form (per cent of GDP unless otherwise specified) and—in most cases—also in 2007 logged-level and 2003–2007 boom growth forms.[75]

- **Income-Related:** ***Income*** (log[GDP/c], IFS), and binary dummy variables for the World Bank income classification (***LMIC***, ***UMIC***, ***HIC***) and for the "development" classification (***AE***, ***EME***, ***DE***) from Chapter 2.
  - ***Population***, ***GDP*** and ***GDP per capita*** (IFS), also tested in linear and logged forms.
- **Pre-GFC Output Dynamics:** (calculated from WEO and IFS data)
  - ***Boom Growth*** (2003–2007) and ***Trend Growth*** (1990–2007 & 1990–2002 versions).
  - ***Output Correlation:*** Pearson correlation coefficient (R) between (HP-filtered) cyclical components of country and rest-of-world real GDP (2005=100, quarterly, s.a.), over 1990–2007 (or as data allow).
  - ***Output Volatility:*** standard deviation of (HP-filtered) cyclical component of the country's real GDP (2005=100, quarterly, s.a.) over 1990–2007 (as data permit).[76]
- **Basic Trade:** (WDI) ***Current Account***, ***Exports***, ***Imports***, ***Net Exports***, and ***Total Trade***.
- **Trade Composition:** (WDI, TMT and MTC) trade flows by service or type of good traded:
  - Types: goods, services, merchandise, manufacturing (WDI); Merchandise (TMC), divided into (MTC): agricultural (subdivided into food and non-food); fuels and mining products (FMP); manufacturing; and other merchandise; plus, a combined

[75] Growth over the 2003-2007 boom period in IV "X" is calculated as the cumulative average growth rate (CAGR) over those years: $(X_{2007}/X_{2002} - 1)^{1/5}$. Other 'growth' IVs are calculated over different periods in a corresponding fashion, for example, including trend GDP growth over 1990-2007 or 1990-2002.

[76] Two alternate Output Volatility IVs were also considered, due to unclear definitions in Ólafsson and Pétursson, but none showed robust significance. *Output Volatility 2:* standard deviation of the ratio between country's (HP-filtered) cyclical and trend components of Real GDP (2005=100, quarterly, s.a.) over 1990–2007 (as data allow); *Output Volatility 3:* standard deviation of (HP-filtered) cyclical component of Real GDP (constant 2005 international dollars, PPP, quarterly, s.a.) over 1990–2007 (as data allow).

food, fuels and mining (FFM) group.

- Flows: imports, exports, net exports (X−M), and total trade (X+M).
- Scalings: as per cent of GDP, and as share of total corresponding flow type (e.g., food exports as share of total exports).

- **Trade Partners:** (IMF DOTS) Measures of bilateral trade with major economies:
  - Partners: World (≈basic trade), United States (US), China (CN), Japan (JP), Germany (DE), European Union (EU), Euro Area (EA), and Advanced Economies (AEs).
  - Flows: exports, imports, net exports, and total trade.
  - Scalings: as per cent of GDP, and as a share of the world total for the corresponding flow type (e.g., exports to Japan as a share of total exports to the world).
- **Advanced Trade: (UNCTAD)**
  - ***Trade Diversification***: A modified Finger-Kreinin measure (0.0–1.0) of similarity in trade, measuring the absolute deviation of the trade structure of a country from world structure, with higher values indicating greater divergence from the world pattern.
  - ***Trade Concentration*****:** The Herfindahl-Hirschmann Index, ranging from 0 to 1, with higher values indicating that trade is more concentrated on a few products, and lower values reflecting "trade more homogenously distributed among a series of products".
- **Oil:** ***Exports***, ***Imports***, and ***Net Exports***, as per cent of GDP (WEO); and ***Oil Rents*** (WDI).[77]
- **International Financial Flows:** (EWN) total flows and by asset type, with various scalings:
  - Total Flows: financial assets (FA; outward flows); financial liabilities (FL; inward flows); net financial assets (NFA=FA-FL; net outward flows); total financial assets and liabilities (FA+FL; "Financial Openness").
  - Flows by Asset Type: (each as assets, liabilities, net assets, and total flows) foreign

[77] The Oil Rents indicator (from the WDI, and used by Berglöf et al. 2009) faced data paucity limitations, but is fairly well correlated with Oil Net Exports (R=.88) and Oil Exports (R=.85) on this Chapter's full sample.

direct investment (FDI); portfolio equity; debt; derivatives (but facing severe data paucity problems); foreign exchange reserves (FXR).

  - <u>Scaling:</u> all are first scaled as per cent of GDP; Asset type flows (other than FXR) are also scaled to the corresponding total flow type (e.g., FDI liabilities to total financial liabilities);[78] FXR are scaled as percentages of GDP, FA, FL and NFA.

- **<u>Domestic Financial System:</u>** (FDS) (including some international-related items)
  - ***Assets:*** of the central bank, of banks (formally regulated "deposit taking banks"), or of banks and OFIs.
  - ***Credit:*** credit to the domestic private sector (from banks, or banks and OFIs).
  - ***Deposits*** (total at banks, or banks and OFIs).
  - ***Leverage:*** ratio of credit-to-deposits (for banks, or banks and OFIs).
  - ***Liquid Liabilities:*** M3 monetary aggregate (as per cent of GDP, or in 2000 USD).
  - ***Bank Concentration, 3-Bank:*** assets of 3 largest banks, as a share of assets of all commercial banks.
    - ***5-Bank Concentration*** (from GFD) was also tested.
  - <u>Other Domestic Banking System Measures:</u> ***Overhead***, ***Return-on-Assets***, ***Return-on-Equity***, ***Cost-to-Income*** ratio, ***Z-score***.
  - <u>Stock Market Measures:</u> ***Capitalization*** and ***Total Value Traded*** (as per cent of GDP), plus ***Turnover***, and ***Listings per 100k Population***.
  - <u>Bond Market Measures:</u> ***Capitalizations*** (for public and private bond markets).
  - <u>Insurance Sector Measures:</u> ***Premium Volumes*** (for life and non-life insurance).
  - <u>International-Related Measures:</u>

[78] However, various shares of net assets in total net foreign assets (e.g., net FDI assets as share of total net foreign assets) are not particularly meaningful, with negative values possible in both the numerator and denominator, such that interpretation of any coefficient values would be difficult.

    - ***International Debt Securities*** (amount outstanding and net issuances);
    - ***Loans From Non-Resident Banks*** (to domestic non-banks);
    - ***Offshore Bank Deposits*** (from domestic non-banks to non-resident banks);
    - ***Net Remittance Flows.***

- **Short Term International Debt Securities:** (JEDH) Debt owed in the form of short-term international debt securities (total, and divided into bank or non-bank issued securities).
- **Foreign Banks:**
  - ***Foreign Bank Ownership (FBO):*** (Claessens and van Horen 2012)
    - ***FBO, by Number:*** share of foreign-owned banks among total banks;
    - ***FBO, by Assets:*** share of foreign bank assets among total bank assets.
  - ***Inward Foreign Bank Claims*:** (calculated from BIS data, following Llaudes, Salman, and Chivakul 2010) consolidated 2007 Q4 stock of claims by foreign BIS-reporting banks on the domestic economy, on immediate borrower basis (as per cent of 2007 GDP; log and boom forms also tested).
  - ***Outward Foreign Bank Claims*:** (from BIS data, following Claessens et al. 2010) consolidated 2007 Q4 stock of claims by domestic BIS-reporting banks on non-residents, on immediate borrower basis (as per cent of 2007 GDP; log and boom forms also tested).
- **Government Finances:** (WEO)
  - General Government ***Total Expenditures*** and ***Gross Debt***.
  - General Government ***Net Debt*** and ***Structural Balance*** were also tested, but faced data paucity issues (with N=49 and 53 respectively).
- **World Bank Indebtedness Categories:** (WDI) binary dummy IVs for ***Severely***, ***Moderately***, and ***Less*** indebted countries, and for those ***Not Classified*** (typically higher income countries).
- **Inflation:** (WDI) Consumer Price Index ***Inflation Rate.***

- **<u>Exchange Rate Regime (XRR) and Monetary Policy:</u>** binary dummy variables for:
    - Reinhart and Rogoff's "***Coarse***" classification (peg, crawl, intermediate, float)
    - Reinhart and Rogoff's "***IMF Coarse***" classification (peg, crawl, intermediate, float)[79]
    - The IMF's **De Facto** Classification of XRRs and Monetary Policy Frameworks: XRRs (peg, intermediate, float); XR Anchor (U.S. dollar; euro; composite; other); Monetary Policy Target (Monetary aggregate, inflation, or "other")[80]
- **<u>Exchange Rate Outcomes:</u>** ***REER (or NEER) Variability:*** standard deviation of monthly changes in nominal or real effective exchange rates in 1994–2007 (from BIS data).[81]
- **<u>Economic Freedom of the World (*EFW*) database:</u>**
    - All 55 ratings and composites in the *EFW* dataset were tested as 2007 level IVs only.
- **<u>Worldwide Governance Indicators:</u>** all 6 WGIs were included individually: ***Control of Corruption***, ***Government Effectiveness***, ***Political Stability and Absence of Violence***, ***Regulatory Quality***, ***Rule of Law***, and ***Voice and Accountability***.
- **<u>Polity IV:</u>** ***Polity***, ***Democracy***, ***Autocracy***, and ***Executive Constraints***
- **<u>Freedom House:</u>** ***Civil Liberty*** and ***Political Rights*** ratings
    - <u>Freedom Status:</u> ***Free***, ***Partly Free***, ***Not Free*** (binary dummy variables based on ranges of values for the sum of the civil liberty and political rights ratings).

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[79] Data for Reinhart and Rogoff "coarse" and "IMF coarse" IVs were downloaded as Excel files from their website (accessed 2016–04–06, but no longer available). Those files each indicate "Dataset for Ilzetzki, Reinhart and Rogoff (2008)", but which has not been located and is presumed to be unpublished. The files are updates to the data from Reinhart and Rogoff (2004), more recently updated in Ilzetzki, Reinhart, and Rogoff (2019). No countries in this chapter's sample were classified by Reinhart and Rogoff as "freely falling" or having a "dual market in which parallel market data is missing".

[80] A rough "monetary policy interest rate" measure was also created, combining (potentially incommensurable) interest rates related to monetary policy, and hoping to represent the central Bank's room for Monetary Response. This IV showed no significance.

[81] Ólafsson and Pétursson's (2010) XR variability IV uses quarterly (rather than monthly) changes in the NEER; it is unclear why they did not also consider REER variability. They also tested an "XR noise" IV (measure of the standard deviation of the exchange rate risk premium), but which was not included in their preferred specifications, and has not been implemented here as the necessary data was not available.

Appendix 3B: Other Tables and Figures

Note: Figures 3B.1 through 3B.6, plus 3B.10 and 3B.11, plot the depth and duration models’ *DV partial residuals* for each model-IV against that IV, illustrating the contribution made to the model by each IV when controlling for the influence of other IVs.

If the linear (Tobit or OLS) regression model, with residual ε and predicted value ŷ, is:

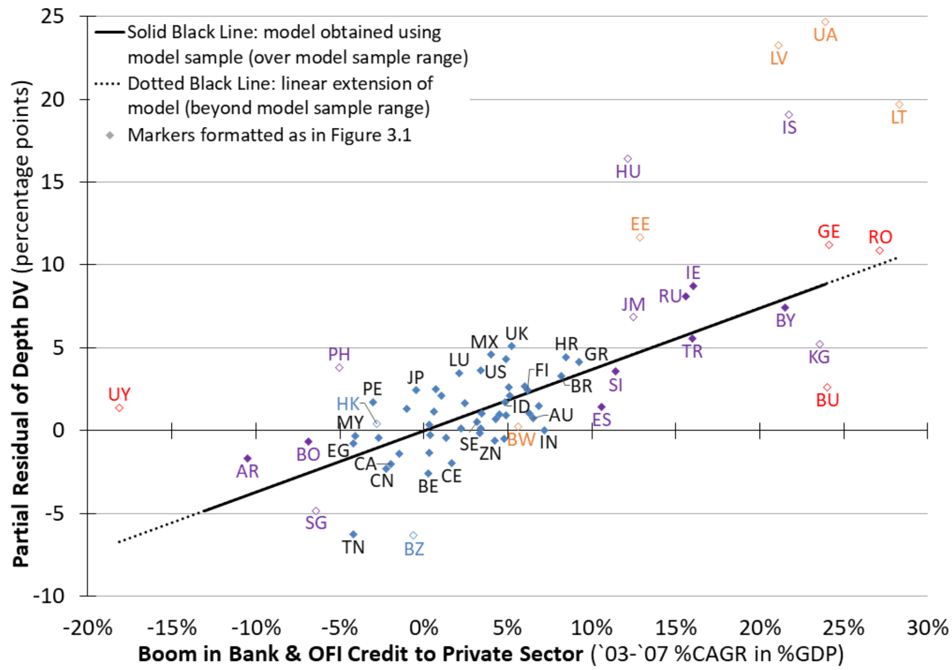
$$y = \hat{y} + \varepsilon = (b_0 + b_1 \cdot x_1 + \ldots + b_k \cdot x_k) + \varepsilon$$

Then the partial residual for the i^{th} IV (x_i) is:

$$\varepsilon^p{}_i = \varepsilon + b_i \cdot x_i$$

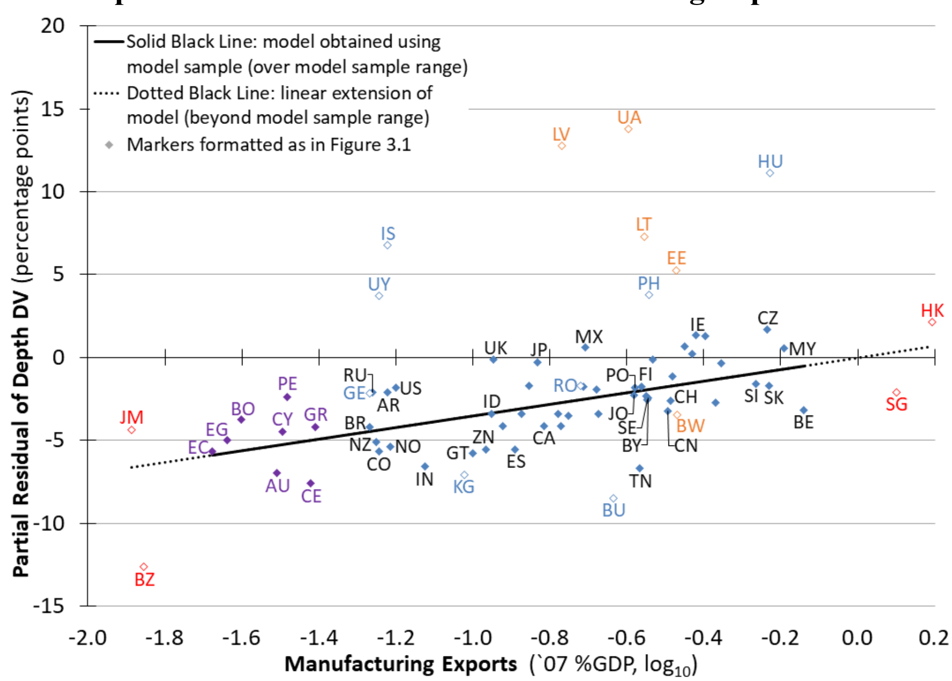
In contrast to plots of the (“regular”, “non-partial”, or “full”) DV residuals against each IV, the partial residual plots illustrate the specific contribution of the particular model-IV, and highlights how differently the poorly predicted cases behaved, relative to the expected effect from particular IVs.

Figure 3B.1. Depth DV Partial Residual vs. Credit Boom



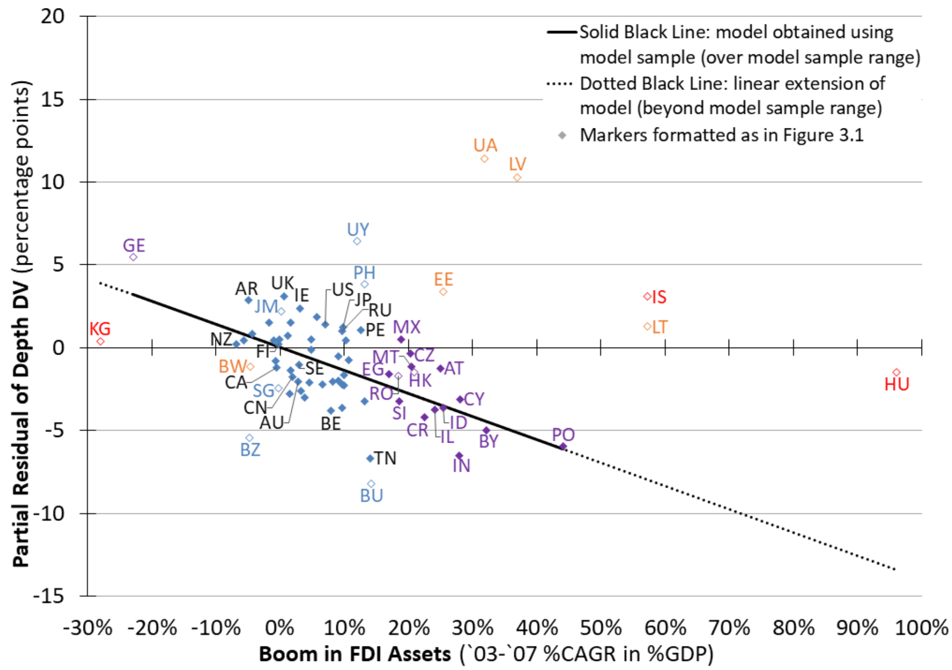
Source: IFS, FDS, author's calculations (see Appendix 3A).

Figure 3B.2. Depth DV Partial Residual vs. Manufacturing Exports



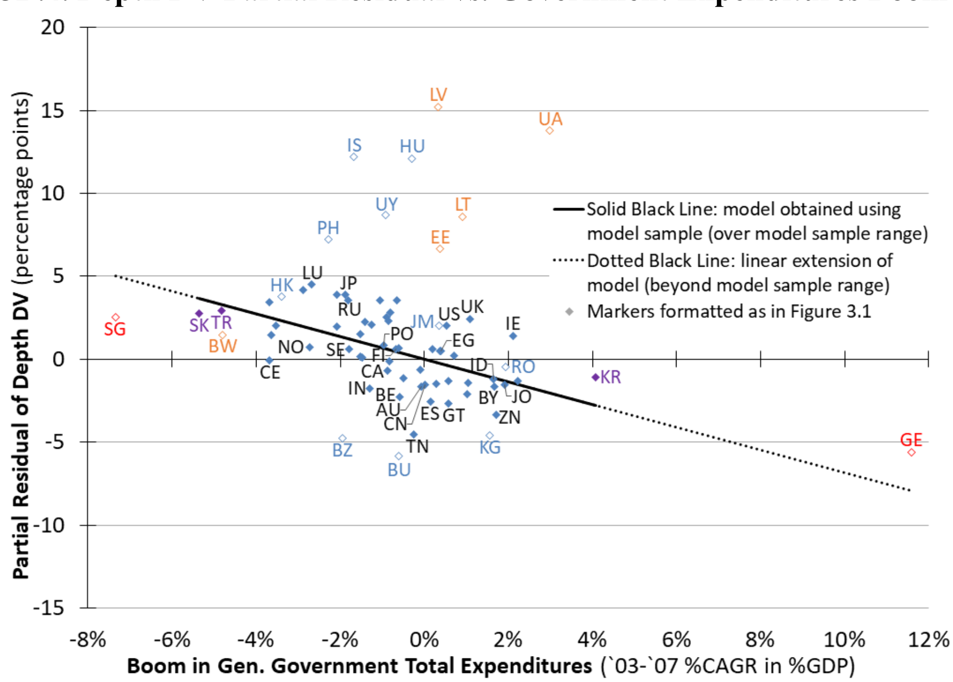
Source: IFS, MTC, author's calculations (see Appendix 3A).

Figure 3B.3. Depth DV Partial Residual vs. FDI Assets Boom



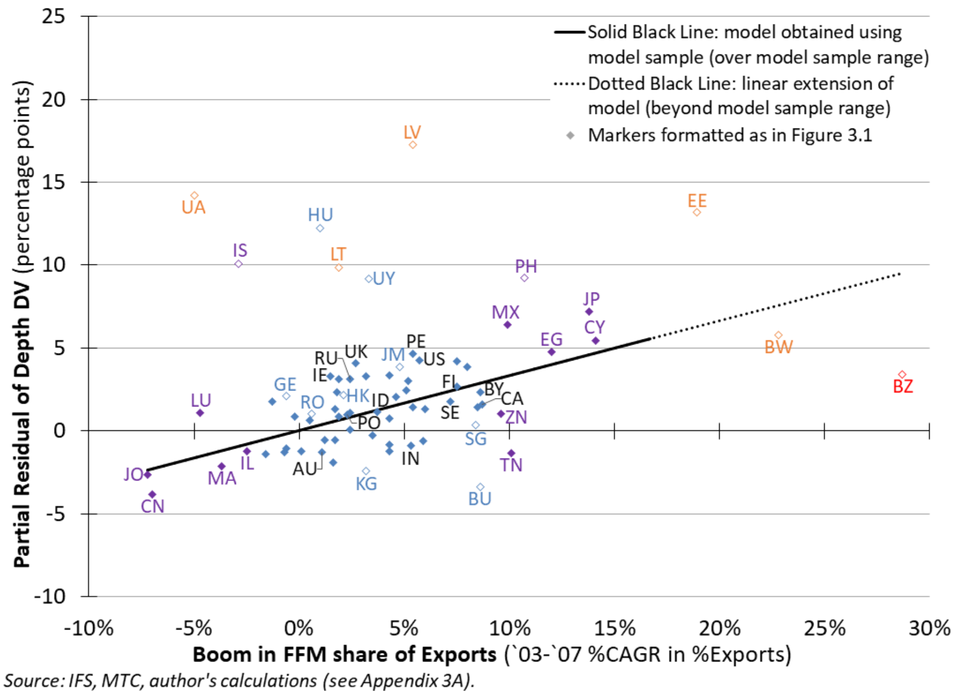
Source: IFS, EWN, author's calculations (see Appendix 3A).

Figure 3B.4. Depth DV Partial Residual vs. Government Expenditures Boom



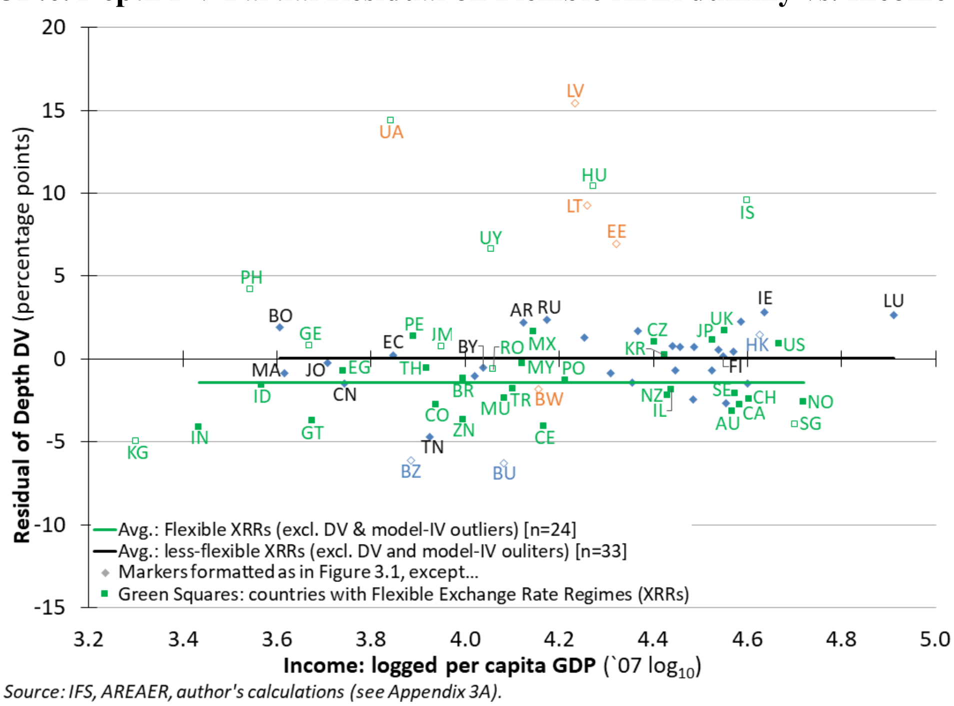
Source: IFS, WEO, author's calculations (see Appendix 3A).

Figure 3B.5. Depth DV Partial Residual vs. FFM Exports Boom



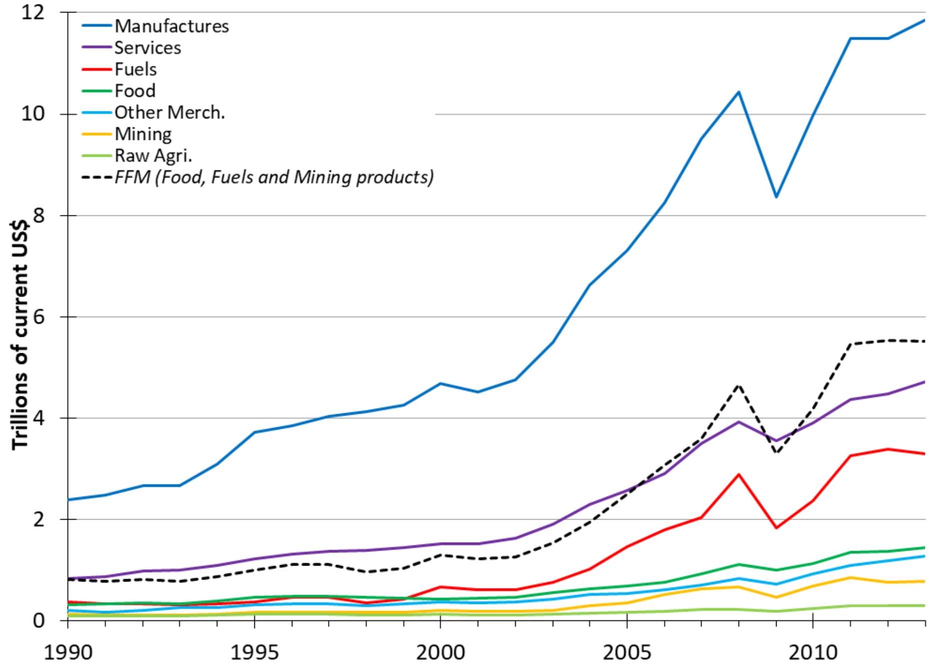
Source: IFS, MTC, author's calculations (see Appendix 3A).

Figure 3B.6. Depth DV Partial Residual on Flexible XRR dummy vs. Income



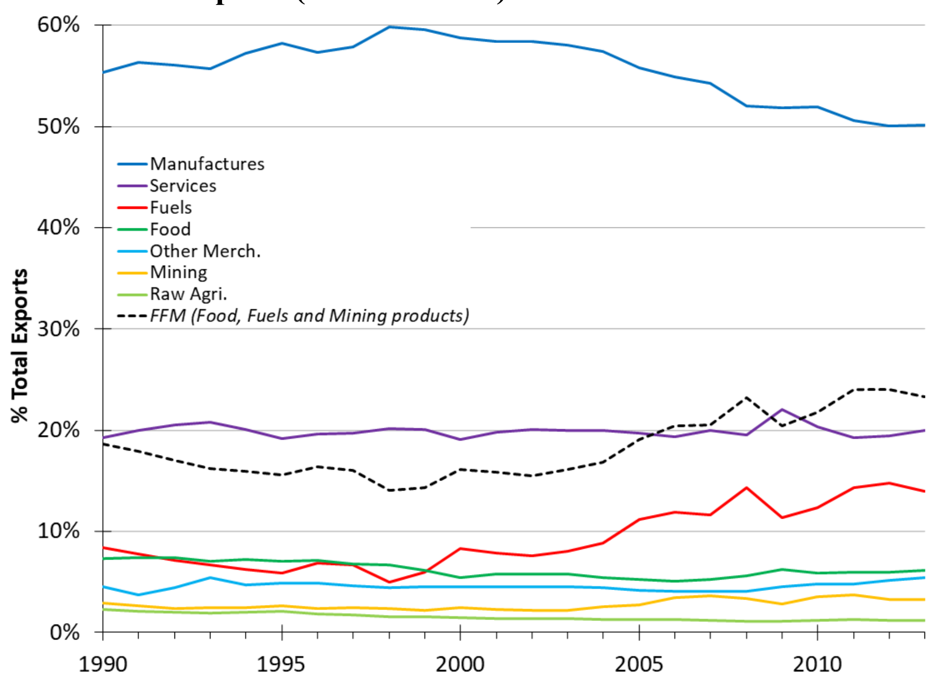
Source: IFS, AREAER, author's calculations (see Appendix 3A).

Figure 3B.7. Global Exports (USD)



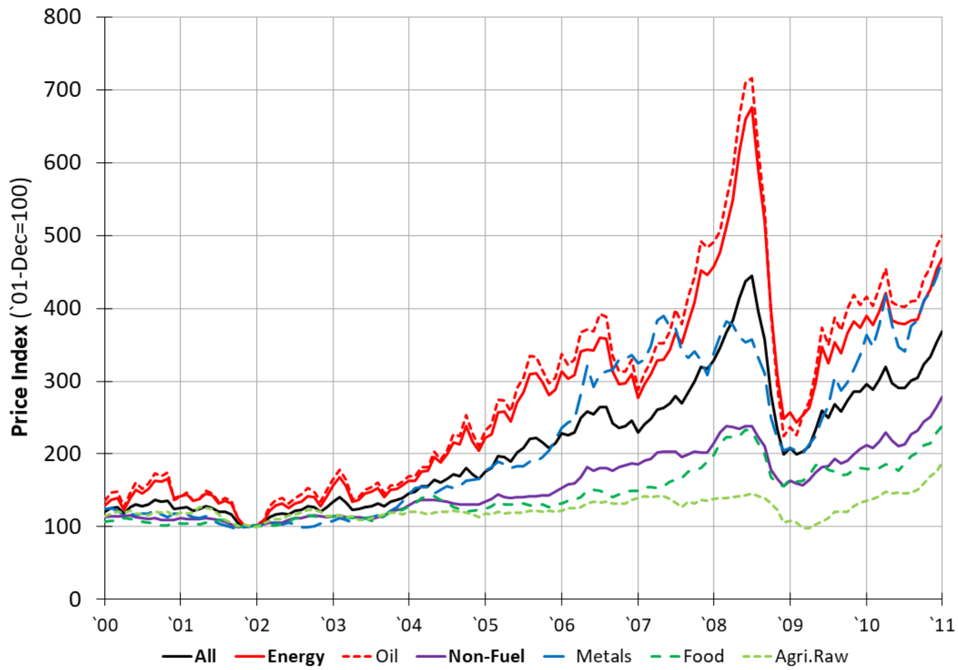
Source: MTS, TCS (see Appendix 3A).

Figure 3B.8. Global Exports (shares of total)



Source: MTS, TCS, author's calculations (see Appendix 3A).

Figure 3B.9. Global Commodities Price Indices



Source: IMF IFS, author's calculations.

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Table 3B.1. Contraction Depth-Income Relationship: LMIC Difference (expanded)

DV	**Contraction Depth**						**DV Residual from [3]**		
Regression Type	**Tobit**						**OLS**		
Sample	**Full Sample**	**Exclude obs. missing IV data**	**Excl. obs. missing IV data & DV outliers**	**Model Sample(a)**				**Reincl. IV outliers**	**Reincl. IV&DV outliers**
Model	**[1]**	**[1b]**	**[1c]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
LMIC dummy	**-4.7*****	**-4.7*****	**-4.7*****	**-5.4*****		**-1.7****	**-0.8**†	**-0.5**	**0.01**
	(.001)	(.001)	(<.001)	(<.001)		(.020)	(.159)	(.599)	(.991)
n_{LMIC}(b)	*17(c)*	*16(d)*	*15(e)*	*13(f)*		*13(f)*	*13(f)*	*15(e)*	*17(d)*
Credit Boom					**37.0*****	**33.2**			
					(<.001)	(<.001)			
Manufacturing Exports					**3.5*****	**3.0**			
					(<.001)	(<.001)			
FDI Assets Boom					**-13.9*****	**-12.6**			
					(<.001)	(<.001)			
Gov. Expend. Boom					**-68.5*****	**-58.2**			
					(<.001)	(<.001)			
FFM Exports Boom					**33.2*****	**28.0**			
					(<.001)	(<.001)			
Flexible XR dummy(g)					**-1.5*****	**-1.4**			
					(.007)	(.008)			
Constant	**7.2*****	**7.2*****	**6.3*****	**5.9*****	**6.7*****	**6.9*****	**0.3**	**0.5**	**1.0***
	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(.331)	(.208)	(.063)
N	76	72	67	55	55	55	55	67	72
Pseudo R^2	.026	.025	.057	.087	.248	.268			
Back Calc R^2	.117	.110	.232	.329	.748	.763			
OLS R^2	.117	.110	.232	.329	.748	.765	.037	.004	.000
OLS Adj.R^2	.105	.097	.220	.316	.716	.730	.019	-.011	-.014

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) **The Model Sample excludes observations that are:** (i) missing data on any model-IV; (ii) first round outliers on the depth DV; and/or (iii) first round outliers on any model-IV.

(b) **n_{LMIC} represents the numbers of countries in each sample that are LMICs.**

(c) **n_{LMIC}=17: all LMICs** = {BO, CN, CO, EC, EG, GE, GT, ID, IN, JO, MA, MK, PE, PH, TH, TN, UA}.

(d) **n_{LMIC}=16: LMICs not missing data on model-IVs** = [full 17] − {MK}.

(e) **n_{LMIC}=15: LMICs not missing data on model-IVs and not outliers on depth DV** = [full 17] − {MK; UA}.

(f) **n_{LMIC}=13: LMICs not missing data on model-IVs and not outliers on depth DV or any model-IV** = [the full 17] − {MK; UA; GE, PH} = {BO, CN, CO, EC, EG, GT, ID, IN, JO, MA, PE, TH, TN}.

(g) **$n_{XRR.Flex}$=28: number of countries in the model sample with Flexible XRRs** (for details see Table 3.2).

Table 3B.2. Contraction Depth-Income Relationship: log[GDP/c]

DV	**Contraction Depth**						**DV Residual from [3]**		
Regression Type	**Tobit**						**OLS**		
Sample	**Full Sample**	**Exclude obs. missing IV data**	**Excl. obs. missing IV data & DV outliers**	**Model Sample** (and further excluding the Income IV’s outlier)[(a)]				**Reincl. IV outliers**	**Reincl. IV&DV outliers**
Model	**[1]**	**[1b]**	**[1c]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
Income (log[GDP/c])	**3.4***** (.042)	**3.2*** (.065)	**3.4***** (.006)	**5.2***** (<.001)		**1.6*** (.055)	**0.89** (.222)	**1.22** (.235)	**0.78** (.565)
Credit Boom					**37.6***** (<.001)	**36.3***** (<.001)			
Manufacturing Exports					**3.3***** (<.001)	**2.9***** (<.001)			
FDI Assets Boom					**-12.6***** (<.001)	**-11.4***** (<.001)			
Gov. Expend. Boom					**-71.0***** (<.001)	**-67.1***** (<.001)			
FFM Exports Boom					**33.1***** (<.001)	**30.3***** (<.001)			
Flexible XR dummy[(b)]					**-1.4**** (.011)	**-1.3**** (.013)			
Constant	**-7.9** (.250)	**-7.2** (.320)	**-9.0*** (.082)	**-17.4***** (.004)	**6.38***** (<.001)	**-0.8** (.840)	**-3.6** (.240)	**-4.7** (.279)	**-2.2** (.696)
N	76	72	67	54	54	54	54	67	72
Pseudo R^2	.009	.008	.021	.048	.256	.269			
Back Calc R^2	.041	.035	.093	.208	.752	.765			
OLS R^2	.042	.035	.093	.208	.752	.765	.029	.022	.005
OLS Adj.R^2	.029	.021	.079	.193	.721	.730	.010	.007	-.009

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on any model-IV; (ii) first round outliers on the depth DV; and/or (iii) first round outliers on any model-IV. In this table, the samples for models [2] through [5] also exclude the single first round outlier on the Income IV (Kyrgyzstan).

(b) $n_{XRR.Flex}$=28: number of countries in the model sample with Flexible XRRs (for details see Table 3.2).

Table 3B.3. Combinations of Depth model-IVs with the LMIC dummy

DV	Contraction Depth						
Regression Type	Tobit						
Sample	Model Sample[(a)]						
Model	[1]	[2]	[3]	[4]	[5]	[6]	[7]
LMIC dummy[(b)]	**-5.4***** (<.001)	**-4.6***** (<.001)	**-4.8***** (<.001)	**-5.3***** (<.001)	**-5.2***** (<.001)	**-5.3***** (<.001)	**-5.4***** (<.001)
Credit Boom		**23.8***** (.001)					
Manufacturing Exports			**2.2**** (.036)				
FDI Assets Boom				**-6.6*** (.093)			
Government Expenditures Boom					**-27.3** (.230)		
Food, Fuels and Mining (FFM) Exports Boom						**4.7** (.620)	
Flexible Exchange Rate dummy[(c)]							**-1.2***** (<.001)
Constant	**5.9***** (<.001)	**4.9***** (<.001)	**7.6***** (<.001)	**6.5***** (<.001)	**5.7***** (<.001)	**5.7***** (<.001)	**6.5***** (<.001)
N	55	55	55	55	55	55	55
Pseudo R^2	.087	.126	.102	.096	.091	.087	.094
Back Calc R^2	.329	.454	.388	.359	.350	.335	.359
OLS R^2	.329	.454	.389	.359	.350	.336	.360
OLS Adj.R^2	.316	.433	.365	.334	.325	.311	.335

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on any model-IV; (ii) first round outliers on the depth DV; and/or (iii) first round outliers on any model-IV.

(b) n_{LMIC}=13: number of LMICs in the model sample (for details see Table 3.3).

(c) $n_{XRR.Flex}$=28: number of countries in the model sample with Flexible XRRs (for details see Table 3.2).

Table 3B.4. Depth model, plus LMIC dummy, with each model-IV removed

DV	Contraction Depth						
Regression Type	Tobit						
Sample	Model Sample[(a)]						
Model	[1]	[2]	[3]	[4]	[5]	[6]	[7]
LMIC dummy[(b)]	**-1.7**** (.020)	**-3.6***** (<.001)	**-2.8***** (.001)	**-2.6***** (.004)	**-2.6***** (.002)	**-2.9***** (.001)	**-1.9**** (.017)
Credit Boom	**33.2***** (<.001)		**31.6***** (<.001)	**28.9***** (<.001)	**28.8***** (<.001)	**30.4***** (<.001)	**33.3***** (<.001)
Manufacturing Exports***	**3.0***** (<.001)	**2.6***** (.008)		**2.2***** (.008)	**3.2***** (<.001)	**2.5***** (.003)	**3.3***** (<.001)
FDI Assets Boom	**-12.6***** (<.001)	**-9.5***** (.009)	**-10.2***** (.001)		**-12.7***** (<.001)	**-10.3***** (.001)	**-12.5***** (<.001)
Government Expenditures Boom	**-58.2***** (<.001)	**-31.4**† (.130)	**-64.1***** (.001)	**-57.3***** (.003)		**-41.4**** (.019)	**-52.0***** (.002)
Food, Fuels and Mining (FFM) Exports Boom	**28.0***** (<.001)	**20.4**** (.023)	**22.4***** (.003)	**20.6***** (.008)	**21.6***** (.003)		**24.4***** (.001)
Flexible Exchange Rate dummy[(c)]	**-1.4***** (.008)	**-1.4*** (.059)	**-1.7***** (.006)	**-1.3**** (.040)	**-1.1*** (.064)	**-0.9**† (.120)	
Constant	**6.9***** (<.001)	**8.3***** (<.001)	**4.8***** (<.001)	**5.6***** (<.001)	**7.9***** (<.001)	**7.4***** (<.001)	**6.6***** (<.001)
N	55	55	55	55	55	55	55
Pseudo R^2	.268	.145	.209	.195	.221	.211	.244
Back Calc R^2	.763	.527	.667	.646	.686	.651	.727
OLS R^2	.765	.530	.668	.648	.688	.652	.729
OLS Adj.R^2	.730	.471	.627	.604	.649	.609	.695

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on any model-IV; (ii) first round outliers on the depth DV; and/or (iii) first round outliers on any model-IV.

(b) n_{LMIC}=13: number of LMICs in the model sample (for details see Table 3.3).

(c) $n_{XRR.Flex}$=28: number of countries in the model sample with Flexible XRRs (for details see Table 3.2).

Table 3B.5. Contraction Depth-Income Relationship: Emerging Europe Difference (expanded)

DV	**Contraction Depth**							**DV Residual from [4]**		
Regression Type	**Tobit**							**OLS**		
Sample	**Full Sample**	**Exclude DV outliers**	**Excl. obs. missing IV data**	**Excl. obs. missing IV data & DV outliers**	**Model Sample**[(a)]				**Reincl. IV outliers**	**Reincl. IV&DV outliers**
Model	**[1]**	**[2]**	**[1b]**	**[2b]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**	**[8]**
Emerging Eur. dummy	**5.8*** **	**3.5*** **	**6.7*** **	**4.3*** **	**4.8*** **		**1.0**	**0.5**	**0.3**	**3.0*** **
	(<.001)	(.001)	(<.001)	(<.001)	(<.001)		(.290)	(.490)	(.733)	(.007)
n_{EmEur}[(b)]	*19*[(c)]	*15*[(d)]	*17*[(e)]	*13*[(f)]	*9*[(g)]		*9*[(g)]	*9*[(g)]	*13*[(f)]	*17*[(e)]
Credit Boom						**37.0*** **	**33.8*** **			
						(<.001)	(<.001)			
Manufacturing Exports						**3.5*** **	**3.4*** **			
						(<.001)	(<.001)			
FDI Assets Boom						**-13.9*** **	**-14.4*** **			
						(<.001)	(<.001)			
Gov. Expend. Boom						**-68.5*** **	**-61.0*** **			
						(<.001)	(<.001)			
FFM Exports Boom						**33.2*** **	**32.3*** **			
						(<.001)	(<.001)			
Flexible XR dummy[(g)]						**-1.5*** **	**-1.4*** **			
						(.007)	(.010)			
Constant	**4.8*** **	**4.6*** **	**4.6*** **	**4.5*** **	**4.0*** **	**6.7*** **	**6.6*** **	**0.01**	**0.4**	**0.3**
	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(.973)	(.377)	(.526)
N	76	71	72	67	55	55	55	55	67	72
Pseudo R^2	.048	.031	.062	.044	.045	.248	.252			
Back Calc R^2	.251	.154	.316	.217	.222	.748	.754			
OLS R^2	.251	.154	.316	.217	.222	.748	.754	.009	.002	.098
OLS Adj.R^2	.241	.142	.306	.205	.208	.716	.717	-.010	-.014	.085

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on any model-IV; (ii) first round outliers on the depth DV; and/or (iii) first round outliers on any model-IV.

(b) n_{EmEur} represents the numbers of Emerging European countries in each sample.

(c) n_{EmEur}=19: Emerging Europe = {BU, BY, CZ, EE, GE, HR, HU, KG, LT, LV, MK, PO, RO, RS, RU, SI, SK, TR, UA}.

(d) n_{EmEur}=15: Emerging Europe, but not outliers on the DV = [the full 19] − {EE, LT, LV, UA}

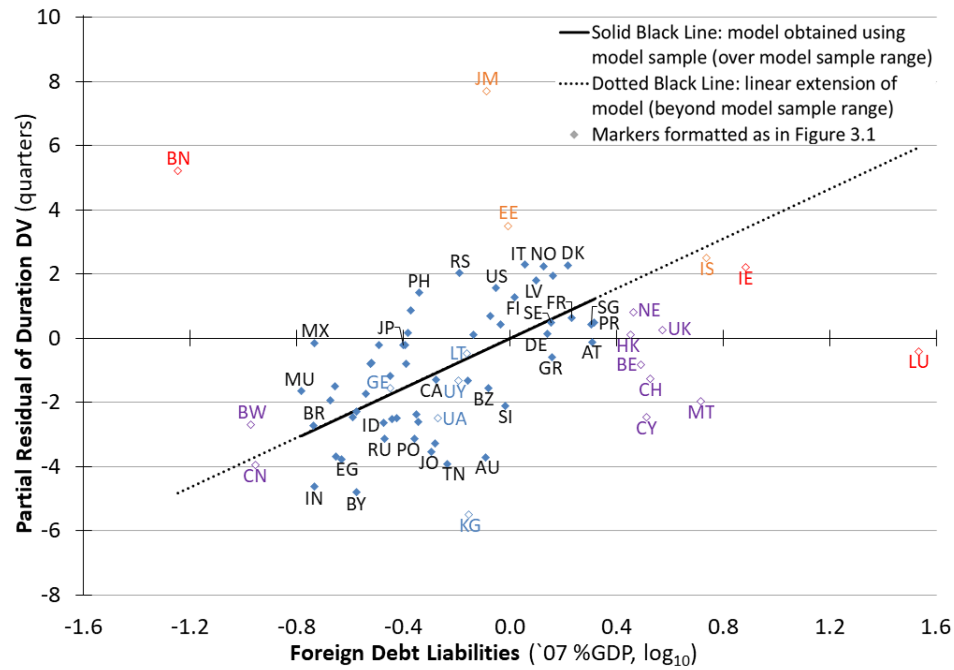
(e) n_{EmEur}=17: Emerging Europe, but not missing data on model-IVs = [full 19] − {MK, RS}.

(f) n_{EmEur}=13: Em. Eur., not missing model-IV data, not outl. on DV = [full 19] − {MK, RS; EE, LT, LV, UA}.

(g) n_{EmEur}=9: Emerging Europe, not missing data on model-IVs and not outliers on the DV or model-IVs = [the full 19] − {MK, RS; EE, LT, LV, UA; GE, HU, KG, RO} = {BU, BY, CZ, HR, PO, RU, SI, SK, TR}.

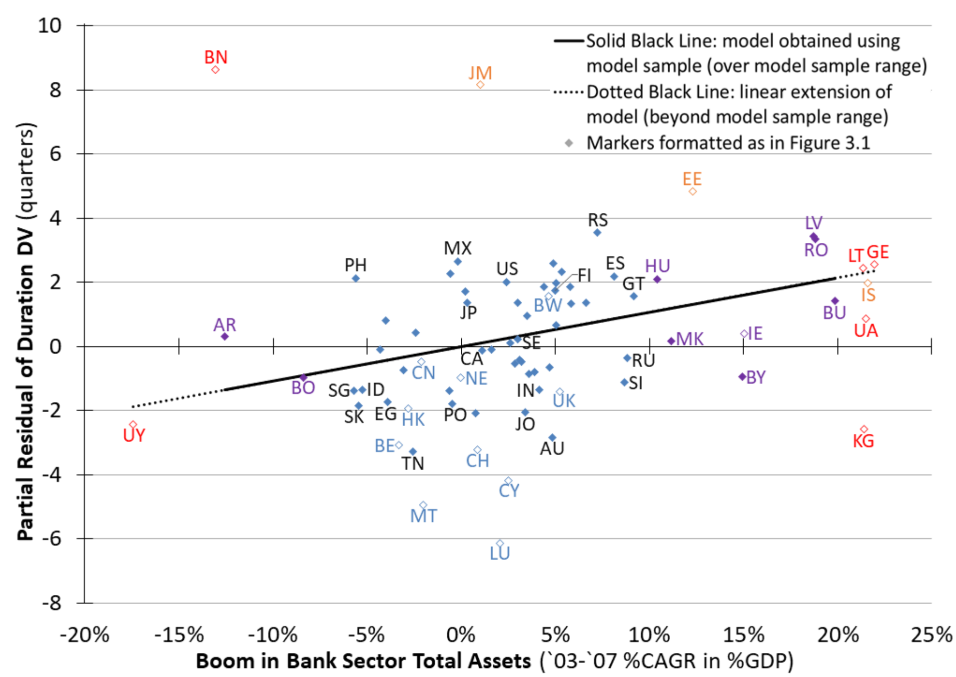
(h) $n_{XRR.Flex}$=28: number of countries in the model sample with Flexible XRRs (for details see Table 3.2).

Figure 3B.10. Duration DV Partial Residual vs. Foreign Debt Liabilities



Source: IFS, EWN, author's calculations (see Appendix 3A).

Figure 3B.11. Duration DV Partial Residual vs. Bank Assets Boom



Source: IFS, FDS, author's calculations (see Appendix 3A).

Table 3B.6. Contraction Duration-Income Relationship: LMIC Difference (expanded)

DV	Contraction Depth						DV Residual from [3]		
Regression Type	**Tobit**						**OLS**		
Sample	**Full Sample**	**Exclude obs. missing model IV data**	**Excl. obs. missing model-IV data & DV outliers**	**Model Sample**$^{(a)}$				**Reincl. IV outliers**	**Reincl. IV&DV outliers**
Model	**[1]**	**[1b]**	**[1c]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
LMIC dummy	**-2.4*****	**-2.5*****	**-2.1*****	**-2.3*****		**-0.8**†	**-0.4**	**-0.1**	**-0.3**
	(<.001)	(<.001)	(.001)	(.001)		(.150)	(.349)	(.931)	(.699)
$n_{LMIC}^{(b)}$	*17*$^{(c)}$	*17*$^{(c)}$	*17*$^{(c)}$	*14*$^{(d)}$		*14*$^{(d)}$	*14*$^{(d)}$	*17*$^{(c)}$	*17*$^{(c)}$
Foreign Debt Liabilities					**3.9*****	**3.4**			
					(<.001)	(<.001)			
Bank Assets Boom					**10.8*****	**9.6**			
					(.003)	(.008)			
Constant	**4.3*****	**4.3*****	**4.0*****	**4.0*****	**4.2*****	**4.3*****	**0.2**	**-0.3**	**-0.1**
	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)	(.517)	(.372)	(.836)
N	76	75	72	55	55	55	55	72	75
Pseudo R^2	.037	.037	.039	.053	.141	.150			
Back Calc R^2	.133	.133	.133	.184	.464	.478			
OLS R^2	.133	.133	.133	.184	.464	.479	.017	.000	.002
OLS Adj.R^2	.122	.122	.121	.169	.444	.448	-.002	-.014	-.012

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on either of the model-IVs; (ii) (first round) outliers on the duration DV; (iii) first round outliers on either model-IV; and/or (iv) iterated outliers on the foreign debt liabilities IV.

(b) n_{LMIC} represents the numbers of countries in each sample that are LMICs.

(c) n_{LMIC}=17: all LMICs = {BO, CN, CO, EC, EG, GE, GT, ID, IN, JO, MA, MK, PE, PH, TH, TN, UA}. (Note: no LMICs are missing data on model-IVs; no LMICs are duration DV outliers.)

(d) n_{LMIC}=14: LMICs that are not first-round outliers on either IV or iterated outliers on the foreign debt liabilities IV = [all 17 LMICs] − {GE, UK; CN}.

Table 3B.7. Contraction Duration-Income Relationship: log[GDP/c]

DV	**Contraction Depth**						**DV Residual from [3]**		
Regression Type	**Tobit**						**OLS**		
Sample	**Full Sample**	**Exclude obs. missing IV data**	**Excl. obs. missing IV data & DV outliers**	**Model Sample** (and further excluding the Income IV’s outlier)[(a)]				**Reincl. IV outliers**	**Reincl. IV&DV outliers**
Model	**[1]**	**[1b]**	**[1c]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
Income	**3.0*****	**3.0*****	**2.9*****	**2.7*****		**0.3**	**-0.1**	**0.0**	**-0.2**
(log[GDP/c])	(<.001)	(<.001)	(<.001)	(.002)		(.770)	(.871)	(.977)	(.801)
Foreign Debt					**3.6*****	**3.4*****			
Liabilities					(<.001)	(.001)			
Bank Assets					**11.0*****	**11.0*****			
Boom					(.002)	(.002)			
Constant	**-8.7*****	**-8.8*****	**-8.8*****	**-7.9****	**4.2*****	**3.0**	**0.5**	**-0.2**	**0.7**
	(.009)	(.009)	(.002)	(.027)	(<.001)	(.450)	(.850)	(.950)	(.831)
N	76	75	72	54	54	54	54	72	75
Pseudo R^2	.040	.041	.058	.044	.138	.138			
Back Calc R^2	.156	.157	.213	.168	.451	.451			
OLS R^2	.156	.157	.213	.168	.451	.451	.001	.000	.001
OLS Adj.R^2	.145	.145	.202	.152	.429	.418	-.019	-.014	-.013

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on either of the model-IVs; (ii) (first round) outliers on the duration DV; (iii) first round outliers on either model-IV; and/or (iv) iterated outliers on the foreign debt liabilities IV. In this table, the samples for models [2] through [5] also exclude the single outlier on the Income IV (Kyrgyzstan).

Table 3B.8. Combinations of Duration model-IVs with the LMIC dummy

DV	Contraction Duration				
Regression Type	Tobit				
Sample	Model Sample[(a)]				
Model	[1]	[2]	[3]	[4]	[5]
LMIC dummy[(b)]		**-2.3***** (.001)	**-1.2***** (.047)	**-1.9***** (.003)	**-0.8***** (.150)
Foreign Debt Liabilities	**3.9***** (<.001)		**3.5***** (<.001)		**3.4**† (<.001)
Bank Assets Boom	**10.8***** (.003)			**10.0**** (.018)	**9.6***** (.008)
Constant	**4.2***** (<.001)	**4.0***** (<.001)	**4.7***** (<.001)	**3.6***** (<.001)	**4.3***** (<.001)
N	55	55	55	55	55
Pseudo R^2	.141	.053	.120	.077	.150
Back Calc R^2	.464	.184	.400	.268	.478
OLS R^2	.464	.184	.400	.268	.479
OLS Adj.R^2	.444	.169	.377	.240	.448

p-value in parentheses; ***: p<.01; **: p<.05; *: p<.01; †: p<.2

(a) The Model Sample excludes observations that are: (i) missing data on either of the model-IVs; (ii) (first round) outliers on the duration DV; (iii) first round outliers on either model-IV; and/or (iv) iterated outliers on the foreign debt liabilities IV.

(b) n_{LMIC}=14: number of LMICs in the model sample (for details see Table 3.6).

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Chapter 4: Case Studies: Ukraine and Latvia as Deviant Cases

4.1 Introduction

This chapter undertakes case studies, seeking to explain why two "deviant cases" are poorly explained by the model of GFC contraction depth in Chapter 3. With the largest depth DV residuals from that model, Ukraine and Latvia are the "most deviant", and are compared—with selection process discussed below—with the relatively well-explained cases of Romania and Belarus respectively.[1] By undertaking comparative case studies, other differences between the case pairs are controlled-for, providing greater methodological "leverage" toward explaining the relevant differences between each pair.

This chapter thus moves beyond the dissertation's initial focus on the "Advanced Economies (AE) Nature" of the crisis, in part because the question of why richer countries appeared to have fared worse during the crisis is largely answered in Chapter 3. That chapter also explains a previously observed "emerging Europe difference", in which Emerging European countries experienced significantly deeper (though not longer) contractions. However, while the depth model explains the general emerging Europe difference observed in the model sample, several of the dependent variable (DV) or independent variable (IV) outliers excluded from that sample—including the cases being examined here—are in emerging Europe.

[1] Estonia and Lithuania are also considered, as less extreme deviant cases that also pair best with Belarus, though not as well as does Latvia.

The choice to focus on these cases was made primarily with regard to the broader interest in and political importance of those European "deviants", as well as the opportunity to increase generalizable knowledge based on these cases (e.g., in contrast to the duration DV deviants of Brunei and Jamaica).[2] The depth DV is itself also arguably more important and better-defined than the duration DV. As will be seen, periods of negligible growth or contraction starting before or extending after the GFC acute phase of contraction makes identification of the timing of the exact peaks and troughs—and thus contraction durations—somewhat ambiguous, but without greatly affecting the contraction depths .

4.2 Methodology

The comparative case study approach first undertakes case selection, identifying the poorly-explained "deviant" cases of primary consideration, and then identifying well-explained pairing cases that are as similar as possible to the corresponding deviant case. The pairing cases provide partially-controlled references for how each deviant case ought to have behaved according to the model. Following preliminary consideration of some overly simple mono-causal explanations, the existing literature on each of the cases is examined, to identify potential differences for further examination. The analysis then examines how each deviant case's GFC experience differs from their well-explained pairing case, seeking explanations for their differing contraction depths in particular.

[2] With a large portion of its economy dominated by oil, case study results for Brunei seem unlikely to be generalizable to other countries. Similarly, results for Jamaica may be less-generalizable, because its extreme contraction duration is certainly related to its 2010 sovereign debt crisis.

Chapter 4: Case Studies

"Deviant cases" are defined here as outlier cases on the depth DV residual—that is, with residual values (ε_{Dep}, in percentage points (pp) of peak GDP) more than two standard deviations from the mean residual value ($|Z_{Dep}| > 2.0\ \sigma$), with mean and standard deviation calculated on the model sample.[3] The model sample is assumed to be a "causally homogenous" group, for which the model applies relatively well—though with some unexplained residual variation—with members (relatively) "on" the regression line (or "on-the-line").[4] As residual outliers, the deviant cases are "off-the-line", showing disparate outcomes, poorly explained by the model, with actual contractions significantly deeper (positive residuals) or shallower (negative residuals) than the model predicts. These off-the-line, deviant cases require further explanation, in terms of how the model fails to apply or applies differently, or for which additional explanatory factors are at play (but which play little role for most countries in the model sample).

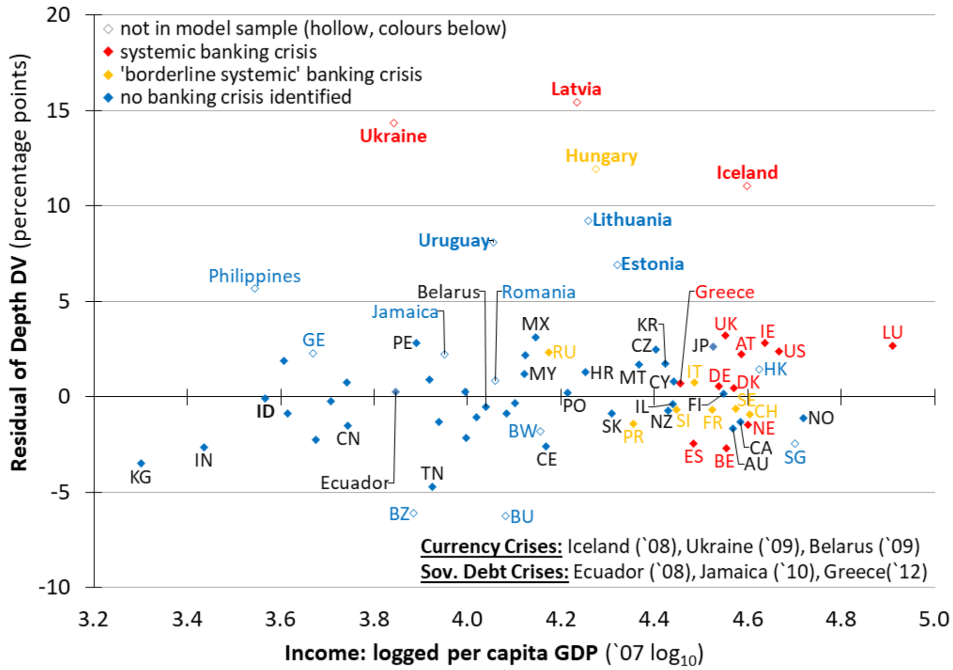
Figure 4.1 plots the depth DV residual from Chapter 3 against income.[5] In addition to Ukraine (UA: ε_{Dep}=14.4 pp, Z_{Dep}=8.8 σ) and Latvia (LV: 15.5 pp, 8.6 σ), the deviant cases showing contraction deeper than predicted are Hungary (HU: 11.9 pp, 6.6 σ), Iceland (IS: 11.1 pp, 6.2 σ), Lithuania (LT: 9.2 pp, 5.1 σ), Estonia (EE: 6.9 pp, 3.8 σ), Uruguay (UY: 8.1 pp, 4.5 σ) and the Philippines (PH: 5.7 pp, 3.1 σ); those shallower than predicted

[3] Recall that the coefficient values from Chapter 3's regression model are obtained from the "model sample" that excludes outliers on either the depth DV or the IVs included in the model, with "outliers" defined as having values greater than two standard deviations from the *full sample*'s mean on a given variable (i.e., showing a Z-score magnitude greater than two: $|Z|>2.0$).

[4] Note that in multivariate regression, with *k* IVs the "line" is actually a *k*-dimensional hyper-plane in a *k*+1-dimensional hyperspace (*k* IVs plus 1 DV).

[5] Figure 4.1 replicates Figure 3.3 from Chapter 3, but providing additional information discussed below. Note that Ukraine is positioned lower in Figure 4.1 than in Figure 3.3, explained further below.

Figure 4.1. Depth DV Residual vs. Income



Source: Author's calculations (Chapter 3 results), IMF IFS, and Laven and Valencia 2012.

are Bulgaria (BU: -6.3 pp, -3.6 σ), Belize (BZ: -6.1 pp, -3.5 σ), Tunisia (TN: -4.7 pp, -2.7 σ), and Kyrgyzstan (KY: -2.5 pp, -2.002 σ, barely an outlier). To narrow the scope of analysis, the choice was made to focus on the deviant cases with contractions deeper than predicted by the model (excluding BU, BZ, TN and KY), and which showed high values on the credit boom IV (excluding UY and PH).[6] As discussed below, the cases are narrowed further due to the unavailability of adequate pairings for Hungary and Iceland. The remaining cases of interest—the Ukraine and the Baltics—are also the only outliers on the raw depth DV that remain poorly-explained by the model (with Botswana well-explained). As such, this analysis also effectively seeks to explain the remaining worst

[6] See Figure 3B.1 in Appendix 3B of Chapter 3.

performing cases—that is, with the deepest observed contractions.

In comparative study of a deviant case, a pairing case needs to be identified that is as "similar" as possible to the deviant case, but which is "well-explained" by the model. The "well-explained" criterion is operationalized by considering only cases with depth DV residuals less than one standard deviation from the model sample's mean (i.e., $|Z_{Dep}|<1.0\ \sigma$). The "similarity" criterion is then operationalized by minimizing the square root of the sum of squared differences between the model-IV Z-scores for each country-pair—that is, the Euclidean distance (d) between case pairs in multi-dimensional "model-IV Z-score space".[7] In this way, "similarity" is based strictly on the significant model-IVs, representing factors already shown to help explain differences in contraction depths, thereby controlling as far as possible for sources of variation known to be relevant.[8]

Through this approach, Romania (RO: Z_{Dur}=0.43 σ) is identified as the best pairing for Ukraine (d=1.67). Likewise, Belarus (BY: Z_{Dur}=-0.34 σ) provides the best pairing for Latvia (d=0.94), as well as for both Estonia (1.96) and Lithuania (1.82). For comparison, Ukraine's next best pairing is with Belarus (d=2.33), differing primarily on the government

[7] Calculating the "distance" using IV Z-scores (and relative to the model sample), rather than using IV values themselves compensates for the difference in types of units between different variables (e.g., for percentages as shares of GDP vs. growth rates). For the binary XRR IV, the unstandardized IV value (0 or 1) was used, thus "implying" that the difference between a more-flexible and a less-flexible pair of countries was weighted equivalently to a 1 standard deviation difference on any of the other (*ratio*) IVs. As with raw Z-scores, the units for the distance values are standard deviations, so that a value less than 1 represents quite similar countries, while those greater than 2 would be considered outliers "from each other".

[8] As an additional, though less-rigorously defined condition relating to "similarity", the "credibility" of the pairing was also considered, which would have rejected case pairings that *intuitively* did not belong together. For example, a case comparison between, say, Latvia and India (which were surprisingly similar, though less so on the credit boom and XRR IVs), would be rejected as pairing countries that were simply too different to be compared directly. The final case pairs identified readily met this "credibility" criterion.

expenditures boom IV, while it is least similar to Belize (d=7.43), despite Ukraine and Belize's more similar incomes (i.e., log[GDP/c] between 3.8 and 3.9 in Figure 4.1). Latvia's next best pairing is with Romania (d=1.89), differing primarily on the flexible XRR dummy IV, and somewhat on the FDI assets boom IV, while it is least similar to Georgia (GE: d=5.93).[9,10] This chapter thus focusses on the Ukraine-Romania and Latvia-Belarus case pairs, with Estonia and Lithuania are considered secondarily (in Appendix 4A). That these countries are all emerging eastern-European transition economies increases the credibility of their pairings. With Belarus the second-best pairing for Ukraine, and Romania for Latvia and Lithuania (but not Estonia), these cases form an interesting cluster for comparison between all pairs.[11]

Of note, Ukraine and Romania were both identified in Chapter 3 as having "managed floating" exchange rate regimes (XRRs), thus falling into the "flexible" categorization of the XRR binary IV (with value of 1). However, closer examination of their entries in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (AREAER) indicates that prior to the crisis Ukraine was in-fact following a de jure conventional peg against the US dollar (IV value 0), while Romania was indeed becoming increasingly flexible. This does not change the empirical results of Chapter 3

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[9] While Latvia is also more similar to Bulgaria (BU: d=1.50) than to Belarus, Bulgaria is not well-enough predicted for comparative purposes (Z_{Dep}=–3.55). Latvia is also quite similar to Lithuania (d=1.59), but less so to Estonia (d=2.58).

[10] As the other deviant cases of interest, Hungary and Iceland were both best-matched with Poland (Z_{Dur}=0.07 σ), but which is deemed too dissimilar from either for those pairings to warrant further consideration (d=3.13 and 2.58 respectively).

[11] Appendix 4B illustrates and discusses the case pairing selection process in more detail.

since Ukraine was excluded from the model sample as a DV outlier. The only necessary changes are an increase in Ukraine's predicted value (by 1.49 pp, the XRR IV coefficient magnitude), with corresponding decrease in the residual value from 15.87 pp to 14.38 pp (e.g., vs. 15.46 pp for LV), or from Z_{Dep}=8.83 σ to 7.99 σ (vs. 8.60 σ for LV). This change shifts Ukraine downward in residual charts (e.g., in Figure 4.1 as compared to Figure 3.3). Even after this correction, Romania remains Ukraine's best pairing (d=1.67 vs. 1.34), with Belarus closer (d=2.33 vs. 2.54), but still clearly in second place.

4.3 Preliminaries

Before proceeding, a few simple explanations can be ruled out as adequately explaining the deviant cases, while also providing directions for further consideration. Firstly, these cases all experienced large credit booms prior to the crisis (see Figure 3B.1). However, with the depth model already controlling for the magnitude of the credit boom, Latvia and Ukraine still show much deeper residual contractions than Belarus and Romania, with Estonia and Lithuania somewhere in-between. While the model does predict Belarus and Romania well, something additional is presumed to be at play for the other four. This may include causal factors not directly related to the credit boom, or may reflect a difference in how the credit boom (and subsequent bust) played out in Ukraine and the Baltics, with other possible mechanisms magnified by and/or magnifying the credit bust effects. As such, credit dynamics are considered further in the main analysis.

Recognizing these cases as former transition economies also suggests a possible influential role for their respective relations with the West and Russia. Latvia, Estonia and Lithuania and Romania all joined NATO in 2004, and the Baltics joined the EU in 2004, but Romania only in 2007. Yet NATO and/or EU membership is not an adequate explanation for their differences, because Ukraine joined neither and experienced almost as deep a (residual) contraction as Latvia, and deeper than Estonia and Lithuania, while Romania experienced a contraction in-line with that predicted. These countries did all experience increasing strategic and economic linkages with the West during this period, with Ukraine seeing better informal relationships and increasing economic connections, especially following the Orange Revolution (2004Q4), but with Romania arguably less-completely committed to integration with the rest of Europe (e.g., re its later EU accession, and limited efforts toward accession requirements for the Economic Monetary Union). Nonetheless, if such an EU or NATO mechanism is actually about increased economic linkages, then the model already controls for significant forms of such linkages, including through the manufacturing exports IV and the food, fuels and mining (FFM) share of exports boom IV, as well as controlling for any credit boom effect incurred through increased financial flows. While NATO and EU membership and generally closer political and economic connections to the West may play a role in helping explain these countries' differential outcomes, a more detailed explanation would still be required to explain the differences between these cases.

Laeven and Valencia's (2012) identification of countries that experienced systemic banking crises and currency crises, also provides a potential avenue for explaining differential outcomes during the crisis. However, as illustrated in Figure 4.1, the explanatory power of these concepts (as defined by Laeven and Valencia) is not clear.[12] While Latvia and Ukraine experienced systemic banking crises and the others did not, many other countries also experienced systemic banking crises, but with no generalizable significant contribution to contraction depth (e.g., as tested by regressing a banking crisis dummy IV against the DV residual on the model sample, or by regressing the dummy IV simultaneously with the other model-IVs against the raw depth DV). Any explanation involving systemic banking crises will require further clarification concerning why these affected Latvia and Ukraine excessively.[13] Laeven and Valencia also only identify Belarus and Ukraine (and Iceland), but none of the Baltics or Romania, as experiencing currency crises, so it seems difficult to argue that a currency crisis helps explain how Ukraine fared worse than Romania, while not explaining how Belarus fared better than Latvia.

Regarding both banking and currency crises, though, Laeven and Valencia's definitions seem problematic. Two conditions define a systemic banking crisis:

> *Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations)*
>
> *Significant banking policy intervention measures in response to significant losses in the banking system. (4, emphasis added)*

This definition distinguishes between systemic banking distress and a systemic banking

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[12] Laeven and Valencia (2012) also identify episodes of sovereign debt crisis, but which did not occur for any of the cases under consideration during the GFC. Only Ecuador (EC) and Jamaica (JM) experienced sovereign debt crises, in 2008 and 2010 respectively.

[13] Bakker and Klingen indicate that "[w]hile many countries in advanced Europe experienced significant banking crises, in emerging Europe only Ukraine experienced a full-fledged banking crisis" (2012, 22, footnote 19), suggesting that Latvia's bank crisis was somehow less intense than Ukraine's, despite meeting Laeven and Valencia's criteria.

crisis through the extent of policy response. Their database also only includes systemic banking crises, whether "full" (meeting three out of their six policy intervention criteria) or "borderline" (meeting only two of the criteria).[14] Countries that experience "significant" banking system distress, but which do not undertake two or more of the policy response criteria—whether because the distress was deemed tolerable, or because of an inability or unwillingness to intervene—are excluded from their database altogether.

Following Frankel and Rose (1996), Laeven and Valencia likewise define a currency crisis as "a nominal depreciation of the currency vis-à-vis the U.S. dollar of at least 30 percent that is also at least 10 pp higher than the rate of depreciation in the year before" (11). They thus identify only Ukraine, Belarus and Iceland as having experienced currency crises during the GFC. By focusing on the outcome, their definition of currency crisis excludes from consideration countries with fixed exchange rates that may have experienced but "survived" a near currency crisis or a speculative attack against their currency—including countries which chose internal adjustment over external adjustment. Thus, in both of these cases, the operationalization of banking crisis and currency crisis overlooks potentially important cases, and so additional consideration must be given to the details of how banking and currency "distress" actually played out during the GFC period.

[14] Laeven and Valencia's criteria for determining whether policy interventions in the banking sector are "significant"—and thus whether the banking distress constitutes a full crisis, with three of these criteria met; or merely a "borderline" crisis, with only two criteria met—are as follows (2012, 4): (i) extensive liquidity support (5 per cent of deposits and liabilities to non-residents); (ii) bank restructuring gross costs (at least 3 per cent of GDP); (iii) significant bank nationalizations [with no threshold specified]; (iv) significant guarantees put in place [with no threshold specified]; (v) significant asset purchases (at least 5 per cent of GDP); (vi) deposit freezes and/or bank holidays.

It should also be noted that the choice to undertake internal vs. external adjustment is itself an inadequate mono-causal explanation for the differential outcomes because Latvia chose internal adjustment while Ukraine eventually undertook external adjustment; yet both remain very poorly explained, relative to Belarus and Romania, which both "chose" external adjustment (via a flexible exchange rate for Romania, and devaluation of the fixed XR for Belarus). Likewise, the exchange rate regime (XRR) itself does not explain the differences, because—with the exception of Romania—all of these cases pursued (at least de facto) exchange rate pegs before the crisis, with Ukraine and Belarus both pegged to the U.S. dollar, and Latvia (as well as Estonia and Lithuania) pegged to the euro. A small XRR effect—relative to the magnitude of the deviant cases' depth residuals—has also already been controlled for in the Chapter 3 regression model.

Choices concerning fiscal policy responses are also not expected to play a large role in explaining the differences between these cases, due especially to the expected lags in legislating and implementing changes in spending and taxation. Recall that the Chapter 3 regression model already includes a government expenditures boom term, tentatively interpreted as reflecting a medium-term stimulative effect from pre-crisis spending increases. Additional direct effects from reactive fiscal policy may also play a role, for example influencing the precise timing and depth of the contraction trough once the "main" portion of contraction has occurred. Fiscal policy may also help indirectly, reinforcing the credibility of overall adjustment choices and policy responses by signalling the government's commitment to fiscal sustainability.

4.4 Literature Review

A small literature examines the GFC experiences of these cases, typically considering them individually, or in loose comparison to each other (e.g., especially the Baltics) and/or to other emerging European neighbours. There are two "generations" of papers: those written in the immediate aftermath of the crisis (typically dated from 2009 to 2011); and those emerging somewhat later (in or after 2013), providing more detail, perspective and analysis, including of claims made in the earlier generation.

Bakker and Klingen (2012) provide the most comprehensive analysis of emerging Europe, with a five-chapter regional overview of the crisis, and individual chapters for nineteen emerging European countries, including those under consideration here.[15] Likewise, Åslund (2009a) considers the Eastern European experience generally, but with less detail about individual countries. Other papers considering more than one country tend to group them sub-regionally: Martin (2010) and Purfield and Rosenberg (2013) for the Baltics; Lane (2011) and Hegerty (2014) for Russia, Ukraine and Belarus; and Akalin and Edmund (2015) for Russia, Turkey and Ukraine. Others examine particular countries within a broader context: Koyama (2010) for Latvia and the Baltics; Davulis (2012) for Lithuania and the Baltics; or Voinea (2013) for Romania and "other new EU members". These groupings make geographical, historical and/or geopolitical sense, but by not controlling for relevant differences between the countries they do not permit direct

[15] Specifically, Bakker and Klingen (2012) examine Albania, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Estonia, Hungary, Kosovo, Latvia, Lithuania, Macedonia (FYR), Moldova, Montenegro, Poland, Romania, Russia, Serbia, Turkey and Ukraine.

comparative analysis. Still others examine cases individually, all providing descriptive and historical analysis, but without any comparative element: Korosteleva (2011) for Belarus; Raudla and Kattel (2011) for Estonia; Åslund and Dombrovskis (2009) and Kasjanovs and Kasjanova (2011) for Latvia; Grajauskas (2014) for Lithuania; Åslund (2009b) and Goczek and Malyarenko (2015) for Ukraine. As such, these studies are all very usefully descriptive, but are less rigorous than required for the comparative goals of this chapter.

This literature also provides only limited analysis of the real impact of the crisis on the given cases, primarily describing contraction depths and other real effects (e.g., changes in unemployment, current account, inflation), but with limited discussion of how those effects resulted from the GFC. An important exception to this generalization—discussed in more detail below—is Blanchard, Griffiths and Gruss's (2013) "forensic" examination of Latvia, which clearly problematizes and analyses the question of why Latvia experienced such a deep contraction in output.

In the broad consensus of the literature, the countries of emerging Europe experienced a "typical" boom-bust cycle, exacerbated by the financial and trade shocks of the GFC itself. The pre-crisis boom emerges from high global liquidity, providing large capital inflows—primarily in the form of (relatively "hot") bank lending—that underpin domestic credit and domestic demand booms, and creating additional "vulnerabilities" (discussed below). The large capital flows into emerging Europe are seen as reflecting greater potential returns due to catch-up and income convergence effects, including for some in view of recent or anticipated NATO membership, EU accession, and/or euro adoption (Bakker and Klingen 2012, 17, 146, 225; Purfield and Rosenberg 2013, 4). Differences in inflows presumably reflect different circumstances and perceived potential returns between these countries. The Baltics also saw increased bank flows from Nordic (and especially Swedish) banks competing for market share in newly-open, developing markets. These Nordic inflows occurred to a somewhat smaller degree for Latvia, where domestic banks maintained a larger share of its banking system, while Estonia and Lithuania allowed much greater foreign ownership (Bakker and Klingen 2012, 113, 214, 225–6; Purfield and Rosenberg 2013, 4).

Before the full impact of the GFC was felt—that is, in the mid-2007 to mid-2008 time-frame—the boom slowed, with some countries (including Latvia, Estonia and Ukraine) beginning to contract. The early slowing of the Baltic credit booms is generally attributed to Swedish banks' reduced lending to local subsidiaries and branches, seeking to engineer soft-landings to the credit boom excesses (Purfield and Rosenberg 2013, 7; Bakker and Klingen 2012, 33–34, 114).[16,17] This slowdown roughly coincides with the start

[16] The Latvian government and central bank also developed an anti-inflation plan in early–2007, targeting balanced budgets in 2007–2008 and surpluses for 2009–2010, and tightening bank regulatory policy by restricting mortgage lending and increasing reserve requirements. Blanchard, Griffiths and Gruss consider the plan "too little too late" (2013, 335–6); but it may have contributed to Latvia's earlier slowing.

[17] Note that the literature is not always clear on the distinction between foreign bank's subsidiaries and branches. However, Bakker and Klingen point out that "[m]any western banks in emerging Europe operated their subsidiaries as if they are branches" (2012, 22). A subsidiary is a bank incorporated in a "host" country that is majority owned by a parent bank in a foreign "home" country, but which operate under the laws and regulations of the host country. A branch in a host country is wholly owned by a foreign parent bank, and is subject to the laws and regulations of both the home and host countries. Branches can generally originate larger total loans than subsidiaries because assets held by the branch's parent company are included in the leverage base against which permitted credit ratios are determined. Latvia generally allowed only subsidiaries, while Estonia and Lithuania permitted branches.

of financial difficulties internationally: the decline in U.S. housing prices beginning in the second half of 2006 (Åslund and Dombrovskis 2011), the summer 2007 Northern Rock-related bank runs in the U.K., and the Bear Stearns episode of March 2008. U.S. sub-prime losses in April 2008 especially hurt Swiss multinational investment bank UBS, which "play[ed] a central role in the carry trade of low-interest loans in Swiss francs to the wholesale credit market that financed banks in Eastern Europe" (Åslund 2010, 25), with Ukraine "hardest hit" and Latvia also "particularly badly hit", as both had local banks dependent on financing from the international wholesale market (27).

The 2008Q3–2009Q1 "acute phase" of the GFC then struck, triggered by the September Lehman Brother default and ensuing financial crisis in AEs, and spreading globally through the international financial system. Global liquidity dried up and the boom mechanism reversed: net inward capital flows slowed to a halt or reversed; domestic credit plateaued, or even shrunk; and domestic demand dropped. The financial shocks were followed by the trade shock of decreased foreign demand for exports. With these shocks and some additional sources of vulnerability identified, the literature then describes the macro-level outcomes of the crisis (e.g., falling output, rising unemployment), and discusses the timing and nature of the return to positive growth, often referring to "export-led recovery" starting in 2009Q2–3, coincident with the resurgence of global trade.

This outline of the generalized GFC experience of boom, bust and trade shocks is largely consistent with the regression results obtained in Chapter 3, though the regression model provides some additional nuance. The GFC's effect on the real economy through financial shocks is represented in the model's credit boom term, reflecting the differential extent to which global liquidity supported the domestic credit and thus demand booms, with the end of liquidity undermining output proportionally to the magnitude of the credit boom. In this view, the large capital inflows observed across emerging Europe financed the larger domestic credit and demand booms, and it is the magnitude of the actual credit boom—and not of the underlying inflows—that was found to best predict contraction depth. Thus, in addition to the changes in capital flows—increasing during the boom-period and abruptly decreasing during the crash—other factors (e.g., reflecting details of the domestic financial and banking systems and institutional contexts) are presumed to have influenced the extent to which those flows contributed to the credit boom as the more proximate explanatory factor influencing contraction depth.

The GFC's trade shock effect is captured in the model's two trade terms: manufacturing exports level (as per cent of GDP, 2007) and food, fuel and mining (FFM) exports boom (per cent of cumulative average growth rate over 2003–2007 in FFM exports to GDP). While the case study literature tends to focus only on the general decrease in foreign demand for unspecified exports, the model from Chapter 3 identifies more nuanced roles for manufacturing and FFM exports. In the literature, a central role for commodities is only explicitly mentioned for Belarus and Ukraine, noting for both the reduction of Russian subsidies on fuel imports (Bakker and Klingen 2012, 104, 126), and the importance of oil and phosphate exports for Belarus (127) and of steel exports for Ukraine (103). However, while Belarus shows a moderately high FFM exports boom IV value of

8.6 per cent (very similar to Canada's 8.7 per cent, and just short of the high-end cut-off for iterated outliers of 9.2 per cent), Ukraine actually shows a relatively large 5.0 per cent rate of boom-period contraction in FFM exports-to-GDP (somewhat beyond the -2.1 per cent low-end iterated outlier cut-off; see Figure 3B.5).[18] This result is consistent with the notion that the FFM exports boom IV captures the sensitivity of output to FFM-commodities' price fluctuations, in contrast both to the potential "importance" of FFM exports as a source of foreign exchange, and as vulnerable to foreign demand shocks (as is more consistent with the significant level of manufacturing exports-to-GDP term).

Beyond the credit boom-bust and trade shocks, the case study literature identifies additional "vulnerabilities" seen as influencing outcomes in the cases discussed, but which are not represented in the model from Chapter 3. In addition to the large credit booms seen in all six cases, perceived vulnerabilities emerging during the boom-period include large current account deficits, increased inflation, large housing booms, and high foreign debt, including large proportions thereof owed in foreign currencies (Bakker and Klingen 2012, 10; Åslund 2009a, 16). Unfortunately, only limited data is available regarding housing prices in these countries, so few conclusions can be drawn regarding the potential role of housing booms, as distinct from the overall credit boom relationship to contraction depth; however, Latvia and Estonia saw quite similar real estate price contractions, suggesting a limited role for explaining at least their differential outcomes.[19] In contrast, any role for the

[18] FFM boom values calculated from WTO Merchandise Trade by Commodities database as in Chapter 3; see Appendix 3A.

[19] Figure 4C.22 in Appendix 4C shows the limited real estate price data that are available.

foreign currency denomination of foreign debt can be ruled-out, as the major economic actors in these countries were unable to borrow internationally in their respective domestic currencies: data from the Bank for International Settlements (BIS) show no outstanding debt securities denominated in their respective domestic currencies over 2006–2009. The pre-crisis level of foreign debt, along with the boom-period increase therein, and in other types of foreign liabilities and assets, were all tested in Chapter 3, with no significant relationship found for contraction across the model sample; however, this does not rule out an additional role with respect to these deviant cases from outside the model sample.

The literature also raises concerns about potential vulnerability from unsustainable fiscal policy made at the height of the boom, and about the potential pro-cyclicality of expansive fiscal policy, supported by increased revenues during the boom, but then disappearing during the bust. Yet, in contrast to the general expectation that "fiscal profligacy" would increase vulnerability, the government expenditures boom IV included in the model from Chapter 3 indicates that larger increases in boom-period spending (relative to GDP, itself also likely increasing) actually correlate with shallower contractions—that is, apparently providing resilience rather than vulnerability.

Nevertheless, these various potential vulnerabilities provide a set of potential explanatory factors to be considered in the analysis. Some of these vulnerabilities were tested as additional explanatory factors in Chapter 3, but none were found significant, save the credit boom and government expenditures boom IVs included in the model; consideration will thus be given as to whether these vulnerabilities influenced the relative outcomes between the cases under examination here.[20]

The literature also identifies several "dynamic" processes affecting the spread of the crisis, in which output effects may have been intertwined. Predominantly, the GFC threatened the stability of domestic banking sectors (i.e., beyond merely halting or reversing credit expansion), with the withdrawal of foreign parent bank funding and/or wholesale funding undermining individual banks. This withdrawal triggered bank runs by domestic and foreign depositors, and created the potential for bank system contagion domestically (e.g., with interbank lending "freezing up", and systemically important banks coming under threat) as well as internationally (e.g., with problems in domestic subsidiaries creating problems for their foreign parent banks). The nature of the banking systems is also central to many discussions in the literature, particularly concerning the relative importance of domestic banks vs. foreign-owned branches or subsidiaries (including nationality of foreign ownership), and the regulation and oversight thereof (including by which domestic or foreign regulators), as well as the banks' different sources of funding (domestic deposits vs. foreign deposits vs. lending from foreign parent banks of branches or subsidiaries vs. international wholesale funding).

The literature on these countries also notes the threat of currency crisis due to the withdrawal of foreign capital, and the threat of devaluation or de-pegging under a fixed exchange rate, following the exhaustion of foreign reserves. For countries with fixed XRs,

[20] Appendix 4D re-examines those vulnerabilities considered as test-IVs in Chapter 3.

this threat is exacerbated by the potential for speculative attack when adherence to the peg is no longer deemed credible, in terms of maintaining an overvalued currency and with the monetary authority (central bank or currency board) holding inadequate foreign reserves to cover the potential withdrawal of money from the country. The potential for international contagion arises here too, with the credibility of an XR peg being further undermined when neighbouring countries' pegs are successfully attacked (i.e., forced to devalue and/or float), allowing speculators turn their attention and amplified resources to the next weakest targets. As already discussed, of the cases under examination here, Laeven and Valencia (2012) identify only Ukraine and Belarus as having experienced currency crises, though concerns were raised about the nature of their definitions, and about the potential for overlooking crisis situations that didn't result in devaluations large enough to meet their criterion. The literature (i.e., Bakker and Klingen 2012) also does not discuss the potential for currency crisis in Romania, which maintained a more-flexible "managed-floating" XR, and allowed significant depreciation during the crisis, though not enough to meet Laeven and Valencia's criteria for currency crisis.

The case study literature also details the policy responses undertaken in face of the GFC and its financial and real effects, which can be outlined as follows for a generic country. Governments focused first on stabilizing the financial sector by providing liquidity and saving (or nationalizing) banks, and by seeking foreign parent banks' commitments to support their local subsidiaries and branches. In all of these cases, save Romania, the role of the central bank in providing liquidity was constrained by adherence to fixed XRs. Governments also sought to achieve short-term fiscal sustainability in the face of: higher spending commitments made during the boom; a tax base reduced by the contraction itself; increased spending in direct response to the crisis (e.g., toward stabilizing the financial sector); and the limited availability of foreign financing. In deciding on fiscal strategy, a fundamental choice was whether to seek sustainability in the short- and/or longer-terms through stimulus (i.e., using spending to stimulate the economy, ending the contraction, returning to growth, and increasing tax revenues again) or through consolidation (i.e., reducing spending to match reduced revenues), while also accounting both for lags in the implementation of fiscal spending and for the confidence role of fiscal policy in signaling commitment to sustainability.

Many governments sought international help (e.g., from the IMF, European Commission and other multilateral organizations, and/or bilaterally from other countries) as needed, in support of these first two goals, and toward developing a broader response plan. Such plans included the choice of whether to pursue internal or external adjustment—that is, maintaining or devaluing their exchange rates (or allowing them to depreciate). The Baltics pursued internal adjustment. Belarus and Ukraine initially pursued internal adjustment, but eventually undertook external adjustment at the behest of the IMF by devaluing their fixed exchange rates, while Romania undertook external adjustment by allowing its currency to depreciate during the crisis. These latter three cases thus (eventually) allowed the exchange rate to "absorb" some of the external shock. Broader plans also typically included a longer-term strategy for reducing vulnerability to future crises, and for achieving long-term fiscal sustainability.

Internationally, the IMF (and other sources of international help) played a central role in supporting the hard-hit emerging European countries through financing to support government spending and crisis response, and through advice—as well as conditions on that support—pushing countries toward more credible and fiscally sustainable crisis response plans. The European Commission (EC) played a similar or even more central role with respect to EU members—especially for Latvia, supporting their choice to pursue internal adjustment. The Nordic countries also helped the Baltics through bridge loans that supported fiscal deficits until the multilateral packages started to be distributed. Foreign (especially Nordic) parent banks and their subsidiaries also played varying roles. In the initial stages foreign banks helped to create vulnerability by lending extensively during the boom-period, then creating the immediate threat of withdrawal of funds from subsidiaries during the crisis. Later, their role was more benign, helping countries by committing to support their subsidiary operations, first at the request of the local governments, and then as part of the broader Vienna Initiative (see Bakker and Klingen 2012, 85). In addition to supporting the countries themselves, these international initiatives also sought to prevent the contagious spread of banking and currency crises. Latvia was seen as the "first domino", with the contagion of currency crisis threatening Estonia, Lithuania and Bulgaria, and the contagion of banking crises threatening the Nordic parent banks and economies and thus other eastern European countries.

Because the case study literature is primarily descriptive, it does not provide specific expectations regarding how these different cases played out, either generally or with respect to the depth of their output contractions in particular. Instead, they describe the experiences, and discuss the vulnerabilities that are expected to have accounted for the actual outcomes, but generally do not undertake any more rigorous comparisons.

However, in their detailed "forensic" study of Latvia, Blanchard, Griffiths, and Gruss (2013) provide an exception to this generalization, examining the real impact of the GFC on Latvia more closely, estimating contributions of different channels of GFC effect on contraction depth. In their view, Latvia's boom was in the process of "dying a natural death" in 2007, and "[h]ad there been no global financial crisis, Latvia might have gone through a slump similar to Portugal's in the early 2000s" (338). The GFC then affected Latvia's (and other EMEs') output mainly through the financial and trade channels. With Latvian GDP declining 25 per cent from 2007Q4 to 2009Q3, they examine the standard components of the aggregate expenditure approach to GDP—consumption, government expenditures, investment, exports and imports (GDP=C+G+I+X−M)—and how they evolved during the crisis. Foreign demand (X) accounts for 8 pp of that decrease, while domestic demand (C+I+G) accounts for 43 pp, offset by a 26 pp decrease in domestic demand for foreign goods (M).

Using the regression results from Blanchard, Faruqee and Das (2010)—discussed in Chapter 3 as one of the papers in the differential impact literature—and further accounting for the role of re-exports, Blanchard, Griffiths, and Gruss (2013) estimate a 7.5 per cent decrease in GDP due to the unexpected decrease in exports, roughly matching the 8 pp observed value. They then estimate the credit crunch effect through a "back of the envelope computation," finding the observed 8 per cent decrease in loan growth (i.e., the difference between growths in 2007Q4–2008Q3 and 2008Q4–2009Q3, similar to the credit boom IV used in Chapter 3), "may explain a decrease in domestic demand growth of between 3 and 9 percent… substantially less than the decrease in domestic demand of 27 percent over the same period" (342; *sic*: was earlier specified as 26 pp). These estimates leave a remainder of unexplained Latvian contraction depth between 10.5 and 16.5 pp, which they attribute "by process of elimination"—supported by "suggestive evidence" regarding car sales—to "uncertainty and the option value of waiting" (343). Intriguingly, their remainder coincides roughly with the 15.5 pp Latvian contraction depth residual obtained in Chapter 3, reinforcing the need for further investigation into why Latvia experienced such a deep crisis, while also providing a potential explanation thereof. Through comparative analysis, this paper aims to provide further insight.

4.5 Analysis

The analysis will proceed for each case pair by examining the comparative evolution of output and the components of the aggregate expenditure approach to GDP: consumption, government expenditures, investment, and net exports (GDP=C+I+G+NX). A "differential" time series for each component, as well as for output "as the sum of the components" and "as reported", will be considered as the difference between the corresponding series for each pair—for example, as Ukrainian consumption minus

Romanian consumption, and Latvian investment minus Belarusian investment.[21] Examination of these series highlights the differential experiences within the case pairs, providing avenues for closer examination in subsequent sections for each pair. In particular subsequent sections consider: the varying responses to the balance of payments (BoP) stresses affecting each of these countries; as well as the idiosyncratic influence of inflation on Ukrainian consumption; and the role of Belarus's non-market-based credit dynamics.

4.5.1 Ukraine and Romania

4.5.1.1 Differentials

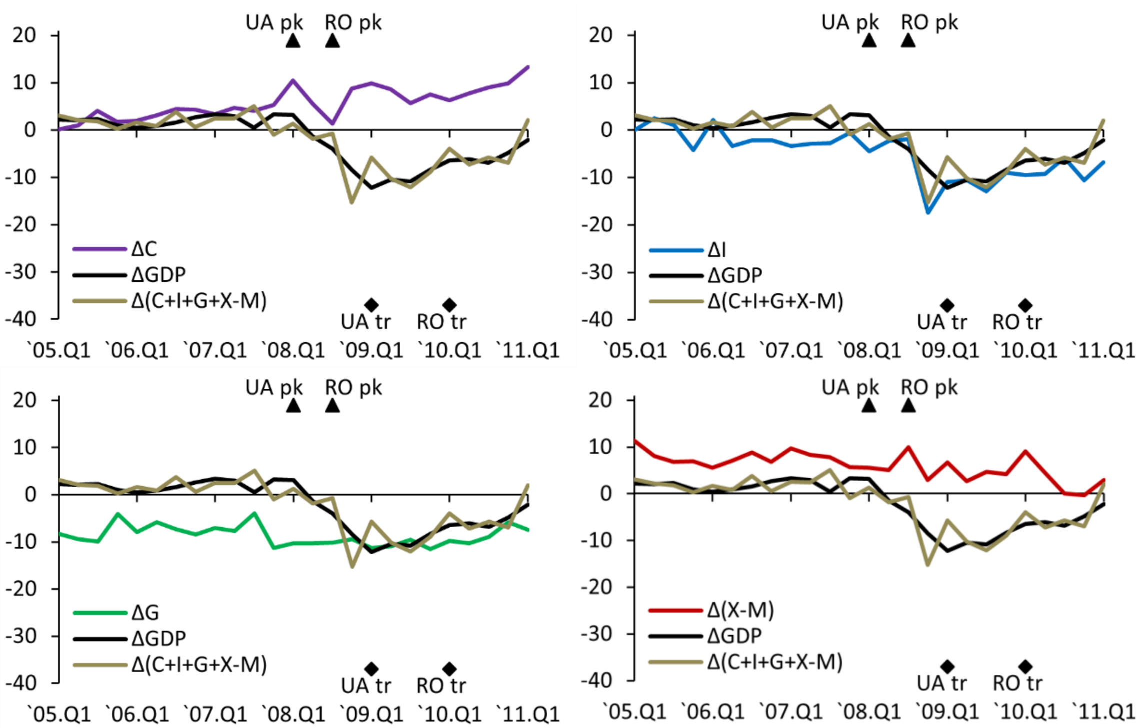
Figure 4.2 shows the difference between Ukraine and Romania in GDP as reported and as the sum of components of the aggregate expenditure approach to GDP—consumption, government expenditures, investment, and net exports (GDP=C+I+G+NX)—and for those components individually in different panels.[22] GDP as reported (solid black line in each panel) tells a relatively simple story, with a stable difference until Ukraine's output peak in Q1 of 2008, followed by a relatively steady decline until Ukraine's trough in Q1 of 2009, and a slow climb thereafter.

This view suggests that the UA-RO difference is largely driven by the Ukrainian

[21] Note that the series for GDP "as reported" in this this chapter use more recent IMF data than the series used in Chapters 2 and 3 to calculate the contraction depth and duration DV values for each country. Where the series in Chapters 2 and 3 were the IMF's published real GDP series from the April 2012 IFS, the series used in this chapter are from the IFS on-line in 2018. Closer examination of countries' GDP deflators found significant retroactive changes in GDP deflators, especially but not only for Belarus. Of the cases examined here, only Belarus is included in the model sample for the depth (and duration) model(s) of Chapter 3, so minimal difference in Chapter 3 results and predications are expected by its slightly different values. (See also note 21, below, regarding additional differences for the Ukrainian series.)

[22] See corresponding charts for exports and imports in Figure 4C.5.

Figure 4.2. Output and Expenditure Component Differences: Ukraine minus Romania



Source: IMF IFS, author's calculations.

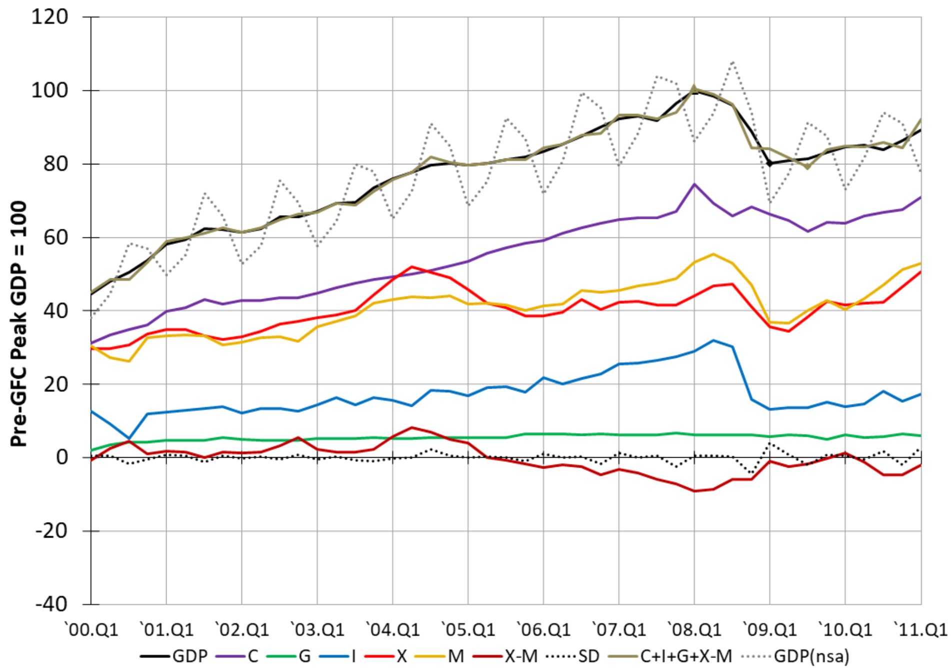
experience: Ukraine's earlier contraction accelerates during the Q4 2008 to Q1 2009 acute phase, just as the Romanian contraction begins, with Ukraine recovering gradually thereafter, while Romania roughly levels off (see also Figures 4.3 and 4.4).[23] However, important differences from GDP "as reported" are revealed by considering GDP as the sum of the expenditure components and looking at each of the components individually. As the

[23] Note that the Ukrainian values used for Figures 4.2 and 4.3 are the expenditure components (and their sum) transcribed from the IMF's monthly IFS publications, rather than taken from the on-line IFS database (as for other countries in corresponding figures). For Ukraine, the on-line IFS data reflects newer accounting methodology, implemented in late-2016 and retroactive only to Q1 of 2010. Figure 4C.1 reproduces Figure 4.3 (and Figure 4C.2 reproduces Figure 4.2) using the IFS on-line data, which includes counteracting discontinuities at 2010 Q1 in the consumption and government expenditures series. These discontinuities reflect the disaggregation of government expenditures into "collective" and "individual" sub-components only from 2010Q1, with the individual sub-component previously part of consumption.

sum of components, the difference between Ukraine and Romania (the tan line in each panel in Figure 4.2, denoted "Δ(C+I+G+X−M)") drifts with increased volatility from slightly positive to slightly negative in late-2007 and early-2008, before dropping sharply in Q4 of 2008. Upward ticks in Q1 of 2009 and 2010 (as well as 2011) punctuate a recovery that otherwise largely follows that for GDP "as reported".

Each of the individual components contributes to their sum's variation in each quarter, but with some playing greater roles than others at different times. Major differences in the Ukraine-Romania consumption differential (Figure 4.2, panel 1) begin with the clear 2008Q1 bump and reversal in Q2–3, reflecting Ukraine's own output-peak-defining consumption bump and reversal. Another increase in the differential then occurs in 2008Q4, as the Romanian consumption contraction starts, while Ukraine sees another one-quarter consumption increase. The acute-phase differential then reverses more gradually, reflecting the end of Romania's consumption contraction by 2009Q2 (with only modest recovery into 2010) and the resumption of Ukraine's consumption contraction, to Q3. As Ukrainian consumption returns to strong growth from 2009Q4, the output differential also returns roughly to its pre-acute-phase trend (with some further acceleration in late-2010). Over the 2008Q4 to 2009Q3 period, then, differential consumption dynamics actually moderates the Ukraine-Romania differential contraction. Indeed, aside from the "extra" contraction associated with Ukraine's 2008Q1 consumption bump, Romanian consumption contracts more (by 8.6 pp of peak GDP from 2008Q3 to 2009Q2) than does Ukrainian (6.8 pp of peak GDP from 2008Q4 to 2009Q3). So, while the differing during-

Figure 4.3. Seasonally Adjusted Real GDP and Components: Ukraine

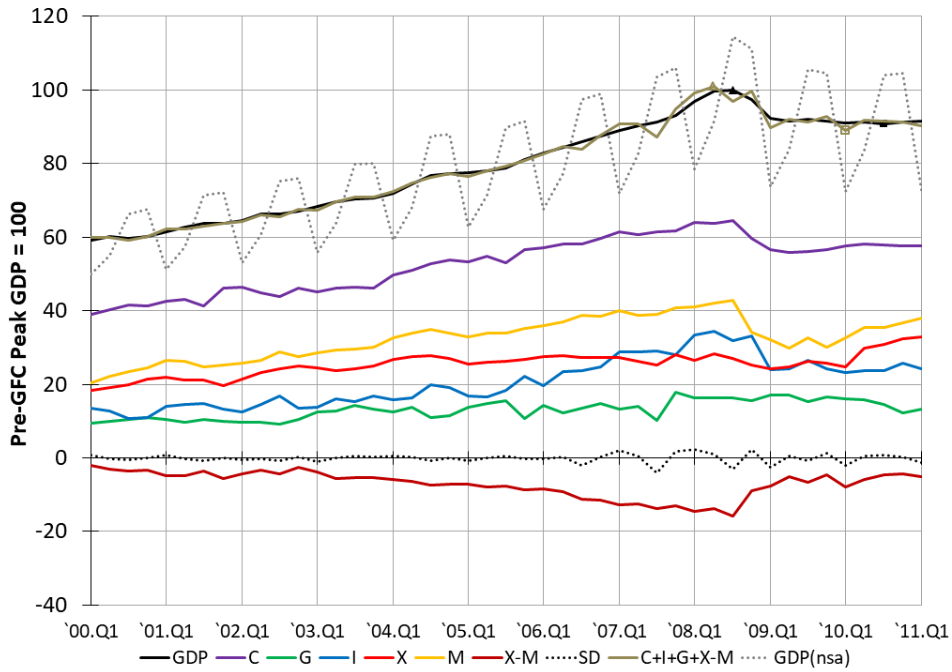


Source: IMF IFS, author's calculations.

and post-acute-phase consumption dynamics are of interest, the main question for the purposes of understanding consumption's contribution to Ukraine and Romania's differential impact patterns is: Why does Ukraine's experience a large consumption bump in 2008Q1, while Romanian consumption growth remains steady?

For differential investment (panel 2), following some relatively mild variation in 2007Q4 to 2008Q2, major movements begin as a large drop in 2008Q4, primarily reflecting Ukraine's very large single-quarter investment contraction. A moderate increase in the differential follows in 2009Q1, with the later start to Romania's investment contraction and moderation of Ukraine's. Through the rest of 2009 and 2010, the investment differential increases slowly but steadily—reflecting very gradual growth in Ukrainian investment against flat investment for Romania—albeit with some variation reflecting

Figure 4.4. Seasonally Adjusted Real GDP and Components: Romania



Source: IMF IFS, author's calculations.

small one-quarter bumps for Ukraine and/or Romania relative to trend. The main question concerning differential investment changes is: why does Ukraine experience such a large investment contraction 2008Q4?

Differential government expenditures (panel 3) show a straight-forward pattern, contributing little to Ukraine and Romania's differing contractions. Modest differential variability prior to 2008 primarily reflects Romanian variation, with a permanent step-up in Q4 of 2008, while a relatively stable difference through 2008–2009 represents stability for both countries. The differential's gradual increase in 2010 then reflects decreasing Romanian expenditures against relative stability for Ukraine. While both countries' fluctuations over 2008–2010 may represent GFC related impacts and policy changes (e.g., including due to IMF conditionality), the fluctuations are very small relative to the large changes in consumption and investment, and so are not considered to provide a major contribution to the differential impact, with no specific questions worth pursuing here.

Net Exports (panel 4) also provides only a little differential variability to account for between Ukraine and Romania, largely reflecting variability in the timing and pace of each country's narrowing trade deficit. Although starting from a wider deficit, Romania sees only a partial net exports reversal, beginning sharply with the GFC acute-phase in 2008Q4, and roughly levelling off from around 2009Q2 as the acute-phase ends. In contrast, and resulting from both the same forces that started the Ukrainian contraction, and from the contraction itself, Ukraine's net exports reversal starts earlier, technically from 2008Q2, but more clearly from Q3. After a pause in 2008Q4, Ukraine's trade deficit reaches near balance in 2009Q1, and (like Romania) remains mostly steady for a quarter or two; but Ukraine then sees further reversal, starting very gradually in Q3, and reaching a small surplus in 2010Q1. The differential's subsequent decrease in 2010 then reflects Ukraine's return to deficit, now roughly matching Romania's. Overall, then, the net exports differential's dynamics reflect variable timing for Ukraine and Romania's partial trade deficit reversals, but with little actual contribution to total difference in peak-to-trough output contraction (i.e., until after 2010Q1).

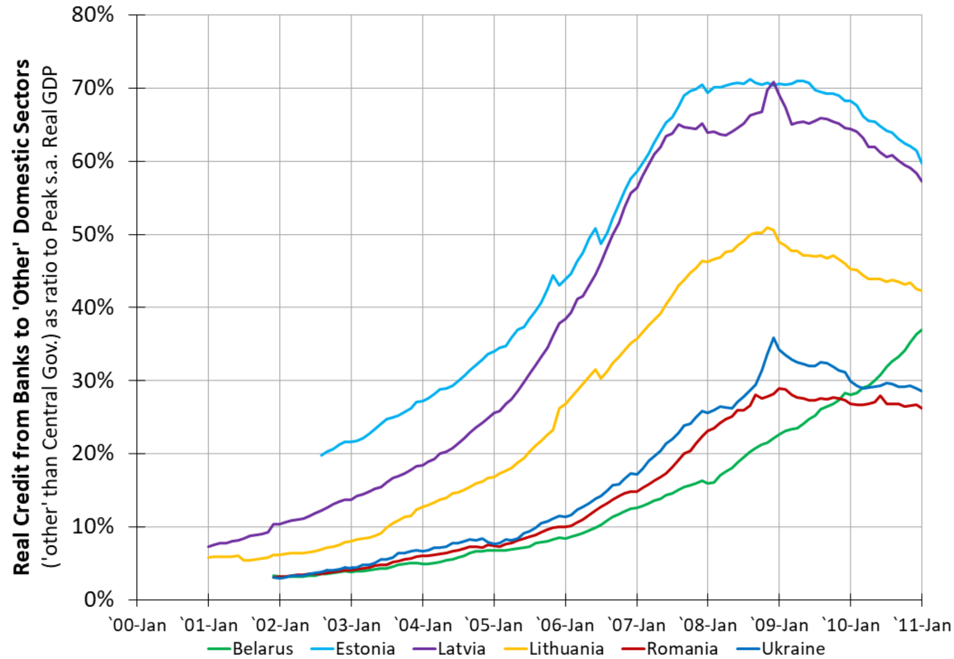
In focusing on the major drivers of the differential Ukrainian-Romanian experience, the next two sections focus on: the pre-acute-phase and Ukraine's 2008Q1 consumption bump; and Ukraine's larger acute phase investment contraction, due to its different experience of and policy choices during its balance of payments (BoP) crisis.

4.5.1.2 Pre-Acute-Phase Inflation

The first major contributor to the difference between Ukraine's and Romania's output contractions occurs in early 2008, ahead of the acute phase of the crisis. Ukraine reaches its peak GDP—whether "as reported" or "as the sum of expenditure components"—in Q1 of 2008, underpinned by a large bump in consumption activity, that recedes over Q2 to Q3 (Figure 4.3). With Romanian consumption seeing only a modest Q1 increase (Figure 4.4), it is the Ukrainian consumption bump that drives the differential consumption dynamics (Figure 4.2, panel 1), though an increase in Romanian investment also moderates the differential a little. The increase in Ukrainian consumption gives an unexpected boost to Ukrainian GDP as the sum of expenditure components, and defines its peak in 2008Q1, also surpassing by 0.4 pp the same-quarter peak in GDP as reported. The Q2 reversal of the consumption bump then initiates Ukraine's contraction, albeit moderated somewhat by increased Q2 investment and the Q3 narrowing of Ukrainian net exports.

Ukraine's consumption bump initially seems quite counter intuitive. The general narrative from the literature suggests that Ukraine and the Baltics faced credit crunches in this pre-acute phase period, including in response to inflation that emerged over the course of 2007. Indeed, Figure 4.5 shows that credit growth nearly levelled-off for Ukraine in early 2008, with Romania experiencing much less credit-slowing. Facing such a credit-crunch, Ukraine would be expected to experience slower growth than Romania, and even possible contraction; but instead, the 2008Q1 increase in Ukrainian consumption overwhelms any contractionary impulse, counterintuitively increasing peak GDP. What

Figure 4.5. Real Bank Credit



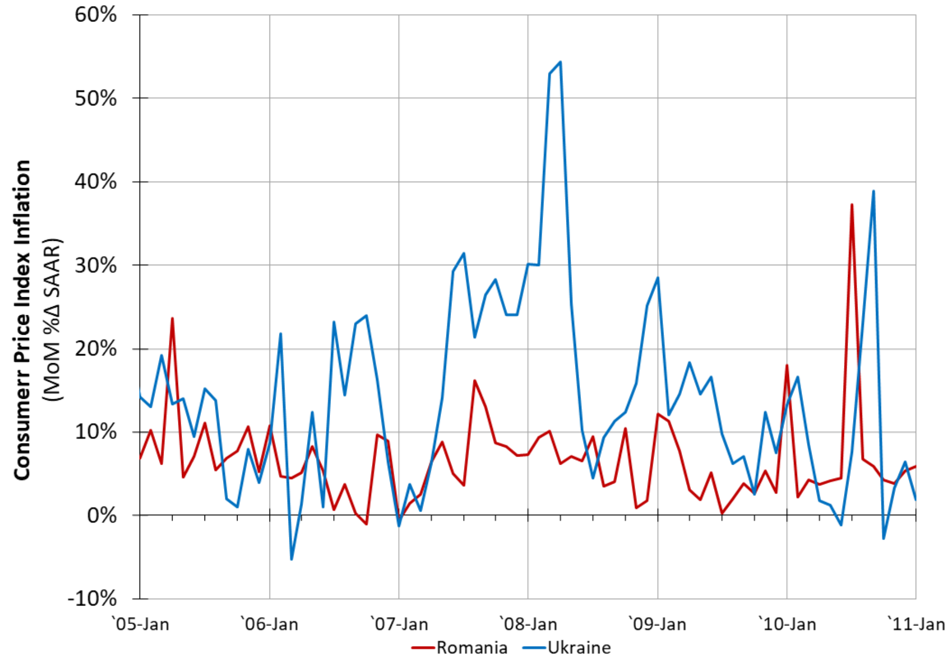
Source: IMF IFS, author's calculations.

then is driving that consumption bump? Inflation.

Ukraine's 2007 inflation was driven by global food and energy price increases, and then by the June-July drought. Yet, high inflation expectations also contributed to inflationary pressures, due to increased political uncertainty: in April 2007 President Yushchenko dismissed of Prime Minister Yanukovich's government, and a new government under Julia Timoshenko was formed after a September election (IMF 2008b, 17; Pirani et al. 2009, 10). Ukrainian inflation remained elevated through 2007, but then jumps in January 2008 and again in March, reaching 54.4 per cent in April (Figure 4.6).[24] The IMF further cites "expansionary fiscal and incomes policies" and "very rapid money

[24] Figure 4C.7 shows the corresponding CPI Inflation chart for the Baltics and Belarus.

Figure 4.6. Consumer Price Index (CPI) Inflation



Source: IMF IFS, author's calculations.

and credit growth," along with increasing world steel prices that also helped fuel domestic demand (IMF 2008a, 4; and see Figure 4C.21). The National Bank of Ukraine remains silent on any monetary role, but seems to agree with the IMF concerning fiscal and incomes policies, with the early-2008 inflation "provoked by the poor yield of 2007" (the June-July drought) and by "raising social standards (minimum wages, pension, subsistence wages), salaries of employees in the budget sector, as well as by the reimbursements of losses from savings depreciation paid to the population" (National Bank of Ukraine 2008, 21).

An additional factor potentially contributing to Ukraine's March–April 2008 inflation spike is the flare up in the on-going Ukrainian-Russian dispute over gas prices. In late 2007, the new Timoshenko government reversed agreements made between the Yanukovich government and Russian company Gasprom. Subsequent negotiations broke down on March 3, 2008, and Gasprom reduced pressure in the pipelines supplying Ukraine for both domestic consumption and transit to Europe (Pirani, Stern, and Yafimava 2009, 10). In response, Ukraine diverted Europe-bound supply for domestic use—so it is not clear that supply actually decreased enough to affect prices directly—and Gasprom returned full pressure on March 5. If this conflict contributed to the March–April inflation spike, it is more likely through its effect on inflation expectations, and more general inflationary pressures, than on inflation in actual gas prices.

Ukraine's 2008Q1 consumption bump is thus interpreted as reflecting inelastic purchases—or even increasing purchases—as inflation rises. Consumers may have unleashed pent-up purchasing needs, delayed since inflation rose in June 2007, while perhaps also trying to beat accelerating inflation, thereby increasing demand and prices in a potentially hyperinflationary spiral. Indeed, in May 2008 the IMF warned that:

> *If not tackled rapidly, the increase in inflation might significantly affect inflation expectations, which seem to be currently drifting up, and feed a vicious inflation-wage spiral potentially harmful for the competitiveness of the Ukrainian economy (IMF 2008b, 16).*

But hyperinflation does not emerge, and Ukrainian inflation falls below 10 per cent over April-May 2008. The consumption bump likewise reverses in Q2, and drops a little further in Q3, possibly reflecting "pay back" for accelerated purchases "pulled forward" into Q1.

At the same time, the 2008Q2–3 reversal of Ukraine's consumption bump is moderated somewhat by a smaller Q2 increase in investment, which reverses in Q3, and by its narrowing net exports deficit, especially from Q3 (Figure 4.3). The Q2 investment bump is interpreted as a secondary effect, representing a lag in the implementation of projects committed-to but not yet paid-for before the high inflation emerged.

Ukraine's 2008Q3 narrowing of net exports—ahead of the GFC acute-phase and Romania's narrowing in Q4—in turn reflects reduced flows of international financing as Ukraine enters recession, as Western flows are cut-off following UBS's sub-prime losses in April (see Åslund 2010, 25; as discussed above), and as the commodities price shocks then hit in August. Romania sees the narrowing of its own sharper net exports deficit reversal begin only with the start of the acute-phase in Q4 of 2008, while the Ukrainian narrowing slows somewhat, allowing Romania to more-than catch up, and resulting in only a little net differential effect in the net exports component (Figure 4.2, panel 4).

4.5.1.3 Acute-Phase: BoP Crises

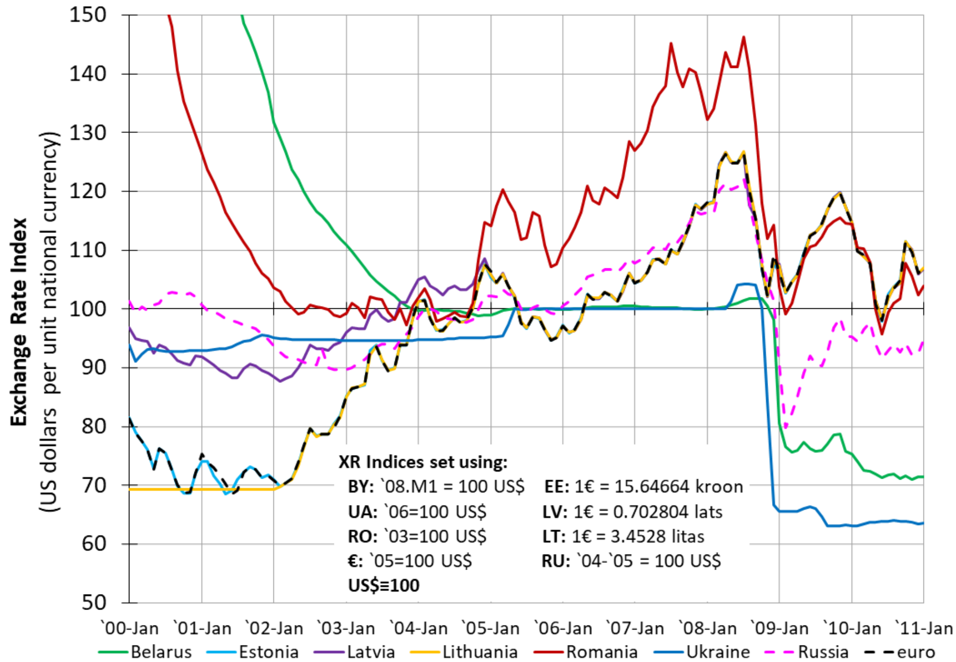
The second major contributor to the difference between Ukraine's and Romania's output contractions takes place from 2008Q4 as GFC acute-phase begins. The Ukraine-Romania investment differential shows a sharp negative shock in Q4 of 2008 (Figure 4.2, panel 2), primarily reflecting a large Ukrainian investment contraction. The investment differential's Q4 drop is then only partly countered by the smaller main contraction in Romanian investment—delayed to Q1 of 2009 following a small 2008Q4 increase—along with the slowing contraction in Ukrainian investment.

Credit crunches are expected to provide the primary contractionary shock during the GFC acute-phase; but Ukraine and Romania again experience very different credit dynamics throughout 2008–2009 (Figure 4.5). Romanian bank credit better illustrates the expected pattern, with a general slowing and a crunch that eventually lasts through 2010 (albeit with some volatility in September 2008 and December 2008 to January 2009).[25] In contrast—following the crunch experienced in early-2008—Ukrainian credit expands again from June 2008; and in sharper contrast, Ukrainian bank credit growth further accelerates from October 2008, peaking in December. That is, Ukraine's late-2008 credit dynamics are the opposite of that which would be expected during the GFC acute-phase, and would initially suggest increased domestic activity as-expected credit crunch. Instead, Ukraine's late-2008 credit surge appears to represent speculative borrowing in-the-face-of and fuelling a BoP crisis and eventual currency crisis.

This section examines the Ukrainian and Romanian currency crises, to demonstrate their differential real effects, and to introduce the framework that will be used in comparing Latvia and Belarus. Analysis of each case starts by considering the pre-crisis conditions playing into the BoP crisis dynamics: the choice of exchange rate regime (XRR); misalignment of the real effective exchange rate (REER); and adequacy of foreign exchange reserves (FXR) as a ratio of the domestic monetary base (MB). Each country's broad GFC period experiences are then described, followed by AA-DD analysis of how those experiences affect the real economy, especially during, but also after the acute-phase. AA-DD analysis (as per Krugman, Obstfeld and Melitz: 2012) provides a tool to examine the effect of economic shocks on both output and exchange rates, and thus on the different

[25] Before 2007 the six cases considered here reported only bank credit, and not also credit issued by other financial institutions (OFIs). Since the GFC Belarus, Romania and Ukraine began reporting some OFI credit data, including retroactively, at only quarterly or annual frequency. Regardless, the main analysis seems likely to hold, as the OFI contributions appears relatively stable over time (see 4).

Figure 4.7. Market Exchange Rates (USD/UNC)

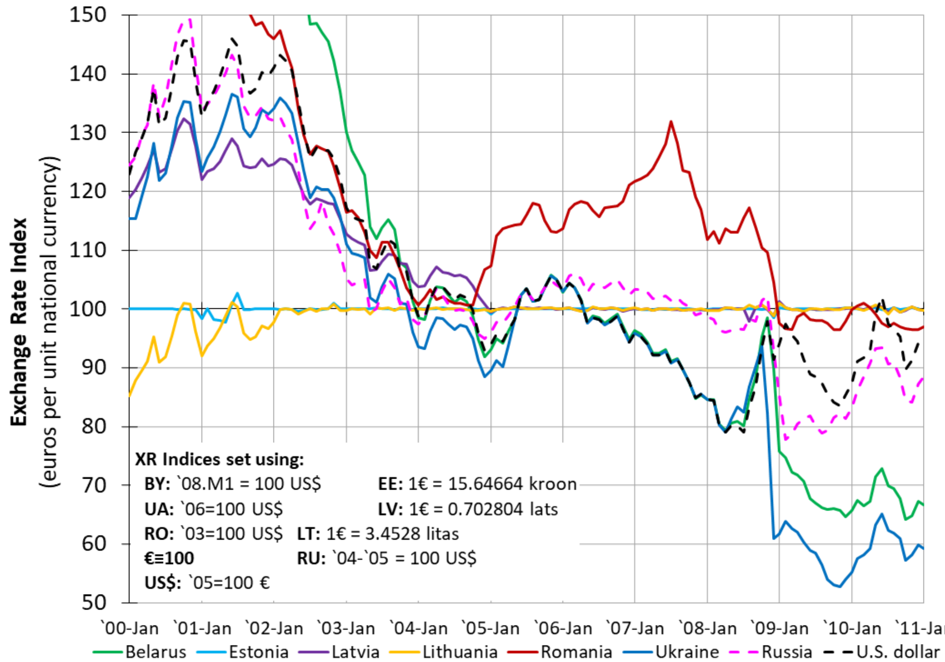


Source: IMF IFS, author's calculations.

output results under different exchange rate regimes. AA-DD is similar to standard aggregate-supply–aggregate-demand analysis (or IS-LM), but focuses on the relationship between output and exchange rates instead of between output and prices. The analysis in this chapter uses the AA-DD model illustratively, to highlight critical shifts, and provide rough estimates of counterfactual outcomes. A brief explanation of AA-DD analysis and of the construction of the AA-DD curves used in this chapter is provided in Appendix 4E. While the AA and DD curves are calibrated to the empirical observations of these cases, the results are still hypothetical.

In addition to movements of each currency's currency with respect to those to the major foreign currencies to which they each may (or may not) peg—that is, the U.S. dollar (Figure 4.7) and the euro (Figure 4.8)—each currency's relative misalignment with respect

Figure 4.8. Market Exchange Rates (€/UNC)



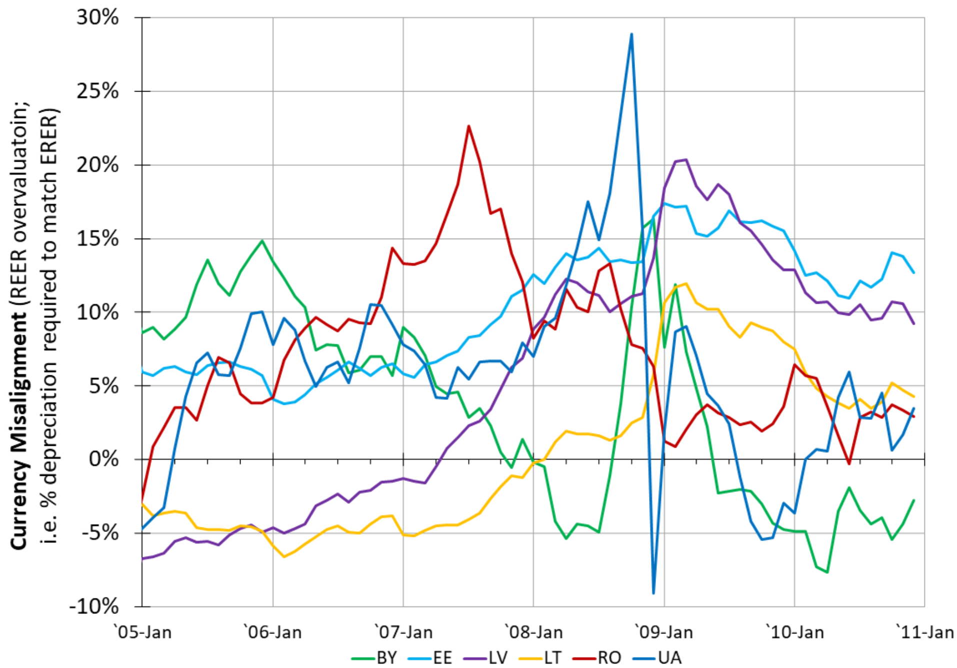
Source: IMF IFS, author's calculations.

to its equilibrium real exchange rate (ERER) must be examined (Figure 4.9). In order to consider such currency misalignments at a monthly frequency, annual ERERs from the EQCHANGE database (Couharde et al. 2017) are adjusted using monthly real effective exchange rates (REERs) from the BIS, (and from the IMF for Ukraine, on which the BIS does not report).[26,27] Based on trade weighted averages of market exchange rates, REERs

[26] The versions of EQCHANGE's misalignments used here are those based on: REERs obtained using a *time variant* weighting scheme and a *broad* panel of (186) trading partners; and ERERs obtained using their *model 3*—which includes terms of trade, relative productivity of the tradable sector and net foreign asset position as the fundamentals underpinning long-run movements of the real exchange rate—specifically on an *EME* sample, save for Estonia, which is only available based on the *full* sample of all countries.

[27] The REERs for each group are shown in Figure 4C.10 and Figure 4C.11. REERs for the Baltics and Romania are from the BIS, while those for Ukraine are from the IFS and for Belarus from the National Bank of the Republic of Belarus. Each source uses slightly different approaches to calculating REERs, so the values for Ukraine and Belarus may not be perfectly comparable to those for the others. However, comparing the BIS and IFS values for Latvia and Romania—the two countries in the sample for which REER data was available from both BIS and IFS—show the discrepancy to be quite small (Figure 4C.12).

Figure 4.9. Currency Misalignments

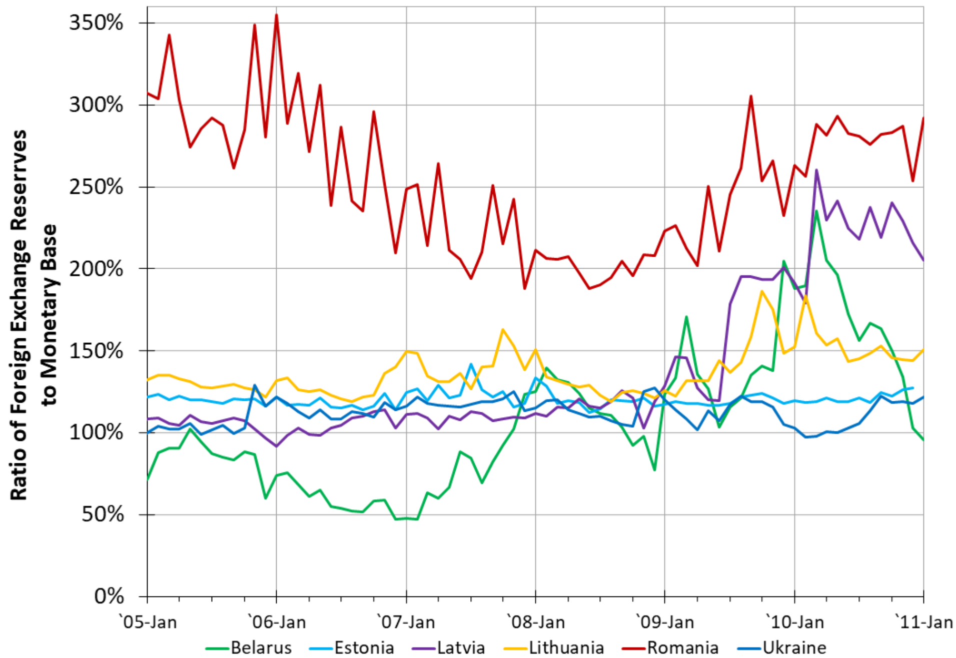


Source: EQCHANGE, BIS, IMF IFS (for Ukraine), National Bank of the Republic of Belarus, author's calculations.

are readily available at the monthly frequency, representing changes in overall exchange rate valuation, but only relative to an arbitrary reference period (e.g., "2005=100"), which neither necessarily nor typically represents a period within which the exchange rate is in fundamental balance. In contrast, using a behavioural equilibrium exchange rate (BEER) approach, EQCHANGE estimates ERERs at which a currency would be in equilibrium with country fundamentals.[28] When subtracted from a currency's actual REER, the ERER provides an estimate of how misaligned the currency is from its fundamental, in absolute

[28] This BEER approach "directly estimates an [ERER] for each country as a function of medium- to long-term fundamentals of the REER" (Couharde et al. 2017, 4), in contrast to: the "macroeconomic balance" approach, which "calculates the difference between the current account (CA) projected over the medium term at prevailing exchange rates and an estimated equilibrium current account"; and the "external sustainability" approach, which "calculates the difference between the actual [CA] balance and the balance that would stabilize the net foreign asset position of the country at some benchmark level" (4).

Figure 4.10. Foreign Exchange Reserves Adequacy



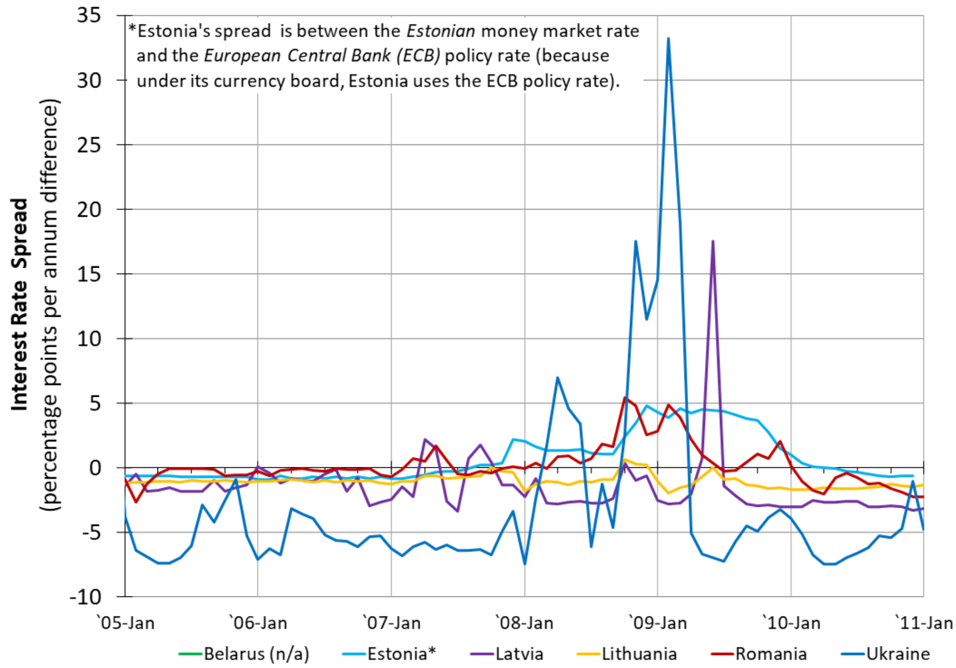
Source: IMF IFS, author's calculations.

terms, with the difference (REER minus ERER) representing the amount of REER depreciation needed to bring the REER to its equilibrium level. However, EQCHANGE provides these ERER and currency misalignment estimates at only the annual frequency, which is not adequate for analysing the currency dynamics of these countries during the GFC. To estimate absolute currency misalignments at the monthly level, the monthly REER values were adjusted, re-centering each year's 12-months of REER change around the annual misalignment values. Figure 4.9 thus illustrates currency misalignment dynamics at the monthly level for each country.[29]

Figure 4.10 shows the ratio between each country's foreign exchange reserves

[29] If Figure 4.9 is too cluttered, Figure 4C.8 and Figure 4C.9 show the currency misalignments separately for Ukraine and Romania, and for the Baltics and Belarus.

Figure 4.11. Interbank Money Market-Central Bank Lending Rate Spreads

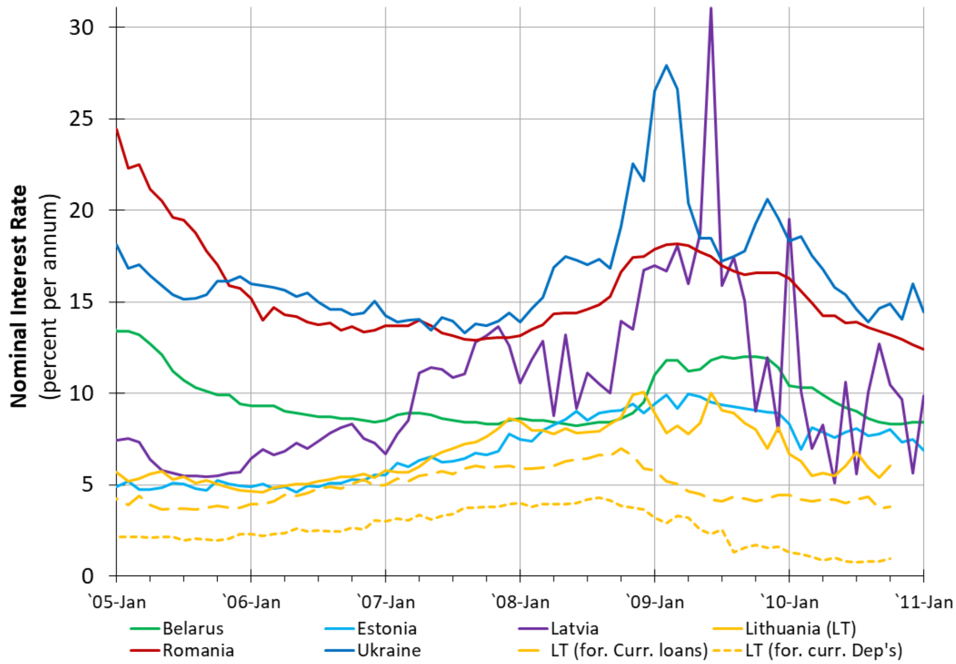


Source: IMF IFS, author's calculations.

(FXR) and the domestic monetary base (MB), providing a measure of the "adequacy" of reserves for maintaining a fixed exchange rate. Under a liberalized capital account, the monetary authority fixes the exchange rate by exchanging domestic currency for foreign currency (i.e., for FXR) on demand. The total of domestic currency available to be exchanged is the MB. Thus, in order to maintain control over the exchange rate, a central bank must hold more FXR than the level of MB in the economy. If reserves become merely expected to drop below the level of the monetary base, a rush to exit ensues, with holders seeking to exchange domestic currency (MB) for foreign currency (FXR) before the exchange rate peg fails and the currency depreciates. The ratio between FXR and MB thereby provides an initial estimate of "reserves adequacy".

Additionally, the Money Market-Central Bank interest rate spread (Figure 4.11)

Figure 4.12. Bank Lending Interest Rates



Source: IMF IFS.

and Bank Lending Interest Rate (BLIR) (Figure 4.12) will be examined for each country, to consider the role of banking system stresses on the real outcomes. As discussed in the literature review, the countries in this comparative analysis all faced some bank system challenges, though these varied significantly. Central to the broader GFC narrative is the freezing up of advanced economy and international interbank markets. Domestically, such problems in the bank system are identified by large increases in the spread between the interbank Money Market (MM) and Central Bank (CB) interest rates.

Under banking system stress, as banks lose confidence in each other's ability to repay loans, they charge higher interest rates for interbank loans, raising the country's overall MM rate. When that rate increases to greater than the CB rate the MM-CB spread becomes positive, with banks charging each other more to borrow than is represented by a large positive MM-CB spread, though no clear cut-off has been generally identified for a “freeze”. However, such interbank freezing does not necessarily directly affect the real economy. As such, each country’s BLIR is considered as an indicator of the influence of the bank system on the real economy during the crisis period. An increasing BLIR reflects higher costs to borrowing domestically, and so provides an indication of the drag on the real economy from changes in the bank system—correlated with but somewhat independent of stresses in the bank system itself

Romania: External Adjustment

During the GFC, Romania allowed simple external adjustment under a flexible exchange rate, minimizing output loss by permitting exchange rate depreciation. The IMF (AREAER) considers the Romanian exchange rate regime to have been increasingly flexible in the lead up to the crisis, shifting from “managed floating” in 2004–2007 to outright floating in 2008–2011. From 2005 the National Romanian Bank (NRB: the Romanian central bank) introduced an inflation targeting regime in aid of Romanian EU accession, planned for and accomplished on January 2007. Under inflation targeting, which trades off increasing inflation for exchange rate appreciation, the relative stability of the leu vis-à-vis the Euro in 2005–2006 (see Figure 4.8) appears to reflect limited inflationary pressures (c.f. Figure 4.6), rather than any direct control of the exchange rate. Then, facing increasing inflationary pressures in 2007, and with the central bank policy interest rate increasing rapidly (Figure 4C.20) to counter actual inflation, the leu appreciates significantly until July, with the REER reaching 22.6 per cent overvaluation in July

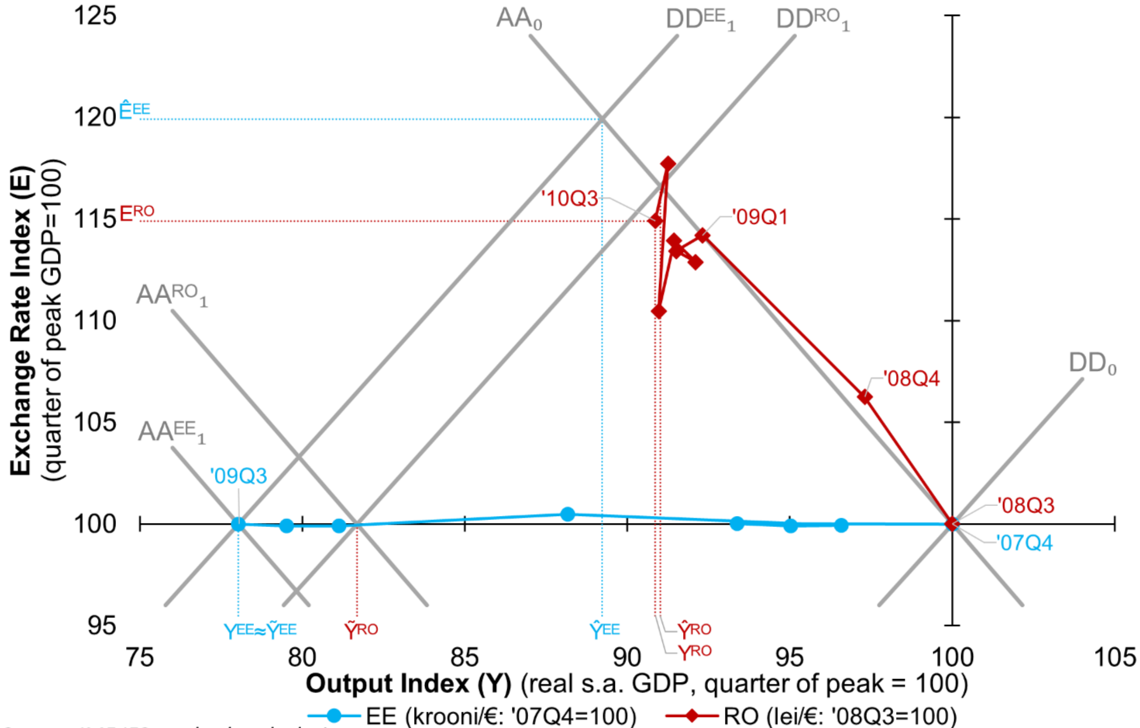
(Figure 4.9). As the severe drought of June to July 2007 creates further inflationary pressures, some inflation is permitted, allowing the leu to retreat to less than 10 per cent overvaluation by year-end. Further moderate appreciation brings Romania to 13.3 per cent overvaluation in August 2008 as the oil price shocks begin, just ahead of the GFC acute phase. Throughout the pre-crisis period, Romania also holds very large FXR, generally on the order of 200 per cent of the monetary base (Figure 4.10). While those reserves would have been clearly adequate to peg the leu against a foreign currency, under a floating exchange rate regime, they serve no such purpose.

During the acute-phase, external shocks wash over Romania: the commodities price collapse, the reduced international financing and reversal of credit booms, and the demand shock for manufactured goods. In this context, the National Bank of Romania allows adjustment to take place externally, through shock-absorbing exchange rate flexibility. Currency overvaluation drops to 7.8 per cent by October, then 1.2 per cent in January, and just +0.9 per cent in February, bringing the leu to near full currency alignment (Figure 4.9).

Figure 4.13 illustrates the Romanian and Estonian adjustments under the AA-DD model, with the AA and DD curves empirically calibrated to those cases.[30] For Romania, the GFC shocks to aggregate demand move the DD_0 curve left, eventually as far as DD_1^{RO} (running through the Romanian trough at ’10Q3); but Romania’s monetary “non-response” leaves the AA_0 curve unchanged (at least initially), allowing full external adjustment: the

[30] See Appendix 4E regarding the calibration of the AA and DD curves to the Estonian and Romanian cases respectively.

Figure 4.13. AA-DD Analysis: Romania and Estonia



Source: IMF IFS, author's calculations.

economy adjusts along AA_0, with 14.2 per cent depreciation by the end of ’09Q1, reaching the market-determined exchange rate consistent with no misalignment, and with contraction by about 7.5 per cent, accounting for most of Romania’s nearly identical predicted and observed contractions (to $\hat{Y}^{RO}$=91.5 and Y^{RO}=90.9 respectively).[31]

Romanian BLIRs increase especially in October and November 2008 (Figure 4.12), which drives the investment slowdown that then manifests in Q1 of 2009. Lending rates are increased to maintain some profit spread, above the increases in bank deposit interest

[31] Additional Romanian dynamics after ’09Q1 suggest further details not considered here (involving additional small shifts both the AA and DD curves after ’09Q1), but which account for only a small portion of the total observed Romanian contraction and depreciation (to Y_{RO}=90.9 and E_{RO}=115.0).

rates needed to slow the withdrawal of bank funds. The BLIR increase also reflects the sharp increase in the MM-CB spread in October (Figure 4.11), as the Romanian interbank market "ground to a halt" in October 2008 following a "short-lived deposit run on one commercial bank" (Bakker and Klingen 2012, 147), but which did not turn systemic. This spread-widening was wholly underpinned by increasing interbank money market rates (see Figure 4C.19). Having already increased the central bank policy rate by 3 pp (Figure 4C.20) to counter the inflationary stresses in late-2007 to mid-2008, the National Bank of Romania held its rate steady in late-2008. Nonetheless, the Romanian policy rate gained in relative terms, as the European Central Bank and the U.S. Federal Reserve decreased the euro and dollar rates starting in October 2008, thereby increasing the relative attractiveness of the leu and providing some counteraction to capital outflows. Specifically, though, the increasing BLIR shows that the Romanian investment decline is the result of private investors being unable to invest due to higher borrowing costs and the scarcity of funds, rather than reflecting investors' lack of desire to invest due to pessimism about the economy; the latter would manifest in lower interest rates as banks decrease the cost of borrowing to match the reduced demand. That is, rather than a demand shock transmitting to an investment decline through the confidence channel, a shock to the supply of capital funding led to the investment decline through the interest rate channel.

Figure 4.13 also illustrates the simple case of simple full internal adjustment, as undertaken by Estonia. (The Estonian case is discussed more fully, with Lithuania, in Appendix 4A.) The crisis-induced shocks push DD_0 toward DD_1^{EE}, creating contractionary and depreciatory pressure on the economy. This output market adjustment takes place relatively slowly, though most strongly over 2008Q4 to 2009Q1. But under a fixed exchange rate, the monetary authority intervenes, undertaking open market operations by purchasing the domestic currency with FXR, thereby shifting the AA curve leftward. As monetary and financial markets adjust much more quickly than the output market, the AA curve adjusts immediately to the reduced monetary supply, almost-precisely matching the DD curve's leftward pace, thereby maintaining the exchange rate (i.e., near E=100, within Estonia's ±2.5 per cent pegged band). With a credible peg and adequate FXR, the DD curve's eventual shift to DD_1^{EE} is matched by AA's shift to AA_1, and the Estonian economy reaches its trough in '09Q4. Under full internal adjustment, Estonia's exchange rate peg is thus maintained, albeit at the cost of greater actual contraction (by 22 per cent, to Y^{EE}=78.0 in '09Q3) than if external adjustment (as for Romania) had allowed the exchange rate to fall (by a third, to $\hat{E}^{EE}$=75.0) with smaller contraction (of 10.8 per cent: $\hat{Y}^{EE}$=89.2).

Ukraine: Unsuccessful Internal Adjustment with Depreciation

Ukraine also experienced a BoP crisis during the GFC, first resisting currency depreciation through internal adjustment, but then having to accept external adjustment, and subsequently facing further complications. According to the IMF (AREAER) the Ukrainian hryvnia was under a conventional peg to the U.S. dollar since 2002, following gradual appreciation in 2001 and notwithstanding further appreciation in April–May 2005 (see Figure 4.7). Fundamentally less credible than the legislated strictures of a currency board arrangement, this conventional peg nonetheless had generally adequate reserves going into 2008 (Figure 4.10) as inflation hit its peak (Figure 4.6).[32] While reserves had been maintained at greater than 108 per cent of the monetary base since November 2005, and reached 120 per cent in March 2008, they fell to 109 per cent in July 2008, before ticking up to just over 110 per cent in August.

The hryvnia was also only moderately overvalued going into 2008, with the U.S. dollar—and thus the dollar-pegged hryvnia—depreciating against the euro in 2006–2007 (Figure 4.8). In 2008 Ukraine's REER then surged upward as hyperinflation began and efforts to counter it gained traction, including permitting a 4.0 per cent appreciation of the hryvnia against the dollar in May–June 2008 (Figure 4.7). The hryvnia reached 17.5 per cent overvaluation in June, but backed off to 14.9 per cent in July as inflation bottomed out. With the oil shocks of August and the onset of the GFC and dollar appreciation, increasing overvaluation and reserves loss began again—reflecting the early stages of capital flight and currency speculation, but also possibly traded-off for less extreme inflation (recall Figure 4.6). Reserves fell to 103.4 per cent of MB and the hryvnia reached 28.9 per cent overvaluation in October 2008, despite the nominal exchange rate decreasing back to its pre-June U.S. dollar level (Figure 4.7).

Facing an imminent BoP crisis in October, Ukraine "sensibly" and "rapidly" requested aid from the IMF, seeking a "large emergency credit line to reopen access to international finance, unfreeze the domestic credit market, and salvage the hryvnia's

[32] See Nenovsky, Hristov and Mihaylov (2002), Camilleri Gilson (2004) and Hanke and Schuler (2015) for discussion and comparison of currency boards, currency board "orthodoxy" and currency-board-like arrangements, the details of which are not important for this study.

exchange rate from too sharp a dip" (Åslund 2009b, 376). Negotiations with the IMF took less than two weeks, and the Ukrainian parliament passed the required budget cuts, which were signed into law on November 3. The IMF executive board approved the stand-by arrangement (SBA) on November 5, releasing a "front-loaded" \$4.5 billion first tranche of \$16.4 billion worth of credit, with subsequent tranches to be released following quarterly reviews over two years. The IMF loan provides the November increase in reserves adequacy seen in Figure 4.10.

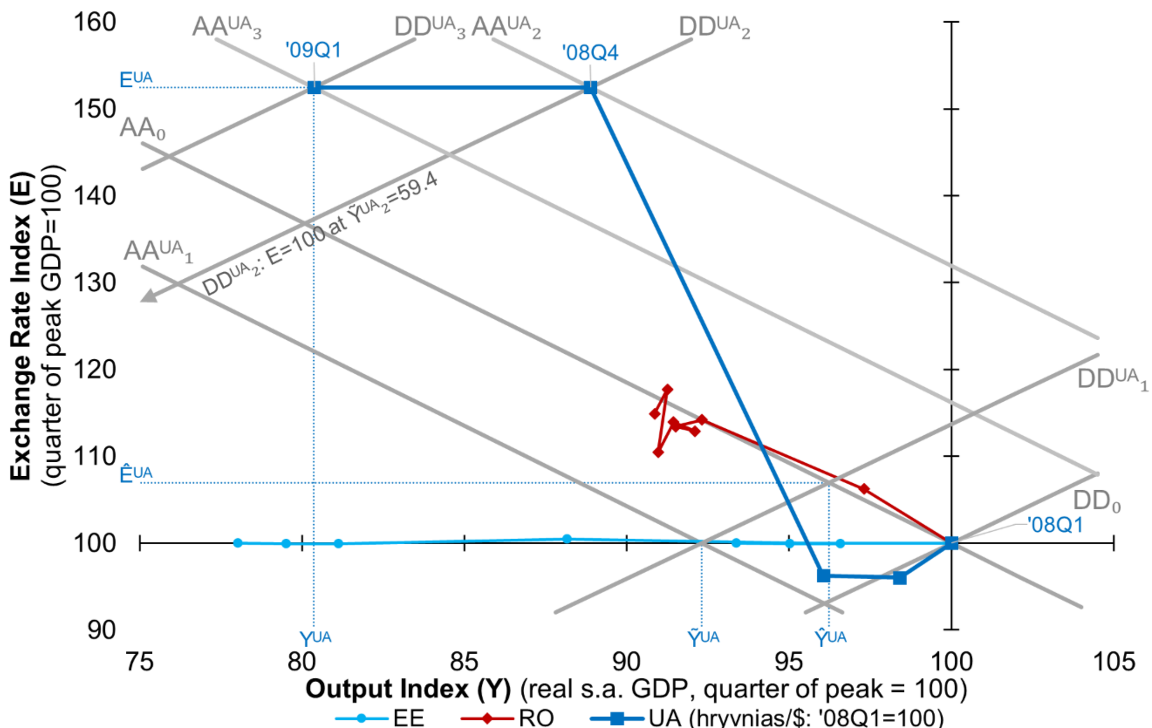
To alleviate the currency pressures Ukraine agreed to float its currency rather than just devalue it—in essence submitting to the currency attack as a condition for IMF support.[33] The hryvnia dropped 59.0 per cent against the dollar (Figure 4.7) by January 2009, relative to early 2008 (or by 52.5 per cent against its mid-2008 level).[34] This depreciation brings Ukraine fully out of currency overvaluation, reaching 9.1 per cent undervaluation in December 2008 (Figure 4.9), but rebounding to 2.5 per cent overvaluation in January—typical overshooting dynamics for an overvalued currency allowed to depreciate freely.

In AA-DD terms, Ukraine initially resisted external adjustment, seeking to maintain its exchange rate peg through internal adjustment. The initial shocks over the course of 2008 shift the DD curve leftward in Figure 4.14, from DD_0 toward DD^{UA}_1, while monetary

[33] Intriguingly, but beyond the scope of this study to explore, the IMF later indicated that "Moving to a flexible exchange rate regime was the pillar of exchange rate and monetary policy program design, but *implementation resembled* a step devaluation (IMF 2011b: 25; emphasis added).

[34] Note that these devaluation values are quoted in standard direct terms (i.e., per cent change in hryvnia per U.S. dollar), though Figures 4.7 and 4.8 are both shown in indirect terms.

Figure 4.14. AA-DD Analysis: Ukraine



Source: IMF IFS, author's calculations.

interventions shift the AA curve leftward, matching the DD shift so as to maintain the exchange rate peg, aiming for an outcome like that where $DD^{UA}{}_1$ crosses the E=100 axis, at $\tilde{Y}^{UA}$=92.3 (which is a little higher than Ukraine's own previous output level in '07Q4, not shown). But Ukraine's peg was not very credible and reserves were dwindling, so people began to expect an end to the peg, and eventual depreciation to take the currency out of overvaluation. The resulting lower expected exchange rate puts rightward pressure on the AA curve, requiring the authorities to spend even more reserves to achieve the leftward AA movement that would maintain the peg by matching the ongoing DD shift. This accelerating loss of reserves represents capital flight, drawing additional capital away from the domestic economy, thereby reducing domestic demand and shifting the DD curve further leftward to $DD^{UA}{}_2$ (far beyond $DD^{UA}{}_1$).[35] An even further leftward shift in AA would then be needed to maintain the peg, expending reserves even more quickly. With enough reserves available, the leftward AA-shift then necessary to maintain the Ukrainian peg would intersect the E=100 axis where $DD^{UA}{}_2$ does (at $\tilde{Y}^{UA}{}_2=59.4$). That is, to maintain the peg, Ukraine would have had to face a consumption contraction of almost 50 per cent (under the assumed linear nature and slopes of the AA-DD curves shown here). The National Bank of Ukraine did not have the reserves needed to undertake this magnitude of adjustment, so it was pulled beyond its *ability* to respond. Yet, even if it had such ability, the political repercussions of such a large contraction would very likely have pulled the economy beyond the authorities' *willingness* to undertake internal adjustment. In either case a shift from internal to external adjustment becomes necessary, ending the peg.

With the IMF unwilling (and perhaps even unable) to provide enough reserves to permit internal adjustment, Ukraine accepted the necessity of breaking the peg. In particular, Ukraine allowed the hryvnia to depreciate over Q4 of 2008, allowing external adjustment with AA shifting rightward. Empirically, the AA curve reaches $AA^{UA}{}_2$, in theory bringing exchange rate out of overvaluation. (The AA curve may also have temporarily shifted even further rightward, reflecting temporary overshooting effects not discernable at the quarterly data frequency shown in Figure 4.14). The economy thus

[35] The additional contractionary effect of capital flight is not endogenous to the AA-DD model, but is described by Krugman, Obstfeld and Melitz as follows (2012, 478, footnote 10):

> *If aggregate demand depends on the real interest rate (as in the IS-LM model of intermediate macroeconomics courses), capital flight reduces output by shrinking the money supply and raising the real interest rate. This possibly contractionary effect of capital flight is another reason why policy makers hope to avoid it.*

reaches a new equilibrium by the end of ’08Q4, with much greater contraction and depreciation than if full external adjustment was pursued from the start (to $\hat{Y}^{UA}$=96.2, assuming such exchange rate flexibility would also have prevented the additional DD-shifting capital flight). This outcome shows the costs of trying but failing to achieve internal adjustment rather than allowing external adjustment up-front.[36]

In comparative terms then, Ukraine’s output contraction during the acute-phase was larger than Romania’s because Ukraine sought to maintain its pegged exchange rate, thereby magnifying any shocks to its economy, and because it did so despite not holding reserves sufficient to the actual magnitude of shocks and ensuing capital flight. Ukrainian investment dropped precipitously in 2008Q4 not only as a result of the external shocks, but also because domestic and foreign economic actors expected the peg to end, so pulled economic resources out of the country and away from the real economy. For Ukraine, the BoP crisis and capital flight in 2008Q4 magnified and accelerated the impact of the GFC shocks, explaining why Ukraine faced a much larger contraction in investment, and thus output, than did Romania. Meanwhile, with a flexibly adjusting exchange rate, Romanian investment contracted under the combined shocks, but not to the extent, nor at the accelerated rate of Ukraine, and with the investment effects “delayed” until Q1 of 2009.

An outcome like that at ’08Q4 (in Figure 4.14) was the goal of Ukraine’s IMF program, but the fourth-quarter devaluations were, in the end, still not enough to end

[36] Ukraine’s contraction at ’08Q4 (Y^{UA}=80.4) is also deeper than the counterfactual of successful internal adjustment with no DD-shifting capital flight (i.e., at $\tilde{Y}^{UA}$=96.2, where DD^{UA}_1 crosses the E=100 axis). This is the outcome that might have been achieved under a highly credible peg with adequate FXR.

Ukraine's BoP crisis. After re-pegging to the dollar in January, the hryvnia reached to 9.0 per cent overvaluation by March, and capital flight resumed, exacerbated by failure to reach agreement in the first IMF review in February.[37] As such, the DD curve again shifts leftward (to $DD^{UA}{}_3$), and Ukraine returns to internal adjustment, moving the AA curve leftward (to $AA^{UA}{}_3$). While maintaining the exchange rate at its new value (E^{UA}=152.5), output fell much further, reaching Ukraine's observed trough (Y^{UA}=80.4) in '09Q1. Eventual agreement on the first review and release of the second tranche staved-off currency collapse again in April, as did agreement on the second review and disbursement of a third tranche in in July and August 2009. That second review agreement also required some devaluation in August and September, bringing the exchange rate to its lowest point at 58.6 per cent devaluation. With the hryvnia thereafter clearly out of overvaluation (reaching 4.2 per cent undervaluation in September 2009: Figure 4.9)—with output expanding again—Ukraine had "passed the most critical phase of the crisis" (Åslund 2009b, 382). Speculators apparently accepted that the currency was roughly in balance.

Ukraine's BLIR (Figure 4.12) also sees large increases from October 2008—much larger than those for Romania—emphasizing that the investment decline was again transmitted through the interest rate channel from a shock to the supply of credit. This credit supply shock is further seen in the huge spikes in the Ukrainian MM-CB spread

[37] Ukraine's limited follow through on program implementation and review reflected a "backdrop of sharp political divisions and weak institutional capacity" (IMF 2011b, 3) that undermined IMF program effectiveness. As of 2011 such "political economy considerations continue to drive policy making in Ukraine" (3), but which—along with potential roles for geopolitical influences, wealth concentration, corruption, oligarchy, kleptocracy and financial mismanagement—are beyond the scope of this dissertation.

(Figure 4.11), reflecting the freeze-up of interbank lending during the BoP crisis in October and November. That freeze—and the first MM-CB spike—eases in December as the IMF program came on-line, but spikes again in February 2009 as capital flight resumed, with the resignation of Ukraine's Finance Minister on February 13 (IMF 2009c), and failure to reach agreement on the first IMF review, scheduled for February 15. With the IMF then "very encouraged" by progress on first review negotiations through the rest of February (IMF 2009d), the spread starts to normalize over March and April. Staff level agreement on the first review on is reached on April 17 (IMF 2009a), and disbursement of the second tranche follows executive board approval on May 8 (IMF 2009e). Like for Romania, Ukraine's widening acute-phase MM-CB spread is wholly underpinned by increasing interbank MM increases (Figure 4C.19), with the CB policy rate held steady, against declining ECB and Fed rates, thereby countering reserves loss (Figure 4C.20). In addition to the decreased supply of credit, the demand for credit—specifically that denominated in hryvnias—may have risen, reflecting borrowing for speculation against the currency, and driving the BLIR up further. As such, Ukraine's banking crisis during its BoP crisis period is consistent with the third-generation model of currency crises, in which the banking and BoP crises are intertwined and mutually reinforcing. As such, any independent effect on output from the banking crisis cannot be distinguished from that due to the BoP crisis, and the AA-DD analysis above is taken to reflect the combined effect.

4.5.1.4 Summary for Ukraine and Romania

In comparing their GFC experiences, two major factors have been identified that help explain why Ukraine experienced a much deeper contraction than Romania. The first is Ukraine's idiosyncratic experience of near hyperinflation in early 2008, with consumption jumping significantly in Q1. This "consumption bump" determines the peak of Ukrainian output in 2008, so that its reversal in 2008Q2 spuriously initiates the Ukrainian contraction before the GFC acute phase. Under inflation targeting—and despite additional inflationary pressure from mid-2007 flooding—Romania sees much less extreme inflation, and no corresponding consumption bump, with its output contraction starting only with the GFC acute phase. As such, Ukraine experiences extra contraction depth, relative to Romania, due to the increase from its early 2008 consumption bump.

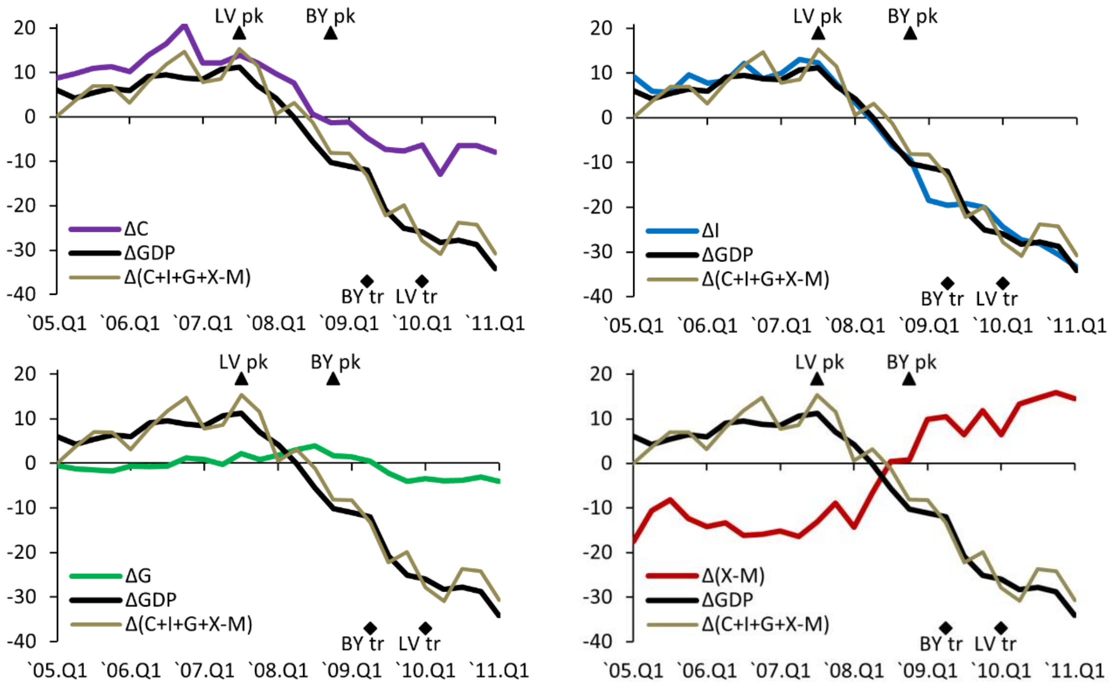
The second major factor explaining Ukraine and Romania's differing contraction depths is their experiences of—and policy choices during—their respective GFC acute-phase BoP crises. Undertaking full external adjustment, Romania's floating exchange rate performed its "shock absorber" role—that is, not magnifying the output shocks, as would a fixed exchange rate. In contrast, Ukraine sought to maintain its fixed exchange rate, with internal adjustment magnifying the shocks to output. Dwindling reserves, a low-credibility conventional pegged arrangement, a rapidly appreciating REER pushing the currency into high overvaluation, and speculative capital flight all reinforced each other. The initial attempts at internal adjustment magnified the investment and thus output contractions in Q4 of 2008, itself reflecting the total freeze-up of Ukrainian interbank lending, and skyrocketing BLIRs for lending to private investors. Outright currency collapse was averted only through external adjustment under an IMF-supported program. Additional internal adjustment in 2009 contributed further to the Ukrainian contraction. Along with the idiosyncratic effect of its early consumption bump, Ukraine's choice to defend its unsustainable peg goes a long way in explaining why Ukraine saw such a deep GFC output contraction, relative to Romania in particular, but—in taking Romania as relatively well-explained by the model in Chapter 3—more generally as well.

4.5.2 Latvia and Belarus

4.5.2.1 Differentials

Figure 4.15 shows the GDP and expenditure component differences between Latvia and Belarus (corresponding to those for Ukraine and Romania in Figure 4.2). The difference in GDP as reported (black line in each panel of Figure 4.15) shows a somewhat oversimplified story of Latvian growth slightly outpacing Belarusian until Q3 of 2007, with the Latvian contraction then dominating from Q4 2007, moderated somewhat in Q1 and Q2 of 2009 by Belarus's shorter and shallower contraction (see also Figures 4.16 and 4.17). The differential then drops again from 2009 Q3 as the Latvian contraction mostly levels out (reaching its actual trough in 2010Q1), while Belarus sees a V-shaped recovery over 2009Q3-Q4 and gradual but steady growth thereafter (and a larger increase in 2011Q1). But looking at the expenditure components, and their sum, again provides additional useful information. The differential between Latvian and Belarusian output as the sum of components (tan line in each panel of Figure 4.15) broadly follows the pattern of output as reported, but with more variation emerging from the various components.

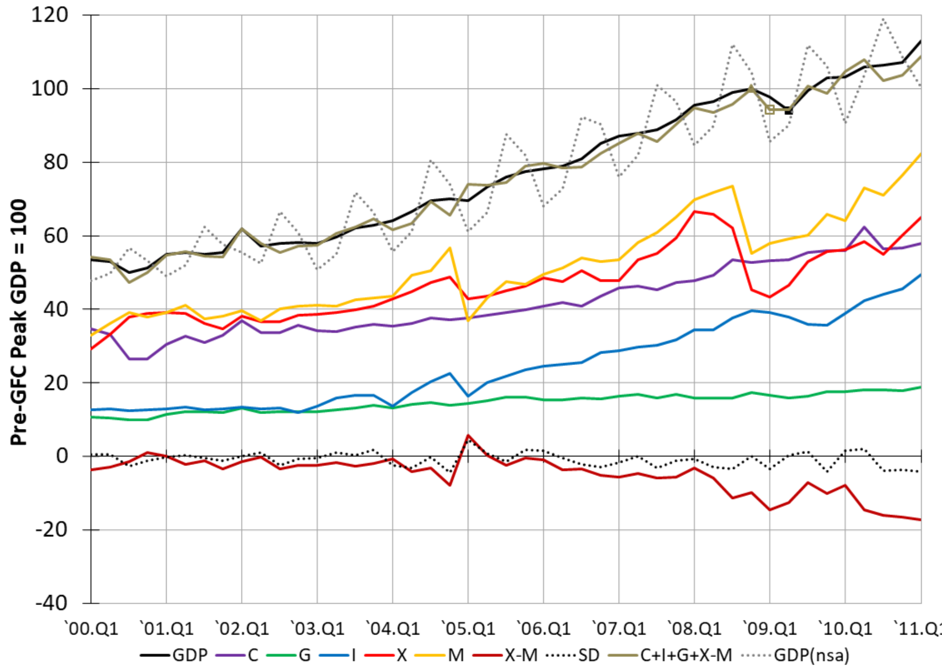
Figure 4.15. Output and Expenditure Component Differences: Latvia minus Belarus



Source: IMF IFS, author's calculations.

The differential between Latvian and Belarusian consumption (Figure 4.15. panel 1) shows overall a gradual increase to mid-2007, followed by a decrease to mid-2009, and levelling-off thereafter, but with additional variation to consider. In 2006, prior to the contraction period, differential consumption drives the sum of components, underpinned by Latvian consumption dynamics. While reminiscent of Ukraine's 2008Q1 peak-defining consumption bump, this increase does not directly determine Latvia's output peak, and largely reverts in 2007Q1, thereby playing little role in explaining the differential and actually increasing a little in 2009Q1—while on-going Belarusian consumption growth accelerates in 2008Q3 and then levels off until 2009Q2, with only negligible contraction in 2008Q4. They each then see similar gradual increases over the rest of 2009 and 2010,

Figure 4.16. Seasonally Adjusted Real GDP and Components: Belarus

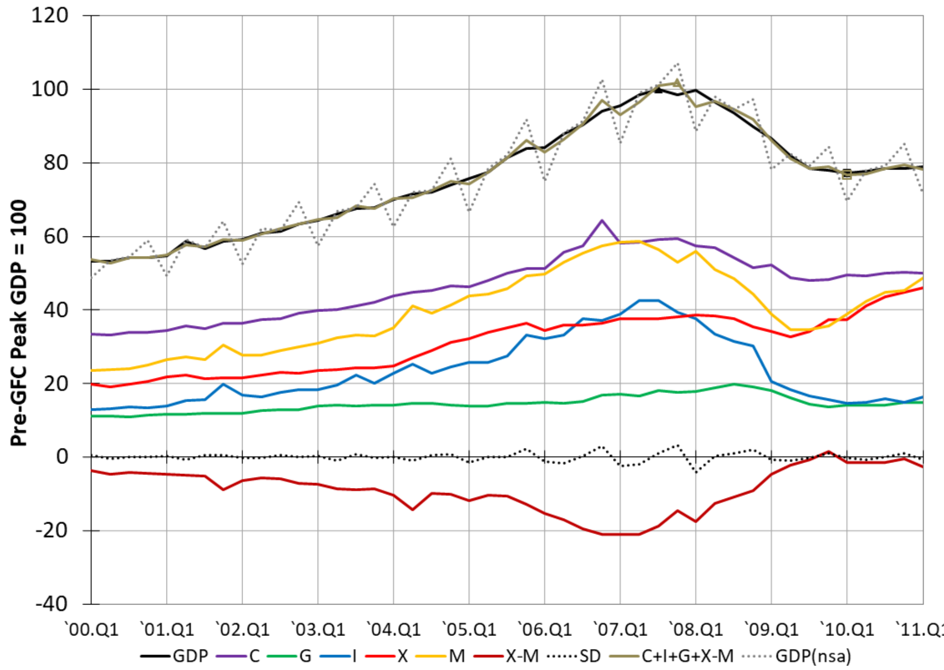


Source: IMF IFS, author's calculations.

with the differential mostly levelling-off, save due to a temporary Belarusian bump in 2010Q2, after both countries' output troughs. The main question here is: what drives Latvia's consumption contraction, as compared to Belarus's lack thereof?

The Latvia-Belarus investment differential (panel 2) again reflects the output pattern of gradual increase until late-2007, followed by decrease through 2010, but with further differences emerging during the acute-phase. A moderation in Latvia's investment contraction in mid-2008 is matched by a similar acceleration for Belarus, such that the investment differential decreases steadily though Q4. Latvia's strong 2009. Q1 investment drop then "overwhelms" the start of Belarus's much more modest investment contraction, pushing the differential down rapidly; but the Latvian contraction then slows to about the same rate as the Belarusian, with the investment differential nearly levelling off in

Figure 4.17. Seasonally Adjusted Real GDP and Components: Latvia



Source: IMF IFS, author's calculations.

2009Q2–Q4. From 2010Q1, the investment differential decreases again as Latvian investment reaches its trough and remains depressed through 2010 (increasing only slightly), while Belarus returns to high investment growth. The main question here is: why does Latvia see a much larger investment contraction in 2009Q1 than does Belarus?

Latvian and Belarussian government expenditures between show much smaller differences and changes (panel 3). Latvian government expenditures gradually increase until 2006, after which they accelerate to a peak in 2008Q3; they then decrease to a shallow trough in 2009Q4, reflecting austerity under the IMF SBA, and roughly level-off thereafter. In contrast, Belarusian government expenditures remain broadly stable, increasing gradually throughout the entire period, with relatively minor fluctuations. Overall, the Latvian changes—and thus the Latvia-Belarus differential changes—are not large, and play a relatively small and straight-forward role in this pair's differential contraction dynamics.

In contrast, the net exports differential for Latvia and Belarus (panel 4) increases, partly countering the decreasing investment and consumption differentials.[38] From mid-2005 the net exports differential decreases a little, and then levels-off in 2006Q4 to 2007Q2, reflecting faster external deficit-widening for Latvia, but with both deficits roughly levelling-off into 2007. From 2007Q3, the differential increases rapidly (with some volatility), as external financing from the Nordic Banks dries up and Latvian net exports starts its overall reversal (with volatility in 2007Q4 to 2008Q2). Meanwhile the Belarusian trade deficit narrows slightly in Q1 of 2008, and then counterintuitively widens through 2009Q1, albeit with some narrowing in 2008Q4 that leaves the differential briefly flat. In 2009Q1, the Latvian narrowing accelerates a little, while the Belarusian trade deficit widens sharply, together pushing the net exports differential up, and holding output level—for only one quarter as the sum of expenditure components, versus two for output as reported—despite the large drop in differential investment. The Latvian narrowing slows again from Q2, reaching full deficit reversal (i.e., a small surplus) in 2009Q4, while the Belarusian deficit peaks in 2009Q1 and narrows over 2009Q2–3, though leaving its trade deficit still larger than it was in early 2008. The differential thus mostly levels off from 2009Q2, but with volatility through 2010Q1 reflecting Belarusian variation and Latvia's return to a small deficit in 2010Q1. Belarus's deficit widens significantly in Q2 of 2010,

[38] See corresponding charts for exports and imports in Figure 4C.5.

and then increases more gradually through Q1 of 2011, while Latvia maintains only a small deficit through 2010, with the differential widening a little further overall. The main question here is: why do Belarus's net exports expand in 2008Q2–3, and especially in 2009Q1, in contrast with the expectation of a current account reversal due to reduced external financing—as seen for Latvia, as well as Ukraine and Romania, and for Belarus itself in 2008Q4 and 2009Q2–3?

Focusing on the major drivers of the differential Latvia-Belarus experience, the next two sections focus on the differences in Latvian and Belarusian output dynamics, resulting from different credit dynamics, and then from differences in their acute phase investment contractions, as related to their different BoP crisis experiences.

4.5.2.2 Credit Dynamics

Figure 4.5 shows the very different credit dynamics experienced by Latvia and Belarus, with major variations starting for Latvia from mid-2007, while Belarus sees relatively steady growth, with only a few minor fluctuations throughout.[39] In particular, Latvia experiences several distinct periods credit growth over 2007–2010. Following the boom, Latvian credit first contracts from mid-2007 through April 2008, though with a small December bump, as Nordic parent banks begin withdrawing funding from Latvian subsidiaries and the output contraction begins, initially in investment and then

[39] Recall that the results of Chapter 3 found no systematic relationship between countries' levels of credit (e.g., as a ratio to GDP) and contraction depth (or duration), but only a relationship with magnitude of their credit booms. As such, the difference between the level of credit going into the GFC (i.e., over 60 per cent of GDP for Latvia, versus around 20 per cent for Belarus) is assumed to not matter here.

consumption. Despite further narrowing of the trade deficit—and thus still limited external financing—moderate credit expansion resumes in May through August, slowing (but not reversing) the investment contraction. Credit growth slows markedly in September and October acute phase begins, representing another credit crunch due to the more general international sudden stop. Then—as seen with Ukraine, and discussed further in the next section—Latvia sees sharp credit expansion in November 2008, attributable to currency speculation and the emerging BoP crisis. With the initial round of IMF support in January 2009, Latvian credit falls through March, leveling-off at late-2007 levels before starting a broader retrenchment from September 2009.

In contrast, Belarus experiences limited changes in its credit growth throughout the GFC period. A relatively modest credit crunch is seen in January and February 2008, and while Belarusian output as reported does slow in early 2008—and even contracts a little as the sum of expenditure components—it accelerates again to reach its peak in 2008Q4, in either form. Rapid credit growth resumes from March 2008, even faster than during the previous boom, with very minimal slowing discernable during the GFC acute-phase, and only mild fluctuations—relative to the wide swings occurring in Latvia—occurring through 2010. It is clear, then, that Belarus is simply not experiencing credit dynamics as would be expected during the GFC period, let alone as Latvia did. Romania again illustrates the expected pattern for credit during the GFC—that is, for countries that did not experience the withdrawal of foreign parent bank financing in late-2007. Romanian credit grows relatively steadily until late-2008, and then mostly levels-off into 2009 (and indeed much longer), under the sudden stop effects of the GFC acute phase.

Underpinning Belarus's unusual credit dynamics is its extensive state control over the economy, including a system of "directed credits" and "bank lending under government programs", providing low-cost government resources to priority sectors at the "recommendation" of the President and/or Council of Ministers (see Bakker and Klingen 2012, 125; IMF 2011a, 12). From well-before the GFC, IMF Staff repeatedly raised concerns about Belarus's directed credit system (e.g., IMF 2005, 15) and recommended it be phased out (IMF 2006, 4). Then, during the 2009 IMF SBA period—and despite IMF staff recommendations and Belarusian authorities' agreement—lending under government programs continued "largely unabated". The IMF attributes the continued credit growth to lack of "full commitment" to or "ownership" of the program by the Belarusian authorities ("including at the highest levels"—that is, the President and Council of Ministers) and to "program flaws" (including lack of explicit conditionality to enforce agreed-on targets for reduced directed lending) (IMF 2011a, 9–12).

This vastly different credit dynamics experience reaffirms that Belarus simply did not face the same market-based pressures and effects of the sudden stop in international capital flows that other countries did during the GFC acute phase (c.f. Bakker and Klingen 2012, 127), let alone the shocks experienced by Latvia from mid-2007. Indeed, Belarus experienced no credit-crunch at all during the GFC acute phase, such that whatever mechanisms underpin the credit boom IV relationship in the Chapter 3 regression model appear to not apply to Belarus at all. Where that model shows that countries on-average experienced greater output contractions related to larger pre-crisis credit booms, Belarus appears to be an exception to the further assumption that the model applies well to countries individually—an assumption embedded in the comparative case selection process of this chapter. From this perspective, Belarus was only *coincidentally* “well-explained” by the model of Chapter 3—that is, with a relatively small residual on the depth DV despite quite different underlying dynamics from those represented in the model. Discounting the model’s predicted 8.0 pp increase in contraction depth associated with Belarus’s credit boom—while self-consciously assuming the other model components still apply relatively accurately—Belarus would counterfactually have experienced a contraction depth of only 1.5 per cent of peak GDP, and a residual of -8.5 pp—that is, even greater than those for Belize (BZ: -6.1 pp) and Bulgaria (BU: -6.3 pp) in Figure 4.1.

Without ascribing too much precision to the values of these counterfactual calculations, the question nonetheless emerges as to why, in the end, Belarus actually experienced such a deep contraction, given the apparent absence of any GFC-associated credit crunch. While not central to the main purpose of this chapter—that is, explaining the worse than predicted outcomes of Latvia and Ukraine—this question nonetheless benefits from the examination of Belarus’s BoP crisis experience, including in comparison to those of the other cases considered here.

4.5.2.3 Acute-Phase: BoP Crises

Belarus: Unsuccessful Internal Adjustment with Devaluation

Going into the crisis, the Belarusian ruble was fixed against the US dollar in a conventional pegged arrangement. The IMF (AREAER) considered the ruble to be de facto pegged against the dollar since 2005; but it was only officially (i.e., de jure) pegged to the dollar, from January 2008, when FXR reached well above 100 per cent of MB for the first time (Figure 4.10). But after peaking at nearly 140 per cent in March, reserves adequacy quickly narrowed. In absolute terms, reserves growth levelled off over April to August 2008, while an expanding monetary base pulled adequacy down in June and July, reaching 110.8 per cent in August. Yet, following the 2006 to early-2008 depreciation of the dollar—for example, against the euro and the Russian ruble (Figure 4.8), as the currencies of Belarus's major trading partners—the ruble became more than 4 per cent undervalued from March 2008 (Figure 4.9). It was then allowed to appreciate a little against the dollar, especially from May 2008, climbing 1.5 per cent by August 2008 (Figure 4.7). So, especially in July—but perhaps also into August—the ruble peg appeared sustainable, partly because it was not overvalued, but also because reserves appeared adequate (FXR/MB>110%), despite a relatively weak conventional peg (i.e., lacking currency board credibility). As elsewhere, though, the situation rapidly changed.

The oil price shocks of August kicked off U.S. dollar appreciation, taking the ruble with it (Figure 4.8). By October, the ruble reached 10.4 per cent overvaluation, reserves adequacy fell to 92.4 per cent, and Belarus requested help from the IMF. The ruble increased to 15.7 per cent and then 16.3 per cent overvaluation in November and December, while reserves remained below 100 per cent—recovering slightly to 97.9 per cent in November, before plummeting to 77.4 per cent in December.

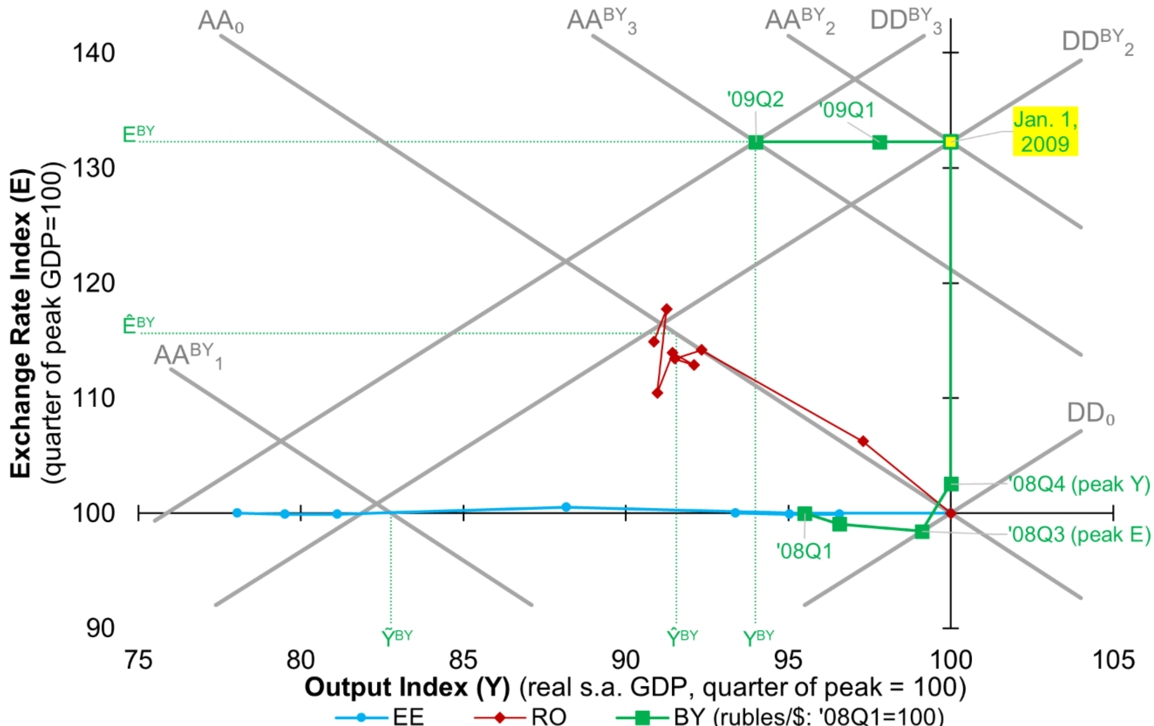
Initially, it is not clear why by that point—any time in October to December 2008—the Belarusian peg had not already collapsed; but the non-market nature of the Belarusian economy provides a ready answer, along with Belarus's lack of reliance on international capital markets (see Bakker and Klingen 2012, 127). The lack of exposure to western capital limited direct effects from the acute-phase sudden stop, and government influence in the Belarusian economy would constrain currency markets and limit currency speculation. Possible capital controls, and financial repression—for example, the government ordering firms and banks to not "flee" or speculate—would limit the potential for straight-forward accelerating capital flight and reserves loss. Indeed, Belarus sees no large surge in credit—financing currency speculation—as did Latvia and Ukraine in late-2008 (Figure 4.5). Perhaps more importantly—and despite Russian financing's previously declining path (Bakker and Klingen 2012, 127)—Russia provided a USD 2 billion government loan, with the first tranche of USD 1 billion disbursed in November. The National Bank of the Republic of Belarus also transferred some foreign currency assets to the foreign exchange reserve (IMF 2009b, 8; Åslund 2009b, 386). The Russian support would have been more than sufficient to cover the December 2008 gap of 1.1 pp of peak GDP between MB and FXR (see Figure 4C.16), equivalent to USD 795 million. Either way, Belarus staved off a currency crisis long enough to obtain further help from the IMF.

Following discussions involving two IMF missions to Belarus over October 27 to December 20, a 15-month SBA of nearly USD 2.5 billion was approved on January 12, 2009. The SBA required ruble "devaluation to a new dollar party 20 percent below the end-

October level… implemented on January 1, 2009… and a simultaneous switch to a currency basket (equal weights on the euro, dollar, and Russian ruble)" (IMF 2009b, 16). Over January 2009, the ruble dropped 24 per cent relative to its January 2008 peg against the dollar, or 26 per cent relative to its August 2008 peak, including additional depreciation in January from its new basket-peg and the appreciation of the dollar against the euro and Russian ruble (Figure 4.8). This devaluation helped reduce the ruble's 16.3 per cent December REER overvaluation to 7.6 per cent in January, but which climbed back to 11.7 per cent in February (Figure 4.9) due to further dollar appreciation. January's first tranche of IMF financing increases reserves significantly in absolute terms (Figure 4C.16), and—with MB decreasing almost as much—raises reserves adequacy to 123.4 per cent (Figure 4.10). The IMF thus helped mitigate the currency crisis, permitting Belarus to undertake only a partial devaluation (i.e., not fully eliminating overvaluation). Capital flight reversed in February, with reserves adequacy reaching over 170 per cent in March (due to increasing FXR, with MB relatively stable).

In AA-DD terms (Figure 4.18), Belarus faced initial GFC shocks pushing the DD curve leftward from DD_0. However, as discussed above, because of the nature of the Belarussian economy, Belarus was far less affected by the shocks of the GFC, so the DD curve did not shift leftward in '08Q1. With the help of renewed credit growth that would shift the AA curve rightward, the economy continued to expand in '08Q4 with only a little

Figure 4.18. AA-DD Analysis: Belarus



Source: IMF IFS, author's calculations.

devaluation permitted.[40] But with Belarussian reserves already less than adequate to fix the exchange rate (FXR/MB<100%), and with U.S. dollar appreciation pulling the ruble into overvaluation, the peg lost credibility. The resulting capital flight shifts the DD curve rapidly leftward, threatening a collapse of the ruble. With Russian support, Belarus turned to the IMF, reaching an agreement focused on partial external adjustment through devaluation, rather than the more complete depreciation required of Ukraine. The step devaluation on January 1, 2009 is shown in Figure 4.18 with an extra point in the otherwise

[40] New AA-DD curves at '08Q4 are not shown in Figure 4.18 to reduce clutter. Belarus's Exchange Rate Index is set to '08Q1=100 (rather than '08Q4=100) to emphasize the de jure USD-peg from '08Q1 at the long term de facto rate, and to highlight the appreciation permitted in '08Q2-3 and depreciation permitted in '08Q4, occurring before any contraction in output.

quarterly series for Belarus: with little change in output between the end of ’08Q4 and the first day of ’09Q1, but a large devaluation, the equilibrium point shifts vertically. The AA^{BY}_2 and DD^{BY}_2 lines are defined to be consistent with (i.e., intersecting) that January 1, 2009 point (still assuming linearity and slopes as per AA_0 and DD_0).[41]

An outcome like that at ’09Q1 in Figure 4.18 was the goal of Belarus’s IMF program, with devaluation helping minimize the contraction, and toward the end of Q1 2009 Belarus’s BoP crisis appeared resolved, with the currency now re-pegged to the dollar-euro-(Russian-)ruble basket. However, capital flight re-emerges in April 2009, underpinned by the still overvalued currency—if modestly at 7.7 per cent overvaluation in April, and declining (Figure 4.9)—and likely triggered by the announcement that Belarus did not fully achieve the IMF’s criteria for the first review. In particular the end-March target for accumulation of net international reserves was missed by USD $221 million, likely interpreted as reflecting inadequate reserves, despite the adequacy ratio reaching 171 per cent in March (but which may be more evident in hindsight). In addition, the first IMF program review dragged on, delaying disbursement of the second tranche planned for May 13, and exacerbating concerns and capital flight. From April, reserves fell steadily, to just 103 per cent of MB in June (with MB itself stable).

Meanwhile though—through the early-2009 recovery of oil prices and depreciation

[41] It is intriguing that DD^{BY}_2 intersects AA_0 very close to $Y=\hat{Y}_{BY}$, such that DD^{BY}_2 lines up surprisingly closely to where DD^{BY}_1 would be. (DD^{BY}_1 is not shown in Figure 4.18, in favour of DD^{BY}_2, and to reduce clutter.) That is, Belarus’s actual demand shocks as of January 1, 2009 (due to the GFC itself and any immediate capital flight) are very close to those predicted by the model from Chapter 2 (with no capital flight, and assuming AA and DD slopes as per AA_0 and DD_0).

of the U.S. dollar—Belarusian currency misalignment decreases in 2009 almost as quickly as it emerged in late 2008 (Figure 4.9). By June 2009, the ruble becomes slightly undervalued (by 2.3 per cent), reducing any fundamentals-based pressure towards currency crisis. With an IMF review agreement reached in June and disbursement in July, reserves start to increase and capital flight again reverses, seemingly more-sustainably this time as the currency remains undervalued through the rest of 2009 and 2010.[42]

In AA-DD terms, capital flight in spring 2009 again pushes the DD curve leftward (to $DD^{BY}{}_3$), with matching AA shift (to $AA^{BY}{}_3$) as internal adjustment maintains the new peg at the cost of further contraction. Belarussian output reaches its trough at ’09Q2, showing again that the actual contraction (to Y^{BY}=94.0) was smaller than predicted by the model under a flexible exchange rate with no capital flight (to $\hat{Y}^{BY}$=91.5)—and also much smaller than under full internal adjustment with no capital flight (at $\tilde{Y}^{BY}$=82.8, a little less than BY’s output in Q4 of 2006), for example, if Belarus had maintained a credible fixed arrangement with adequate reserves.[43] The smaller actual contraction again comes at the cost of a weaker currency (E^{BY}=132.3, versus $\hat{E}^{BY}$=115.6 or $\tilde{E}^{BY}$=100). Following the second IMF disbursement in June, and with the currency reaching undervaluation (see Figure 4.9), BoP pressures were eliminated and output growth turned positive.

Belarus’s BLIR also increases at the end of 2008, starting gradually in October and most rapidly in December, somewhat delayed relative to Romania’s gradual increase from

[42] Belarus does, however, face another balance of payments crisis in early 2011, and was unable to prevent currency depreciation (the details of which are beyond the scope of this dissertation).

[43] See note 37 regarding the similarity of $DD^{BY}{}_2$ to $DD_1{}^{BY}$. (The latter is not shown in Figure 4.18.)

July and sharpest increase in October. Likely reflecting the absence of an actual market for interbank lending, Belarus reports no money market interest rate, and thus no MM-CB spread. As such, it is not clear that an interbank lending freeze is even possible in Belarus. However—and after decreasing them as inflation increased in mid-2007—the National Bank of the Republic of Belarus did raise its policy rates significantly, by 25bps each in July, September, October and November, and then by 100bps in December and 200bps in January of 2009 (Figure 4C.20).[44] Again, then, Belarus's investment contraction—smaller though it is, even than Romania's—appears to reflect a shock to the supply of credit, transmitted to the real economy through the interest rate channel, though this shock was greatly mitigated by non-market environment, as well as government directed lending.

For Belarus, the BoP crisis and capital flight thus increased and magnified the output shocks of the GFC acute-phase, but those shocks were smaller than those faced by other countries. The relative absence of a Belarusian credit shock results in a smaller contraction than expected from the model in Chapter 3, while the BoP crisis and external adjustment in '09Q1-2 still amplifies the effects of the other shocks. These countervailing effects appear, then, to have cancelled each other out, with the coincidental result that Belarus appears "well-explained" by the Chapter 3 regression model, even though different underlying mechanisms are at play.

[44] Belarus's late-2008 policy rate increases would counteract capital outflows, relative to decreasing U.S. Federal Reserve and ECB rates; but they represent a smaller increase relative to Russian policy rates, with Russia as Belarus's main source of external financing, and most likely destination for capital flight.

Latvia: Successful Internal Adjustment with Capital Flight

The Latvian lats (plural: lati) was pegged to the IMF's Special Drawing Right from 1994. Following EU accession in January 2004, and in working toward euro accession by joining the ERM II mechanism on May 1, 2005, the lats was re-pegged to the euro from January 1, 2005, with only small fluctuations around that level thereafter (Figure 4.8). At the start of the new peg, the lats is roughly 6 per cent undervalued (Figure 4.9); but—as a result of maintaining the peg in the face of increasing inflation, a widening current account deficit, and a depreciating U.S. dollar—the lats swings to an average of 11 per cent overvaluation in 2008, still lower than Estonian overvaluation. Latvia also held ample and widening reserves, with FXR-to-MB reaching 125 per cent in September 2008 (Figure 4.10), higher again than Estonia's 120 per cent. With greater reserves adequacy and lower overvaluation than relatively well performing Estonia, it is not immediately clear why Latvia would face a BoP crisis, a situation clearly illustrated by its reserves adequacy (FXR/MB) dropping rapidly from October 2008 to reach just 102.7 per cent in November.

A major factor contributing to the Latvian BoP crisis is the weak credibility of its peg. Though sometimes considered a "quasi-currency board" (Bakker and Klingen 2012, 114; Blanchard, Griffiths, and Gruss 2013, 334), the IMF AREAER classifies the Latvian peg as a "conventional pegged arrangement" from 1994 through 2011. Reinforcing the perception of weakness, Latvia also had a poor history of reserves adequacy, which fell below 100 per cent in December 2005 to May 2006, and close to 100 per cent in December 2006 and April 2007 (Figure 4.10). In each of these episodes the lats remained undervalued (Figure 4.9), preventing any crisis. Reserves rebounded in May 2007, and for the rest of 2007 the monetary base shifted more in-step with reserves, reflecting greater (i.e., "quasi-") currency-board-like behaviour. Then, from around March 2008, reserves expanded further while the monetary base was held relatively stable, presumably to counter further overheating and inflation and to accumulate reserves. Yet, in October 2008 reserves adequacy drops slightly, and then sharply in November—reflecting a large decrease in actual reserves (by nearly 20 per cent from October) against a smaller (5 per cent) drop in the monetary base, bringing adequacy down to 102.7 per cent. Why did those outflows emerge so strongly, and why did Latvia not adjust its MB in corresponding manner?

Blanchard, Griffiths and Gruss (2013, 340–1) answer this question, linking it to the government's choice to help Parex Bank, Latvia's second largest (and largest domestically-owned) bank, holding 14 per cent of total banking assets. A "bank walk" on Parex began in July 2008 and turned into a run in October and November, with much of the withdrawn deposits converted into foreign currency, drawing down reserves. As Blanchard, Griffiths and Gruss point out, had the lats been pegged through a strict currency board, reserves loss would have been automatically matched by a monetary base reduction, such that the adequacy ratio would have been maintained. Instead, without the legal constraints of a currency board arrangement to provide "cover", the Bank of Latvia came under "strong pressure to provide funds to Parex", and:

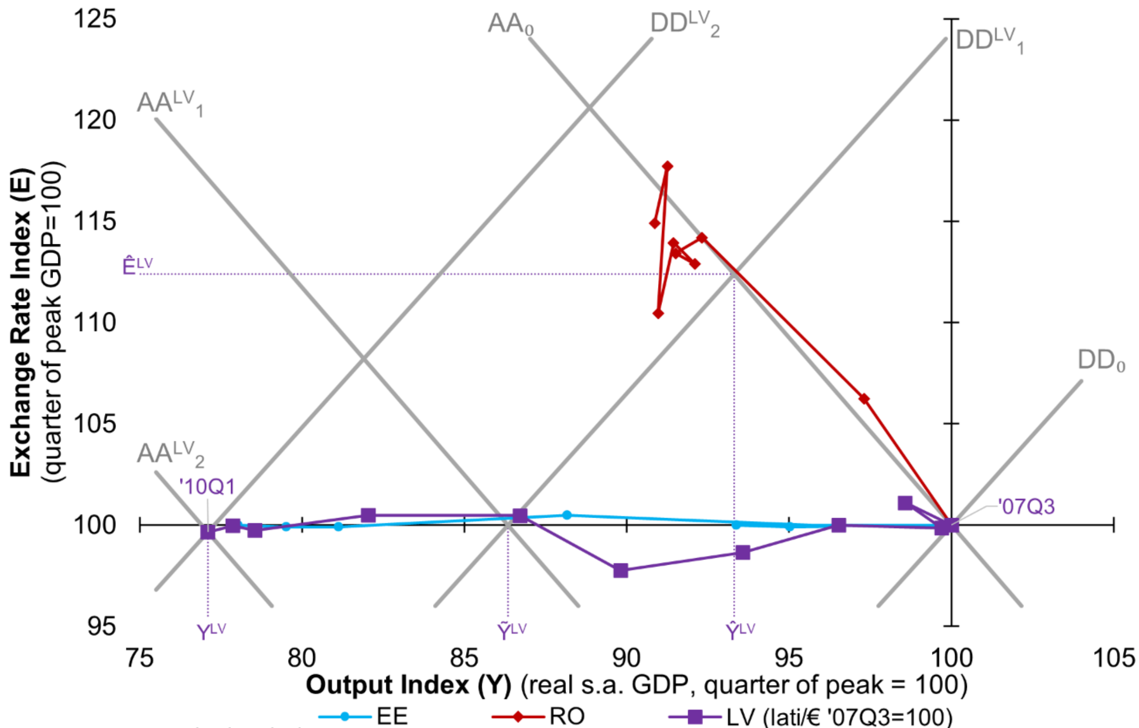
> *This was eventually done, though indirectly. The government placed Treasury bills and increased Treasury deposits at Parex (to one-third of total deposits by end-2008), which in turn used the bills to obtain financing from the central bank to fund deposit outflows. (Blanchard, Griffiths and Gruss 2013, 341)*

That is, by purchasing the Treasury bills from Parex in exchange for lati—which would have not been permitted under a strict currency board—the central bank was effectively sterilizing the effect of the capital flight on the monetary base. By holding the monetary base level despite declining reserves, reserves adequacy quickly decreased. In classic BoP theory, expectation then emerges of an exchange rate change, driving capital flight further, and devaluation becomes a self-fulfilling prophecy.

The Latvian government therefore sought IMF assistance in mid-November. A program worth EUR 7.5 billion was announced on December 19, 2008, supported primarily by the European Commission (EC: €3.1B) and the IMF (€1.7B). The main program objectives were provision of liquidity support and ensuring long-term external stability, as well as maintaining the fixed exchange rate. In the face of IMF "skepticism" that it could be accomplished, the EC supported the Latvian government's strong commitment to the peg, and thus to internal devaluation, also explaining their greater contribution to the package.[45] The first disbursements were made in December 2008 (Åslund and Dombrovskis 2011, 46), seen in the December increase in Latvian reserves away from the adequacy threshold (Figure 4.10). With the immediate crisis averted, the absolute level of reserves almost fully recovered in February 2009 (reaching 18.20 per cent of peak GDP, just short of their pre-crisis peak of 18.22 per cent in October 2008). This

[45] Naturally, the EC was more concerned about member countries—and thus less so with Ukraine and Belarus—and the potential for contagion: e.g., for currency crisis to spread between the EU members with fixed exchange rates that had not yet joined the euro, especially from Latvia to the other Baltics and Bulgaria; or for banking crises in these hard-hit countries to spread to other EU members, especially to Sweden and other Nordic countries through subsidiary-to-parent bank connections.

Figure 4.19. AA-DD Analysis: Latvia



Source: IMF IFS, author's calculations.

increase in reserves appears to reflect the return of capital inflows, with the expectation of devaluation reversed, and the Latvian BoP crisis appearing resolved.

In AA-DD terms, then, Latvia also faced an initial demand shock, shifting DD_0 to DD^{LV}_1 in Figure 4.19. Latvia pursued internal adjustment, shifting the AA curve leftward (toward AA^{LV}_1), to maintain the pegged exchange rate. Under the weak quasi currency board, and reinforced by speculative attacks (see the Q4 2008 increases in Latvian credit: Figure 4.5), the peg was expected to fail. As for Ukraine and Belarus, the lower expected exchange rate again put rightward pressure on the AA curve, requiring more reserve expenditures to maintain the peg. Reduced domestic demand from capital flight again pushes the DD curve further leftward (e.g., beyond DD^{LV}_1, to DD^{LV}_2), also requiring more reserves to keep AA shifting left-ward in-step (to $AA^{LV}{}_2$). But with the support of the EC and IMF, Latvia was able undertake full internal adjustment, maintaining the peg at the cost of further contraction (to Y^{LV}=77.1). The contraction is clearly greater than if Latvia had undertaken internal adjustment with a credible peg and thus no additional demand shock induced by capital flight (to $\tilde{Y}^{LV}$=86.3), or if it had undertaken immediate external adjustment (to $\hat{Y}^{LV}$=93.3, with depreciation to $\hat{E}^{LV}$=112.4).

While the external financial support helped stem the BoP crisis, Latvia too experienced further challenges in 2009. Unable to pass a supplementary budget implementing further agreed-on austerity, the Latvian government fell in February; and in March the new coalition government submitted a "clearly inadequate" first draft budget (Bakker and Klingen 2012, 117). The EC and IMF first reviews (and second disbursements) were thus delayed, pending resolution of the "fiscal crisis". Reserves loss resumed sharply in March, but with countervailing MB reductions temporarily keeping the adequacy ratio stable, before it also fell sharply in April, threatening a return to BoP and currency crisis.[46] With much political effort, this Latvian "fiscal crisis" was resolved with the June 16 passing of a supplementary budget, allowing the EC and IMF first reviews to proceed, though still slowly. With disbursements in July (EC) and late-August (IMF),

[46] Latvian reserves adequacy fell to 120 per cent May. Central bank liabilities owed to the EC and IMF in May amounted to 26.7 per cent of MB. So, if those international lenders refused to release their second tranches—and requested repayment of the first tranche, with their loans to be paid back ahead of any other central bank liabilities—Latvia would immediately revert to a balance of payments crisis state (FXR/MB = 120.0% – 26.7 pp = 93.3% < 100%). Latvia was thus not already in a balance of payments crisis in May and June 2009, but was at risk of immediate reversion thereto, depending on outcome of the IMF and EC reviews, which were stalled by the domestic fiscal crisis.

Latvian reserves adequacy reaches 195 per cent in August 2009, and further absolute losses end. In AA-DD terms, though, these 2009 dynamics merely increase the leftward shift of DD^{LV}_2 and AA^{LV}_2, and thus of the contraction to Y^{LV}.

Latvian BLIRs also show the sharp upward increase in late-2008 (Figure 4.12), consistent with its large acute-phase investment contraction resulting from a shock to the supply of credit transmitted through the interest rate channel. The Latvian BLIR increase is of similar magnitude to the Ukrainian increase, and much larger than either the corresponding Belarusian or Romanian increases. However, unlike for Ukraine, the late-2008 Latvian increase does not correspond with a large spike in the MM-CB spread (Figure 4.11), and the banking system stresses do result in a systemic crisis. A Latvian MM-CB spike is, however, seen starting to rise again as early as April 2009, but jumping primarily in June as the Latvian fiscal crisis reached its peak, threatening the lats with currency collapse if agreement on fiscal matters could not be reached with the IMF. Here interbank lending froze up under the looming threat of a resumed BoP crisis and eventual currency crisis, where for Ukraine in late-2008 the BoP crisis was more the result of the interbank market freezing-up than the cause. Latvia's BLIR spikes correspondingly in June 2009, but reverts just as quickly—as does the MM-CB spread—once agreement was reached with the IMF in late-June; but that BLIR increase does not clearly result in any additional investment shocks (e.g., in Q2 or especially Q3 of 2009), with the Latvian investment contraction (Figure 4.17) and the investment differential with Belarus (Figure 4.15, panel 2) both remaining relatively steady through Q2 and Q3. Again, though, the overall effect of the Latvian BLIR increase during acute-phase is intertwined with the BoP crisis effects already accounted for in the AA-DD analysis above.

4.5.2.4 Summary for Latvia and Belarus

Two major factors have again been identified that help explain why Latvia experienced a much deeper GFC period contraction than did Belarus, one of which undermines the choice of Belarus as a direct comparator for Latvia. The first factor is the very different credit dynamics experienced by Latvia and Belarus over the broad 2007–2009 GFC period. Here, Latvia experienced a well-understood, strong initial credit crunch from mid-2007, resulting from the pull-back of cross-country financing of local Latvian bank subsidiaries by Western (and especially Nordic banks). This crunch initiated the Latvian contraction from its pre-GFC output peak in Q3 of 2007. Although Latvian credit started to grow again in Q2 of 2008 (possibly slowing the contraction somewhat), and then surged in Q4, these credit increases did not translate into actual output growth. These credit increases likely represented higher costs-of rather than increased quantity-of borrowing—though possibly also increased quantities of borrowing for currency speculation (i.e., which would not contribute to boosting demand for real output). In contrast, Belarus experienced distinct credit dynamics reflecting its non-market-based domestic credit allocation mechanisms and relative lack of exposure to international—especially Western—credit flows. Indeed, Belarus experienced no significant credit crunch, specifically relative to the mid-2007 Latvian crunch, and then relative to the expected crunches (e.g., as for Romania) during as the GFC acute-phase (with Latvia then a more complicated comparator). As such, Belarus likely experienced very little contribution to its overall contraction corresponding to the credit boom term in the model from Chapter 3. Counterfactually, that missing contribution would have dramatically reduced Belarus's overall contraction well below that predicted by the model, thus raising the question of why Belarus actually experienced as deep a contraction as it did, but which is clarified by the second overall factor.

The second factor in explaining why Latvia experienced such a deep contraction—and indeed why Belarus did not experience an even shallower contraction than predicted—is again (as for Ukraine and Romania) their experiences of and policy responses during their respective acute phase BoP crises. After the mid-2008 commodity price shocks, Belarussian reserves fell below the threshold needed to maintain a fixed exchange rate, and the related appreciation of the U.S. dollar rapidly put the USD-pegged Belarussian ruble into overvaluation, together triggering a BoP crisis. With IMF and Russian support, Belarus undertook a partial devaluation on January 1, 2009, allowing a weaker currency to reduce the contraction experienced, while maintaining some of the ruble's value relative to undertaking freely floating depreciation (as had Ukraine). However, the devaluation was insufficient to prevent further capital flight in early 2009, and Belarus maintained its newly-devalued exchange rate (now ostensibly pegged to a basket of dollars, euros and Russian-rubles) through contraction-magnifying internal adjustment. While the net effect was smaller for Belarus—reflecting smaller credit shocks and less capital flight—the magnification under partial internal adjustment resulted in an overall contraction very similar to that calculated as if it had been well-explained by the model of Chapter 3.

Latvia's BoP crisis experience and response was instead a successful attempt at full internal adjustment, despite an expected end to the exchange rate peg and the emergence of capital flight. That expected exchange rate adjustment and capital flight emerged due to the low-credibility of Latvia's conventionally fixed exchange rate arrangement (i.e., only a "quasi-" currency board at best), and to government decisions that undermined FXR adequacy (and which would have been prohibited under an actual currency board). Latvia's successful internal adjustment under these conditions was only possible with the external financial support from the IMF and especially the European Commission, which was politically committed to supporting Latvia's entry to the euro. However, completing internal adjustment entailed even further magnification of the output shocks than had the capital flight fuelled adjustment been cut short through controlled devaluation (as for Belarus) or through floating depreciation (as for Ukraine).

4.6 Conclusion

In this chapter, two country-specific factors and one shared factor are identified explaining why Ukraine and Latvia experienced among the deepest contractions associated with the Global Financial Crisis, and which were deeper than expected based on the model obtained in Chapter 3.[47] Additionally, the paired case study methodology—comparing

[47] The shared factor also helps explain why Estonia and Lithuania also saw unusually deep contractions, but which were shallower than those of Latvia and Ukraine (see Appendix 4A). However, it should also be noted that no systematic analysis was undertaken considering the potential role of these three factors in influencing contraction depths for cases other than the four outliers considered here, whether other outliers (e.g., Iceland, Hungary, Uruguay or the Philippines; see Figure 4.1) or countries well explained by

Ukraine and Latvia in direct relation to Romania and Belarus respectively—revealed Belarus's idiosyncratic credit dynamics, and thus the limitations of the Chapter 3 model in actually explaining-well the Belarusian outcome.

Ukraine's country-specific factor was a large jump in consumption seen in Q1 of 2008, associated with a period of extremely high (near hyper-) inflation. This experience contrasts directly with Romania's relatively steady consumption growth until the GFC acute-phase, and relatively well controlled price dynamics under an inflation targeting regime. The consumption "bump" idiosyncratically defines Ukraine's peak in output just ahead of the GFC period, and as inflation was brought under control, its second quarter reversal determined the start of Ukraine's "GFC-period" contraction, thereby adding to Ukraine's overall peak-to-trough contraction depth (as defined in Chapter 1). Arguably, this bump could be considered to be outside of Ukraine's experience of the GFC itself, so that the additional contraction should be subtracted from Ukraine's GFC-associated output contraction depth. Counterfactually, Ukraine could then be seen as having reached pre-GFC peak-output in either Q2 or Q3 of 2008; and in the more-conservative Q3 case, Ukraine's contraction depth and depth DV residual would both be 3.3 pp smaller, and its contraction duration 2 quarters shorter. This "correction" would nevertheless leave Ukraine

the model of Chapter 3. For example, closer analysis (including through the AA/DD lens) could help show whether Iceland's deeper than modelled contraction was (partly) the result of any attempt at internal adjustment before it succumbed to actual currency crisis. In contrast, closer examination of other countries might identify cases that experienced a balance of payments crisis, but for which Laeven and Valencia (2012) do not identify an outright currency crisis, with successful internal adjustment magnifying the contraction depth predicted by the model (as per Estonia). That predicted contraction depth may have been small enough so that any magnification remains within the plus-or-minus two standard deviation depth DV residual range used here to identify outliers for further consideration.

among the deepest raw contraction depths (16.3 per cent of peak GDP, instead of 19.6 per cent: around the same as Lithuania in Figure 3.1 from Chapter 3), and also among the countries worst-explained by the model of Chapter 3 (residual of 11.1 pp of peak GDP, instead of 14.1 pp: about the same as Iceland in Figure 4.1). However, this naïve counterfactual assumes no changes in other expenditure components related to the bump in the consumption component. Additionally, while Ukraine's high inflation through 2007 is largely attributable to global food and energy price increases, Ukraine's inflation is also related to the pre-GFC boom, so is arguably as GFC-related as the commodities price booms and August 2008 bust, taken as an important part of the model in Chapter 3. Either way, Ukraine's Q1 2008 high inflation and consumption bump form an idiosyncratic, but relatively small aspect of its very large GFC-period contraction, with more required to explain Ukraine's overall outcomes (as discussed below).

In contrast, from mid-2007 to early-2008, Latvia experienced an outright credit contraction, related to the well-documented withdrawal of financing from Baltic and other Eastern European subsidiaries of Nordic and other Western parent banks. This credit contraction kick-started the Latvian output contraction from a peak in Q3 of 2007, with only much smaller credit crunches for Belarus as Latvia's direct comparator, and for Ukraine and Latvia. With government directed credit playing a large role in the economy, and with much less exposure to international financial flows from Western (and Nordic) banks, Belarus saw only a very limited credit crunch in early 2008, and output kept growing through to (and into) the acute-phase. Ukraine also saw a much smaller credit crunch than

Latvia, with credit growth mostly only slowing in early-2008; but Ukraine's much higher inflation and idiosyncratic consumption bump overwhelmed any contractionary impulse from the smaller credit effects, again idiosyncratically defining Ukraine's output peak and the start of its contraction. Taken as the comparator case that is actually well-explained by the regression model (i.e., in contrast to Belarus), Romania experienced almost no credit crunch—and no output contraction—before the acute-phase. Latvia can thus be seen as having experienced a much earlier start to its contraction due to the credit crunch resulting from parent bank withdrawals from Latvian subsidiaries. However, it is not clear that this contribution to Latvia's contraction adds much more to its total depth; this contribution may instead be merely an earlier experience of the contraction already accounted for in credit boom IV term in the model from Chapter 3.

The shared factor relating Ukraine and Latvia's worse-than-modelled outcomes was their common choice to undertake internal adjustment and defend their fixed exchange rates in the face of BoP crises and capital flight during the GFC acute phase. Undertaking internal adjustment magnifies the contractionary effect of output shocks, relative to the "shock-absorbing" effect of a floating exchange rate seen for Romania. Also contrasting with the successful internal adjustment undertaken by Estonia and Lithuania—under credible currency board arrangements, backed with adequate foreign exchange reserves—Ukraine and Latvia both used much less-credible "conventionally pegged" exchange rates regimes. Their pegs lacked the legal strictures countering self-reinforcing reserves loss, capital flight and expectations of currency devaluation. While Ukraine allowed reserves adequacy to dwindle over much of 2008, with the GFC acute-phase then pushing it into crisis, Latvia chose to save the depositors of failing Parex bank in a way that eliminated the country's foreign reserves buffer, pushing Latvia likewise into crisis. In both cases, the resulting additional capital flight added to the overall real demand shock, and was magnified further by the additional monetary actions required to maintain the exchange rate. Ukraine and Latvia thus faced greater internal adjustment and faster reserves loss than did Estonia and Lithuania, with their highly credible currency board arrangements.

However, the main difference between Ukraine and Latvia during the BoP crisis comes from the external financial support each received, and the conditions required for that support. Ukraine received emergency financing from the IMF under the condition that it float the hryvnia, allowing full depreciation of the currency, aiming to end capital flight and the on-going output contraction. This largely succeeded, and though some additional capital flight and internal adjustment added to Ukraine's overall contraction in 2009, the bulk of the additional contraction—relative to Romania in particular—occurred during the primary BoP crisis period in Q4 of 2008. In contrast, Latvia sought and received help from the IMF with the support of the European Commission (EC), which together—with additional multilateral and bilateral backing—financed EU-member-Latvia's goal of maintaining the fixed exchange rate, reaching toward planned (though delayed) accession to the Euro Zone. As such, where Ukraine necessarily cut-short its attempt at full internal adjustment, thereby limiting further output contraction at the cost of currency devaluation, Latvia undertook full internal adjustment, maintaining the value of the lats, but at the cost of a much deeper contraction. With Euro Zone accession as a medium-term "exit strategy" from the fixed Latvian exchange rate peg—itself made temporarily credible with the backing of the EC and IMF—the cost of the deeper Latvian contraction appears money well spent. Nonetheless, it seems odd that this trade-off between currency stability and deeper contraction is not made explicit in any of the literature or IMF materials reviewed.

This explanation also challenges Blanchard, Griffiths, and Gruss's view that the unexplained portion of Latvia's contraction depth is attributed to "uncertainty and the option value of waiting" (2013, 343; as discussed in the Literature Review section, above). The BoP crisis interpretation sees Latvian firms and households actively moving their wealth out of lati to avoid real losses in the event of a devaluation or depreciation of the lats. Instead of uncertainty about the future and the relatively passive choice of waiting to see how economic matters progressed before undertaking large purchases such as car sales, Latvians and others actively fled the currency, pulling financing and wealth away from such "productive" spending. Further research would be necessary to determine the different contributions—all, nothing, or somewhere in-between—from these alternative explanations for Latvia's large residual contraction depth; but Blanchard, Griffiths, and Gruss's "process of elimination" does not consider fully the role of the Latvian BoP crisis.

Finally, consideration as a direct case-comparator for Latvia revealed that Belarus was not actually "well-explained" by the regression model of Chapter 3, highlighting some of the limitations of both regression and case-study analyses. This chapter's case-selection process chose Belarus as a country that appeared both relatively "well-explained" by the model in Chapter 3 (i.e., with a relatively small depth DV residual), and relatively "similar" to Latvia (i.e., with respect to the different IVs in that model, including their large credit boom IV values). Nonetheless, Belarus saw almost no credit crunch associated with the GFC acute-phase, as would be expected for most countries with similarly large pre-crisis credit booms, and as was seen for Romania in particular. (Latvia and Ukraine's own credit surges in Q3 and especially Q4 of 2008 are taken to reflect speculative borrowing during the BoP crisis, and are quite distinct from the relatively steady Belarusian credit growth, and from Romania's late-2008 and early-2009 credit crunch.) Underpinning this difference is Belarus's broadly un-liberalized economy, including government directed credit allocation, and the resulting limited effects transmitted from the international financial system. As such, Belarus's low depth DV residual is re-interpreted from being "well-explained" by the model in Chapter 3, to being a coincidental outcome combining: (i) smaller overall acute-phase shocks, due especially to the interrupted mechanism between the international financial freeze and domestic credit allocation, with (ii) magnification of those shocks by attempted internal adjustment during Belarus's own BoP crisis. As with Ukraine, the magnification effect of internal adjustment was largely cut-short by de-pegging the ruble as a condition for IMF financial support (with Russian help); but in contrast to full depreciation (as for Ukraine), the Belarusian devaluation was only partial, trading-off retained currency value for greater magnification, albeit of smaller shocks. The net effect of the smaller shocks and greater magnification was a Belarusian contraction coincidentally in-line with the raw contraction depth predicted by the model of Chapter 3.

Belarus's difference highlights the limitations of applying the results of regression analysis to particular cases, and thus the limitations of the paired case-study approach. Regression models like those in Chapter 3 can be useful in identifying—and especially in ruling-out—causal factors taken to apply broadly but only on-average to the sample under consideration; but those results may have limited applicability to particular cases, especially those outside of the regression sample (including Ukraine, Romania, Latvia, Estonia and Lithuania here), but also including those in-sample (e.g., Belarus). The case-pairing selection process in this chapter assumes that the IVs included in the regression model reflect underlying causal mechanisms that apply more-or-less equally to all countries. Large DV residuals are assumed to represent additional mechanisms at play for the corresponding countries, which increase (or decrease) the DV values of individual cases. Smaller DV residuals may also represent additional causal mechanisms, with relatively small effect on the particular cases at hand; or they could represent variability in how the causal mechanisms identified at the aggregate average level play out for individual countries. Or, as seen here for Belarus, very small residuals (or indeed any residual) could represent "counterbalancing errors", reflecting more than one deviation from how the causal mechanisms taken to underpin the regression model are believed to operate.

However, rather than take these limitations as evidence that the methodology, analysis and conclusions of this chapter are fundamentally flawed, these limitations highlight the importance of the case studies themselves. The case-pair comparisons are made more credible by the pair selection process undertaken; and the results emphasize that closer examination can reveal not only important explanatory factors underpinning the different outcomes of the cases of primary interest (Ukraine and Latvia), but also the ways in which other cases (Belarus) do not conform to the model's predictions, while others (Romania) do. This chapter provides a first take on both of these results, which could be expanded upon in future and deeper research into the cases considered here.

Further comparative case-study analysis could also be undertaken drawing on the regression results from Chapter 3. One avenue for further research would examine other "poorly explained" cases, including those with worse-than-modeled outcomes, such as Hungary and Iceland (though matching cases were difficult to identify for those two) and Uruguay and the Philippines, as well as those with better-than-modeled outcomes, such as Belize and Bulgaria (see Figure 4.1). Another avenue is case study examination of each of the explanatory factors (IVs) in the regression model, seeking to better understand the causal mechanisms underpinning the correlational relationships identified there. Case-pair selection here would identify pairs of relatively similar and well-explained countries, differing primarily on the IV of interest; such pairings would focus on how that main IV-difference led to different raw DV-outcomes that are (ostensibly) well-explained by the model, while largely controlling for differences in the other factors identified as relevant.

Appendix 4A: Estonia and Lithuania

Like a milder version of Latvia, Estonia also saw Nordic parent banks withdraw funding from their Estonian branches in late-2007, with credit growth flat-lining, but not actually contracting (Figure 4.5), and output contracting from 2008Q1 (see Figure 4C.3). In contrast to Latvia, though, the Estonian banking system then experienced much greater difficulties. The Estonian MM-CB spread becomes modestly positive in September 2007, more so in December 2007, and then much more so in October 2008 as the GFC acute-phase strikes (Figure 4.11). However, this drawn-out Estonian banking system crisis does not appear to have translated to significantly higher bank lending rates (Figure 4.12)—especially in comparison to Lithuania (discussed next)—and so it is not clear that the bank system problems contributed much to the depth of the Estonian contraction.

Estonia also undertook full internal adjustment during the crisis, magnifying the shocks it did experience (recall Figure 4.13); but Estonia's very credible currency board and adequate reserves supported stable exchange rate expectations and minimized capital flight, not adding further to the base shocks as seen for Latvia (recall Figure 4.19).[48] The major contributor to Estonia's deeper-than-modeled contraction depth is its "choice" to

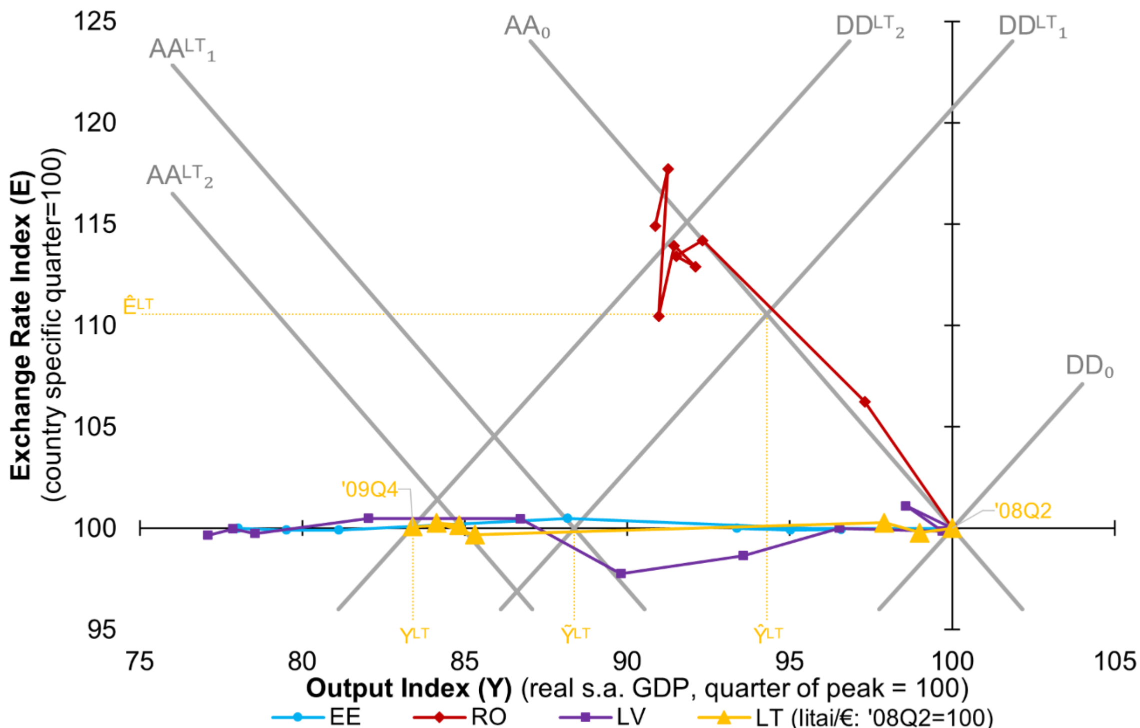
[48] The Estonian kroon (plural: krooni) was pegged under a long-standing and legally binding relatively "orthodox" currency board—to the Deutschmark in 1992, and then the euro from 2002—backed by reserves adequacy consistently maintained above 110 per cent (Figure 4.10). Thus, despite the kroon's moderate overvaluation in 2003–2006 increasing to around 13.6 per cent from April 2008 (Figure 4.9), the Estonian exchange rate peg was highly credible, and thus largely safe from speculative attacks—particularly as long as other less-credible pegs could be attacked. Thus, as the shocks of late-2008 emerged, Estonia was well poised to undertake full internal adjustment, without facing any expected currency devaluation. Further REER appreciation did take place from December 2008, peaking at 17.4 per cent overvaluation in January 2009, but with credibility maintained.

undertake internal adjustment. Likewise, the major reason Estonia did not contract even deeper than did Latvia was the strength of its currency board pre-commitment to maintaining its exchange rate peg through internal adjustment.

Lithuania, in-turn, experienced a minimal credit crunch prior to the GFC acute-phase, with credit growth slowing only in early-2008 (Figure 4.5), and the output contraction only starting in Q3 of 2008 (Figure 4C.4). Lithuanian credit does, however, accelerate through the rest of 2008, comparable to the Latvian and Ukrainian credit surges during their BoP crises, which were attributed to speculative borrowing. Seen as the next target (or “domino”) for currency speculators after Latvia, the Lithuanian credit surge—and especially the smaller additional surge in November and December—may represent limited speculative efforts that were cut-short by EC and IMF support for Latvia. Throughout the GFC period, the Lithuanian banks also see only limited stress, especially in relation to Estonia. The Lithuanian MM-CB spread reaches above zero only occasionally and briefly, in October 2007 and October to December 2008, and nearly so again in June 2009 (Figure 4.11). These spread increases correspond closely with the much larger increases seen for Latvia, likely representing the expectation of spill-over (i.e., redirected speculative attacks) following a potential Latvian currency crisis. These limited periods of higher Lithuanian interbank bank stress do translate to temporarily higher BLIRs (Figure 4.12), but which otherwise remain only modestly elevated.

Lithuania also undertook full internal adjustment during the crisis, magnifying the shocks it did experience; but its relatively credible currency board and more-than-adequate

Figure 4A.1. AA-DD Analysis: Lithuania



Source: IMF IFS, author's calculations.

reserves supported stable exchange rate expectations and minimized capital flight.[49] However, the limited 2008 Lithuanian credit surge (discussed above) also suggests some capital flight beyond that experienced by Estonia, but short of that faced by Latvia. Indeed,

[49] The Lithuanian litas (plural: litai) was also credibly pegged—to the dollar from 1994, and the euro from 2002—under a currency board somewhat less strict than Estonia's, but backed by FXR almost always in excess of 120 per cent of the monetary base (Figure 4.10). Prior to 2007 the litas was also undervalued by roughly 5 per cent, but which increased to just 1.8 per cent overvaluation in April to July 2008 (Figure 4.9). So, as the crisis struck, Lithuania had in place a relatively credible currency board, maintaining a peg that was only slightly overvalued and backed by very adequate FXR. Lithuania was clearly not at risk of a BoP crisis at that point. However, as the crisis proceeded, the Lithuanian REER began to appreciate, slowly in September to November, and then (like Estonia) jumping more significantly in December and January, to peak at 12.0 per cent overvaluation in March 2009. Also like Estonia, the Lithuanian peg retains its credibility, and sees little currency speculation or capital flight. The main threat for Lithuania was the possibility of a Latvian devaluation. Had the Latvian peg broken under the speculative and capital flight pressures, currency speculators would have been freed to focus their attentions on the next weakest target. It is, however, not clear to me whether or not Lithuania (and then Estonia) would also have buckled, particularly given the precise role of Parex Bank in the Latvia story.

as seen in Figure 4A.1 (i.e., under this chapter's assumptions of common linear AA-DD slopes), Lithuania's actual contraction (to Y^{LT}=83.4) is noticeably deeper than its contraction as predicted under a fixed exchange rate with no capital flight (to $\hat{Y}^{LT}$=94.3), consistent with capital flight pushing $DD^{LT}{}_2$ further left than $DD^{LT}{}_1$. As for Estonia, the major contributor to Lithuania's deeper-than-modeled contraction depth is its "choice" to undertake internal adjustment, while its smaller-than-Latvian depth reflects relatively successful pre-commitment thereto.

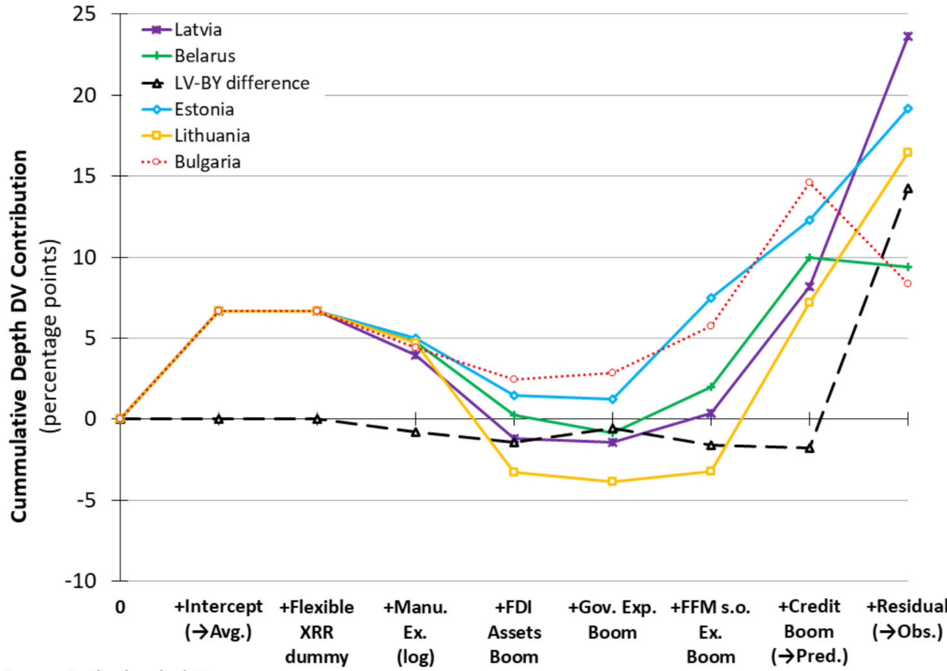
Appendix 4B: Case Selection Details

To illustrate the relative matchings, Figure 4B.1 through Figure 4B.3 show the cumulative contributions to predicted contraction depths provided by the Chapter 3 depth DV regression model's intercept, IVs and residual terms, for each group of countries considered in the case selection process. The ordering of the IVs in these figures is largely arbitrary, but was chosen to emphasize the similarity between the cases, with the usually most-different credit boom IV placed second last, before the residual term.

Figure 4B.1 shows Belarus and the Baltics, and the difference between Latvia and Belarus. The individual IV contributions are precisely each coefficient multiplied by the IV value. These countries all used fixed exchange rates, and so show no cumulative difference when accounting for the intercept and XRR IV. They diverge slightly with the logged manufacturing exports-to-GDP IV, and more noticeably with the FDI assets boom IV, but with Latvia and Belarus remaining most similar. With relatively small differences in the government expenditures boom IV, Latvia's and Belarus's cumulative contributions narrow, while Belarus diverges from Estonia. The FFM share of exports boom IV'S contribution increases the similarity between Belarus and Latvia, while contributing further difference from the other Baltics. The credit boom contribution then makes these four countries' predicted values all more similar, with Latvia and Belarus the most similar.[50]

[50] The Credit Boom contributions are also visible in Figure 4.1, with Latvia and Belarus aligned closely in horizontal terms, while Estonia credit boom value is somewhat lower, and Lithuania's higher. The use of the sum-of-squares "distance" measure in the pairing process seeks to identify a country with a small depth DV residual (i.e. which is close to the model line) that is also horizontally close to the country of interest in each of the partial-residual charts (i.e., with little difference across the IVs).

Figure 4B.1. Cumulative Predicted Contributions to Contraction Depth: Baltics and Belarus (plus Bulgaria)

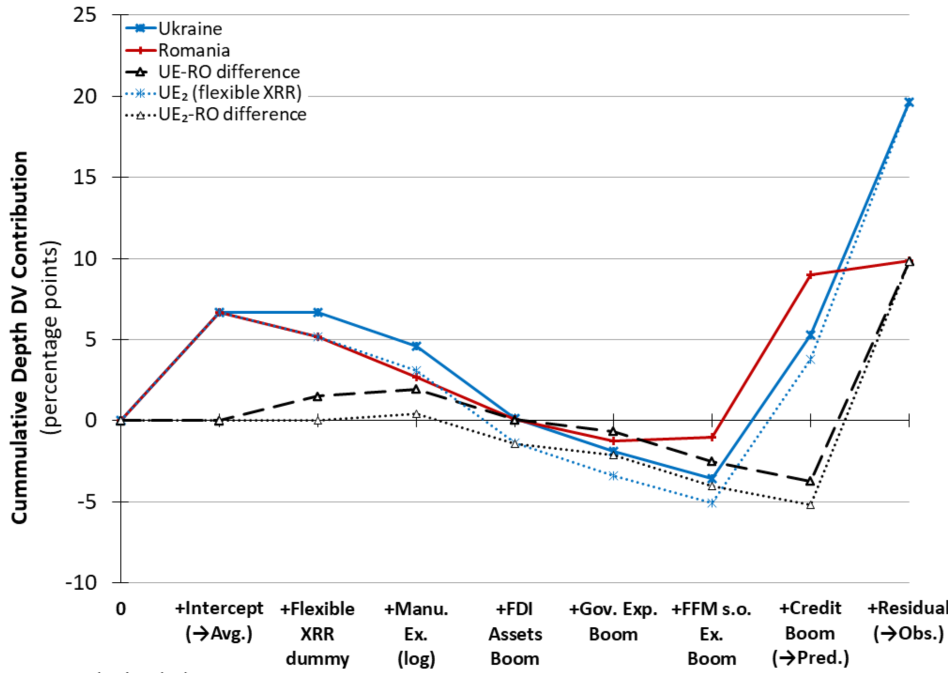


Source: Author's calculations.

Adding the final "contribution" of the residual value—represented by the slope of the final line segment—produces the observed value, highlighting the discrepancy under investigation: Latvia's high residual and Belarus's low residual (as well as Estonia and Lithuania's moderately high residuals), given the relative similarity of their outcomes as predicted by the model—and indeed with Latvia (and Lithuania) even being predicted to experience a slightly shallower contraction than Belarus.

Bulgaria is also shown in Figure 4B.1 to illustrate that—despite geographical and historical similarities—it is not as good a comparative match for Latvia or Lithuania as is Belarus, though it is a relatively good match for Estonia ($d_{(EE:BY)}$=2.06 vs. $d_{(EE:BU)}$=2.26). Bulgaria is also a negative outlier on the depth DV residual (Z_{Dep}=-3.55), and could thus

Figure 4B.2. Cumulative Predicted Contributions to Contraction Depth: Ukraine and Romania

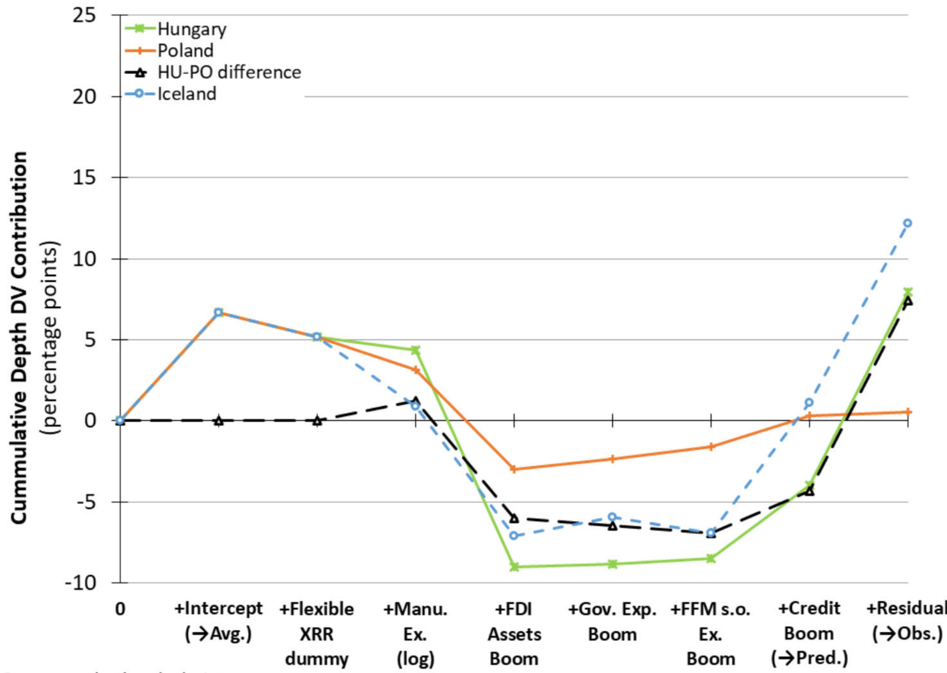


Source: Author's calculations.

be worthy of further investigation, particularly towards understanding why it experienced a contraction markedly shallower than predicted by the model (e.g., demonstrating potential source of resilience). Such investigation may be worth pursuing in future work, but is deemed outside of the scope of the current investigation.

Figure 4B.2 likewise shows lines for Ukraine and the Ukraine-Romania difference, both with Ukraine's corrected fixed XR (solid lines) and the flexible XR (dotted lines) originally attributed in Chapter 3 (as discussed in the main text). In addition to the XRR difference, both sets indicate that the main differences are in the FFM share of exports boom and FDI assets boom IVs, with the credit boom IV providing the third largest difference. Irrespective of the XRR correction, both lines also show that Ukraine is

Figure 4B.3. Cumulative Predicted Contributions to Contraction Depth: Hungary and Poland (plus Iceland)



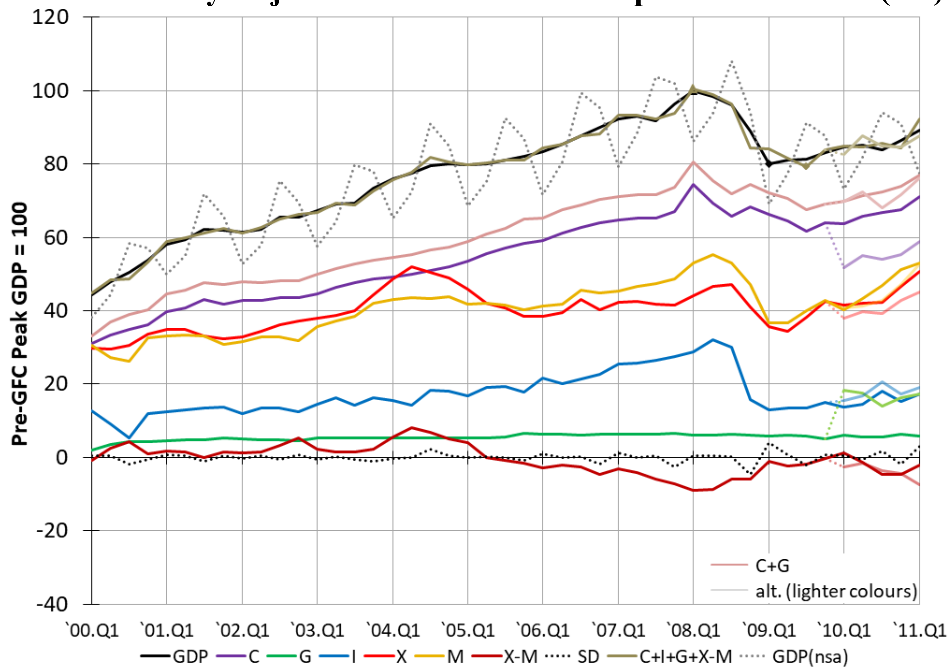
Source: author's calculations.

predicted to have experienced a moderately shallower contraction than Romania, but actually experienced an even deeper observed contraction, due to Ukraine's much larger, unexplained, residual portion of contraction depth. Also of note, the predicted difference between Ukraine and Romania (-6.71 pp) is somewhat larger than between Latvia and Belarus (-1.75 pp), showing the latter to be a better pairing overall.

Finally, Figure 4B.3 shows the lines for Iceland and Hungary, with Poland as the best comparator for both, but which is not similar enough to either for further consideration.

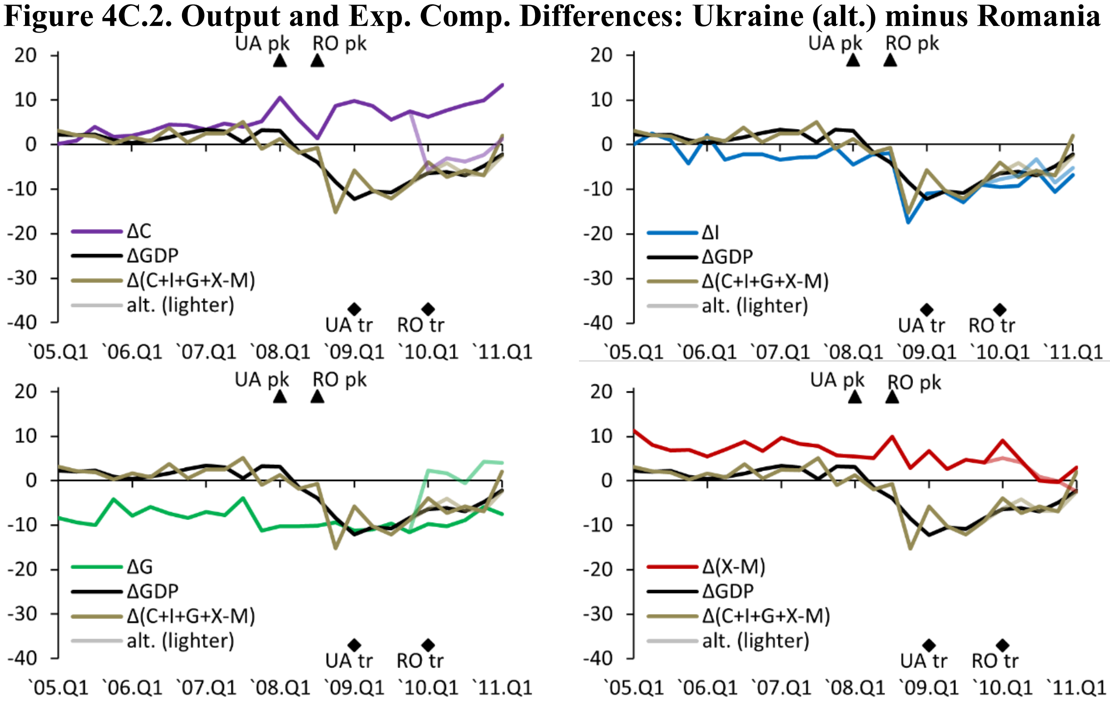
Appendix 4C: Additional Figures

Figure 4C.1. Seasonally Adjusted Real GDP and Components: Ukraine (alt.)



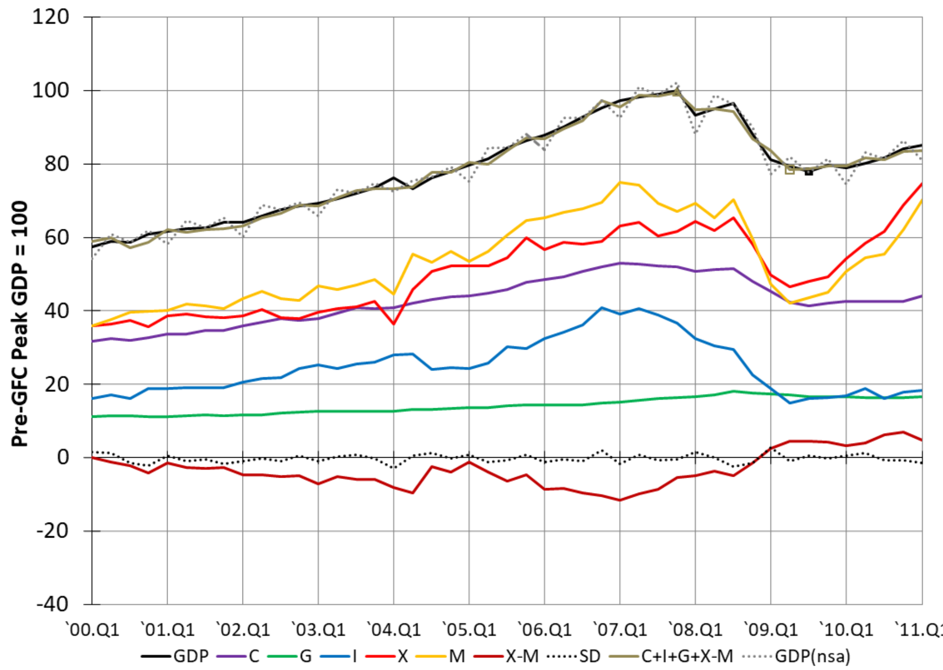
Source: IMF IFS, author's calculations.

Figure 4C.2. Output and Exp. Comp. Differences: Ukraine (alt.) minus Romania



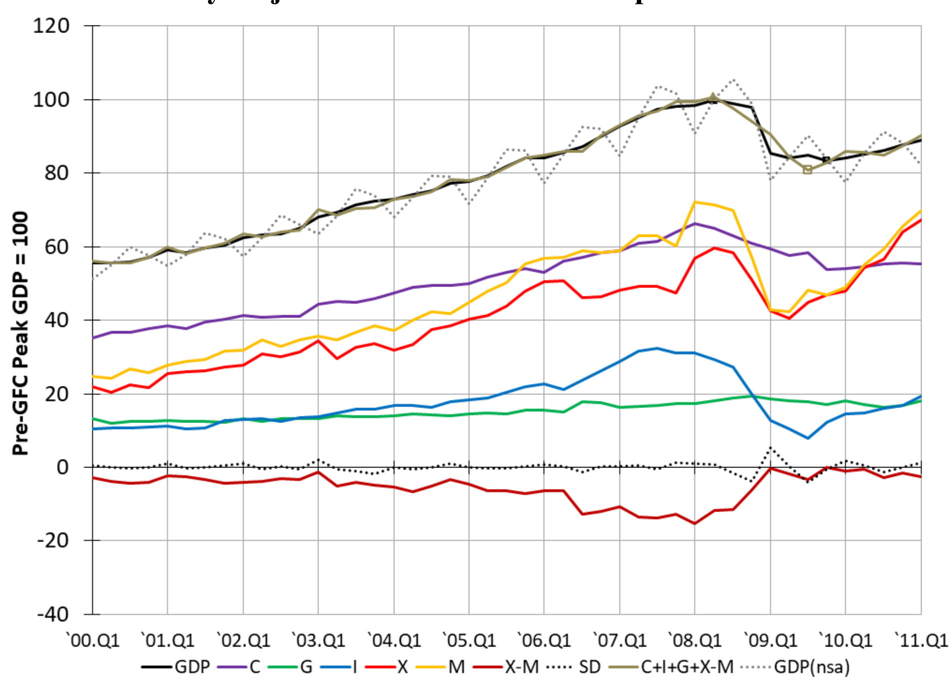
Source: IMF IFS, author's calculations.

Figure 4C.3. Seasonally Adjusted Real GDP and Components: Estonia



Source: IMF IFS, author's calculations.

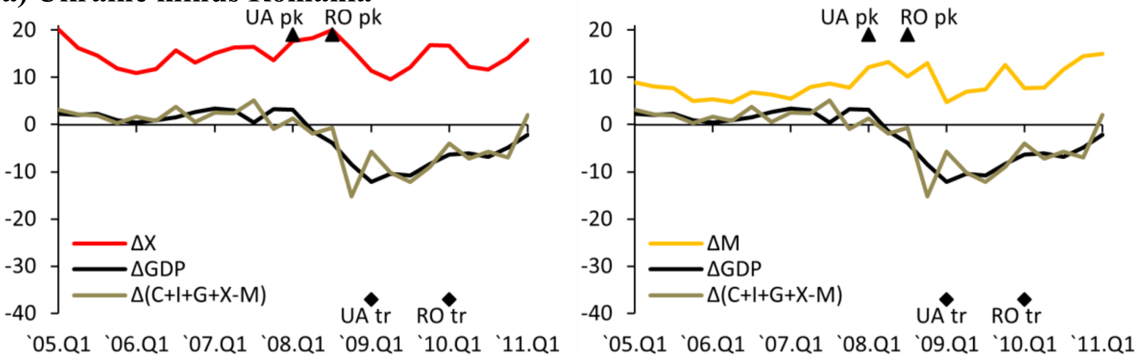
Figure 4C.4. Seasonally Adjusted Real GDP and Components: Lithuania



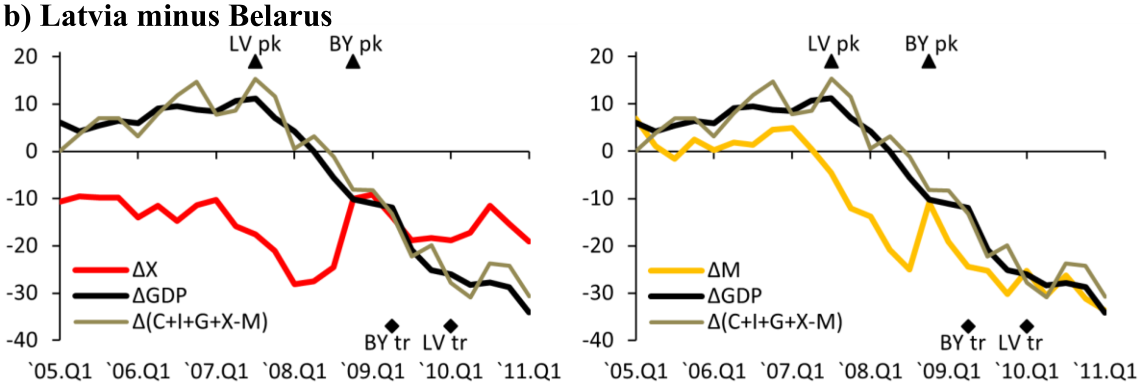
Source: IMF IFS, author's calculations.

Figure 4C.5. Output and Expenditure Component Differences: Exports and Imports

a) Ukraine minus Romania



b) Latvia minus Belarus



Source: IMF IFS, author's calculations.

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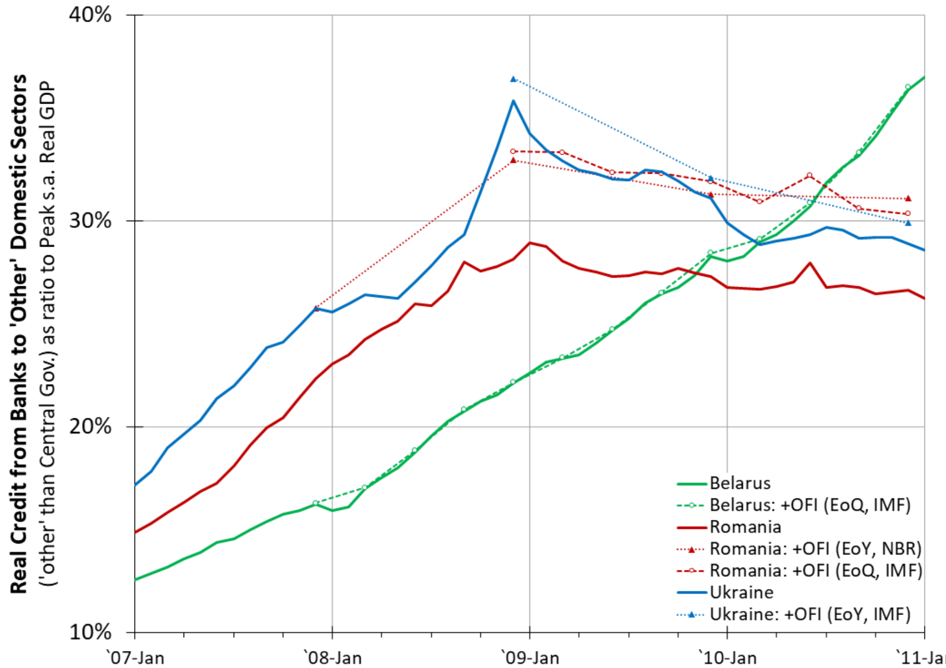
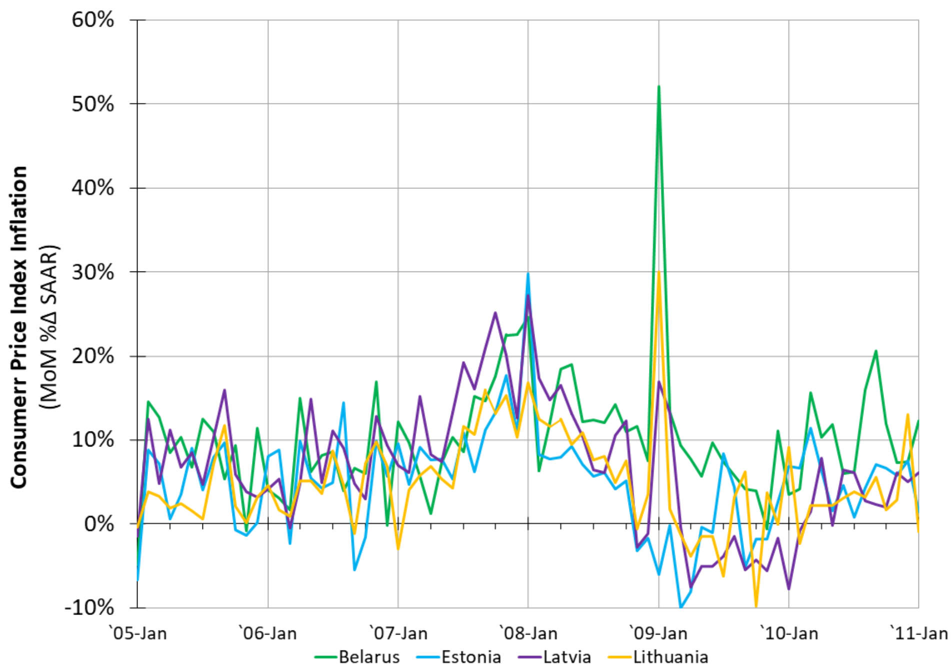
Figure 4C.6. Real Credit: Bank and Bank plus Other Financial Institutions



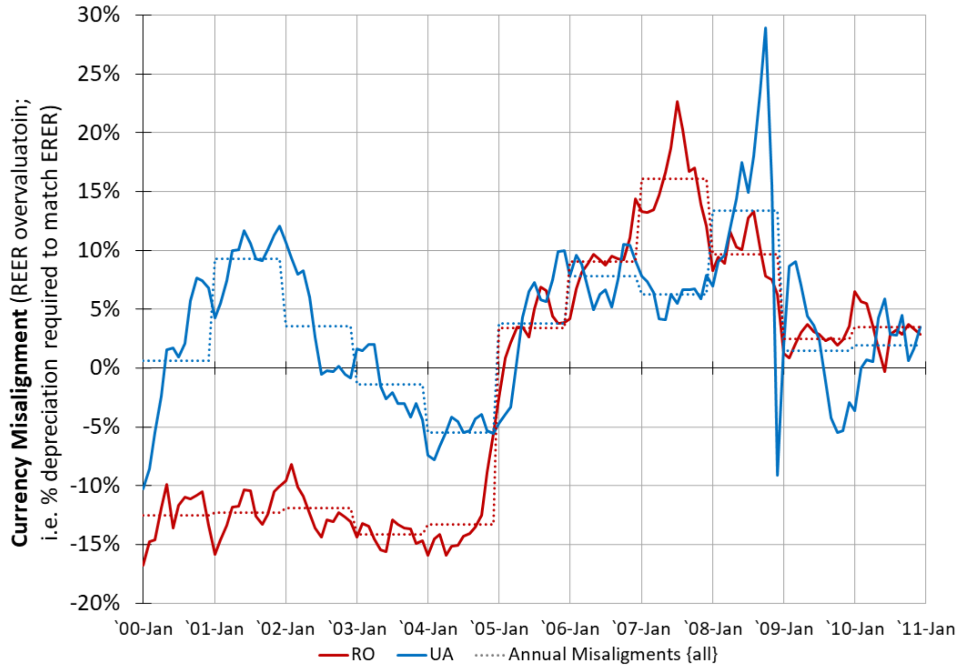
Source: IMF IFS, National Bank of Romania (NBR), author's calculations.

Figure 4C.7. CPI Inflation: Baltics and Belarus



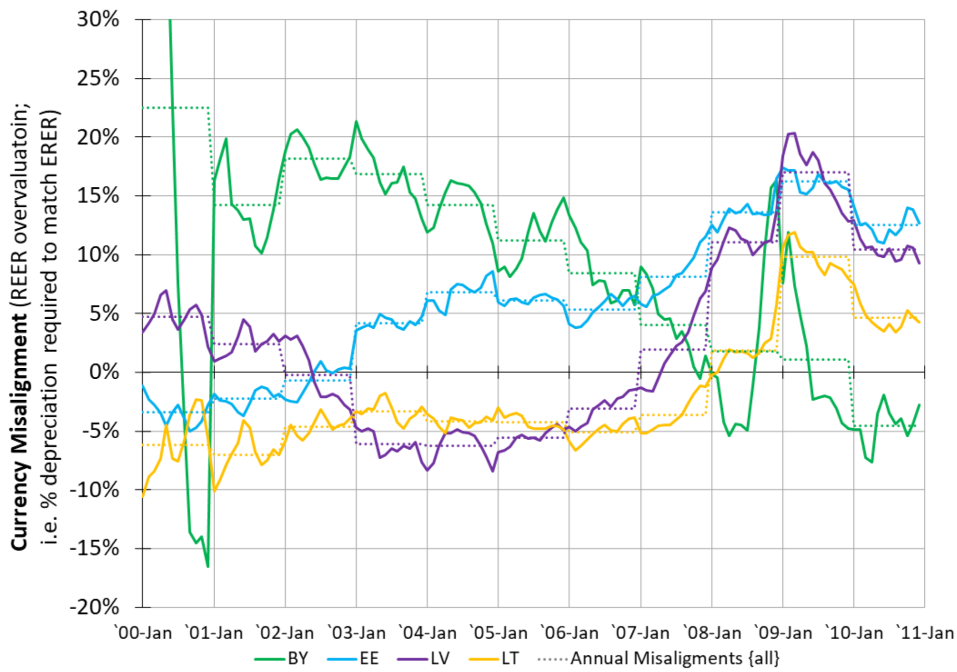
Source: IMF IFS, author's calculations.

Figure 4C.8. Currency Misalignments: Ukraine and Romania



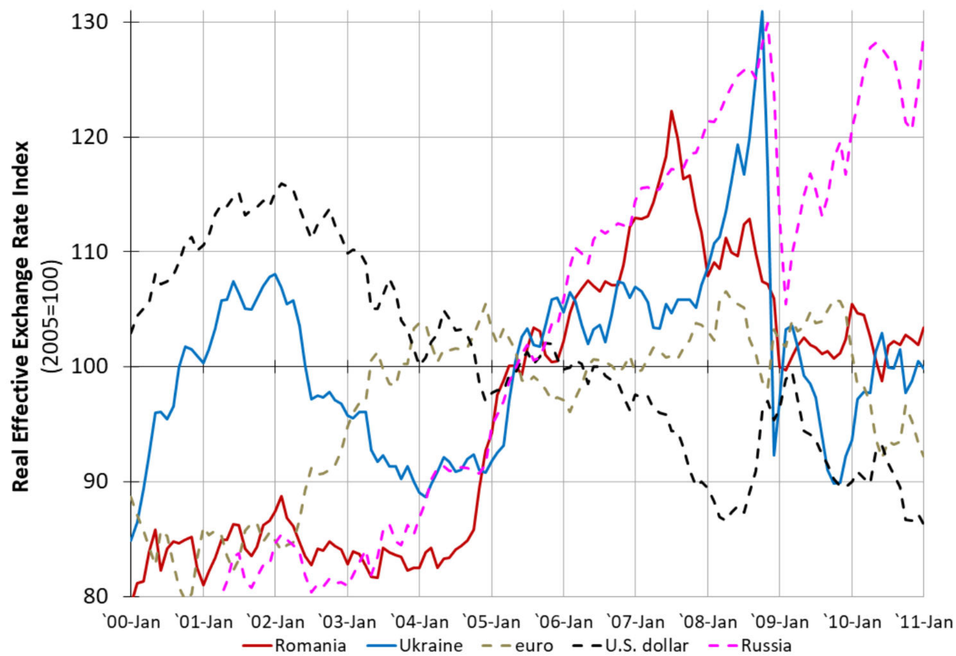
Source: EQCHANGE, BIS, IMF IFS (for Ukraine), author's calculations.

Figure 4C.9. Currency Misalignments: Baltics and Belarus



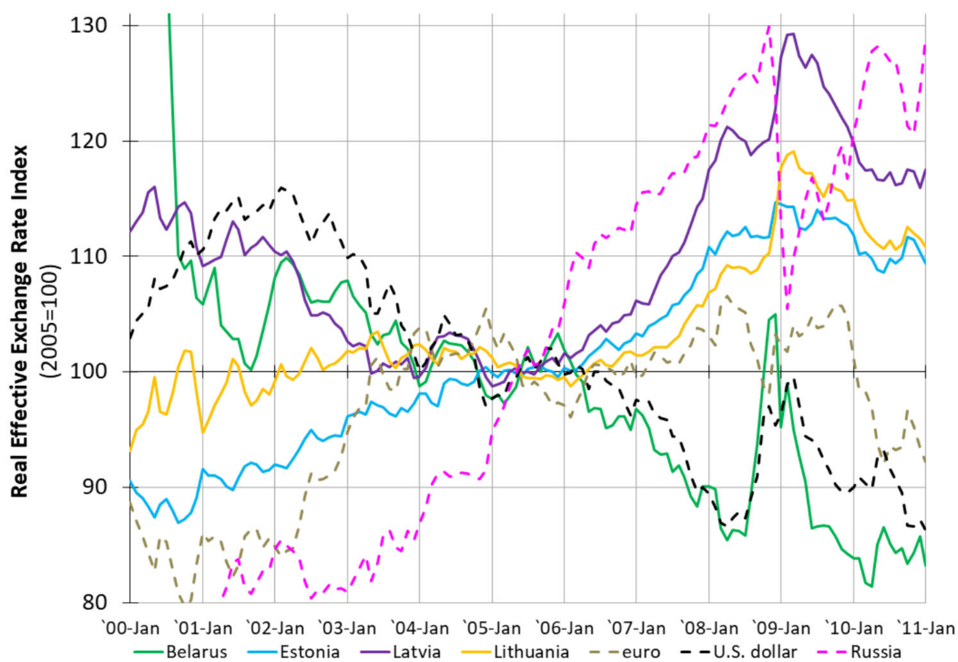
Source: EQCHANGE, BIS, National Bank of the Republic of Belarus, author's calculations.

Figure 4C.10. Real Effective Exchange Rates: Ukraine and Romania



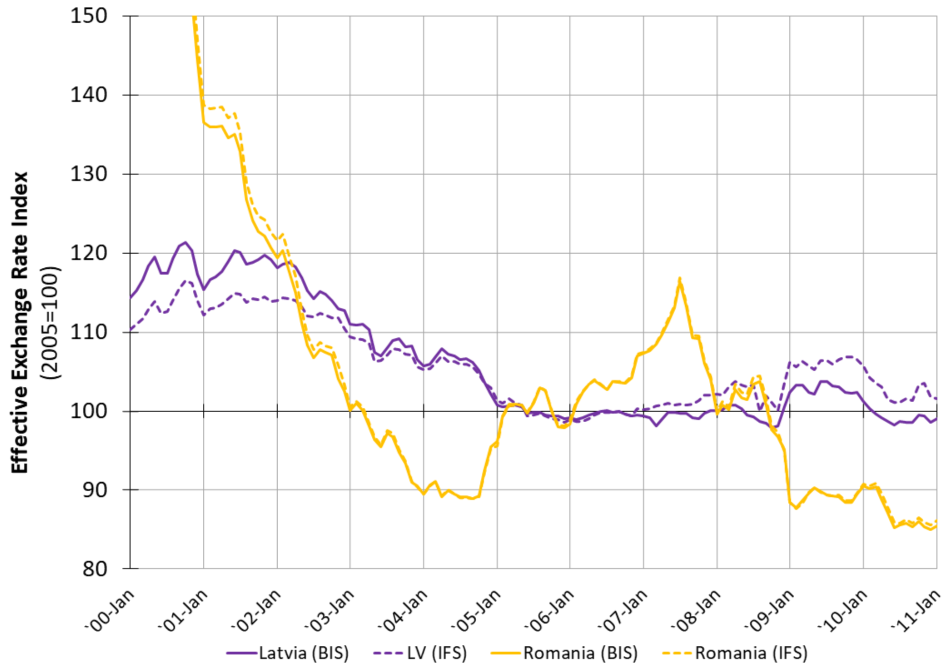
Source: BIS, IMF IFS (for Ukraine), author's calculations.

Figure 4C.11. Real Effective Exchange Rates: Baltics and Belarus



Source: BIS, National Bank of the Republic of Belarus, IMF IFS, author's calculations.

Figure 4C.12. Comparing REERs from BIS and IFS



Source: BIS, IMF IFS, author's calculations.

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Figure 4C.13. Reserves Adequacy Components: Ukraine

** Pink overlay represents inconsistencies in data for Ukrainian Central Bank Foreign Liabilities between monthly editions and the printed, on-line, and CD-ROM versions of the IMF's IFS data set.*

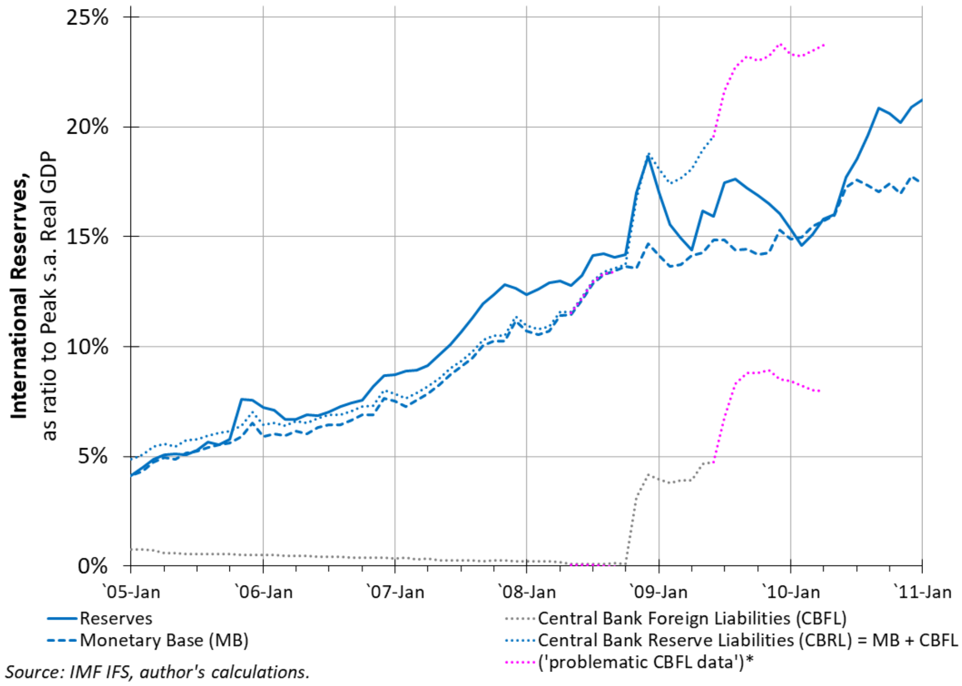


Figure 4C.14. Reserves Adequacy Components: Romania

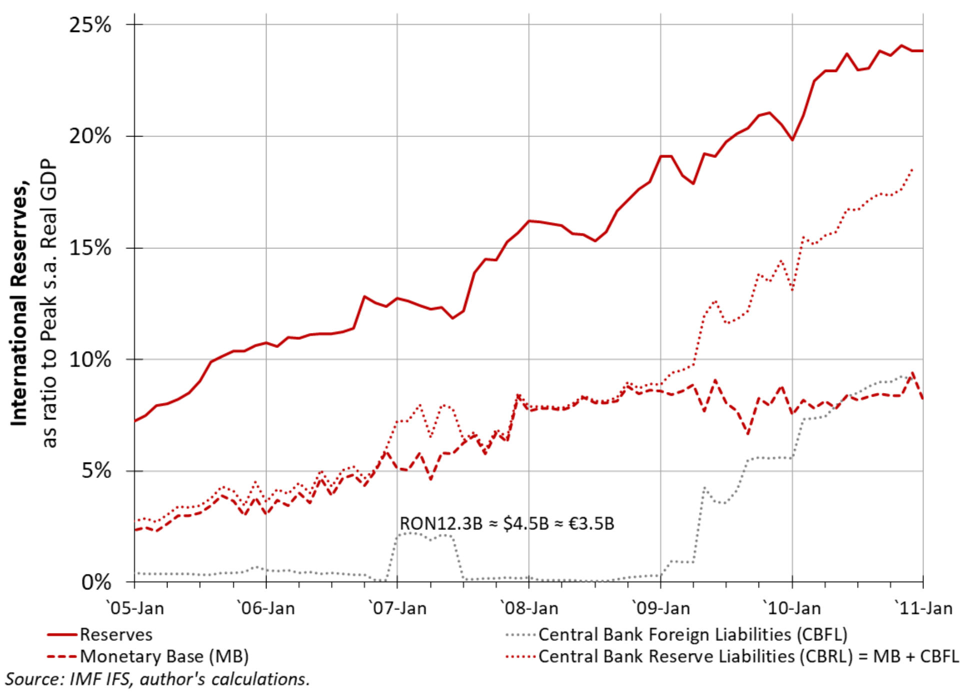
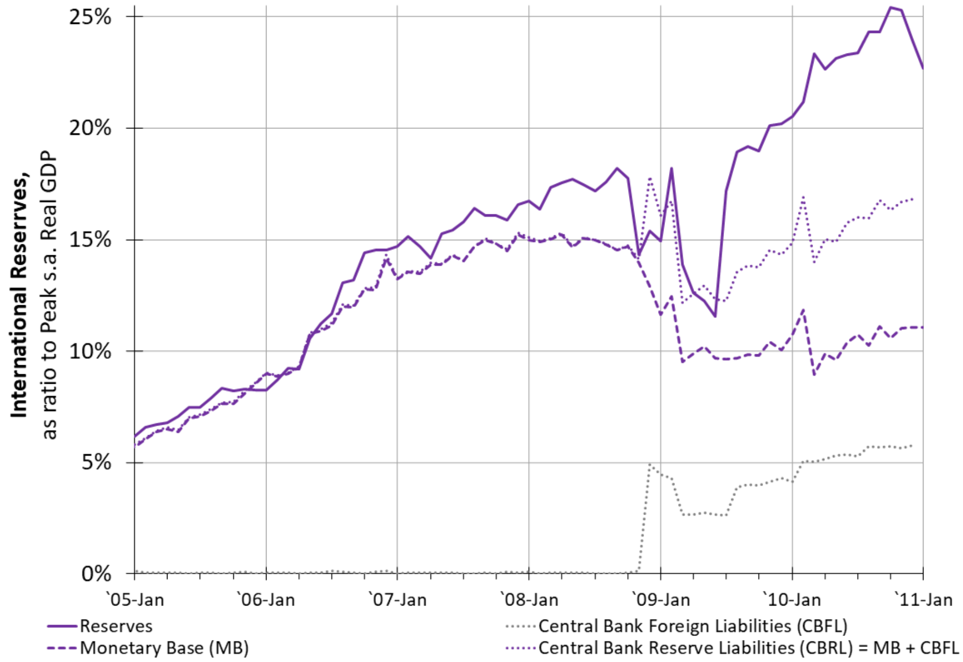
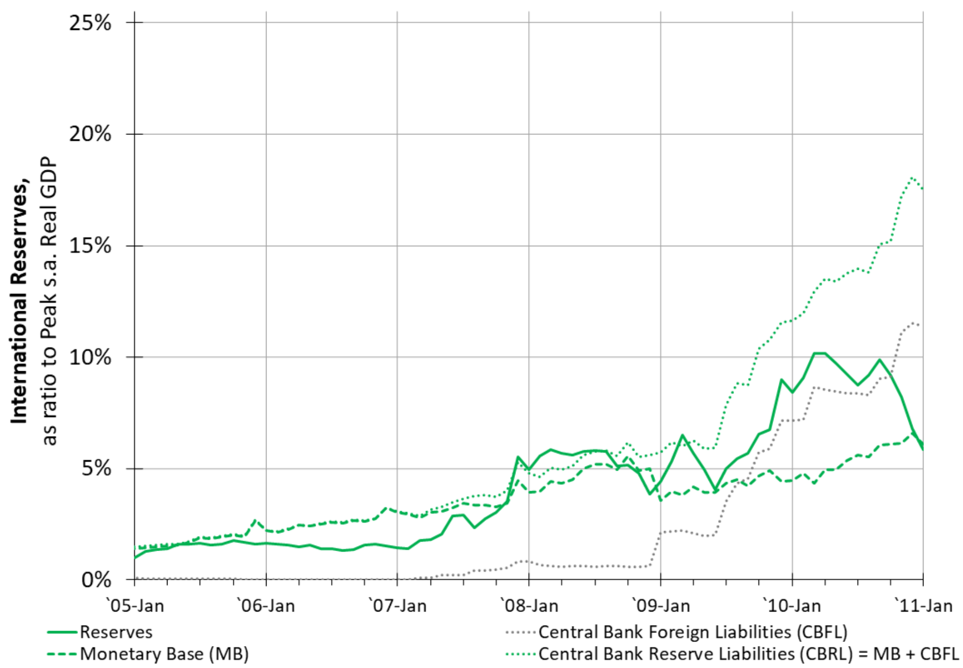


Figure 4C.15. Reserves Adequacy Components: Latvia



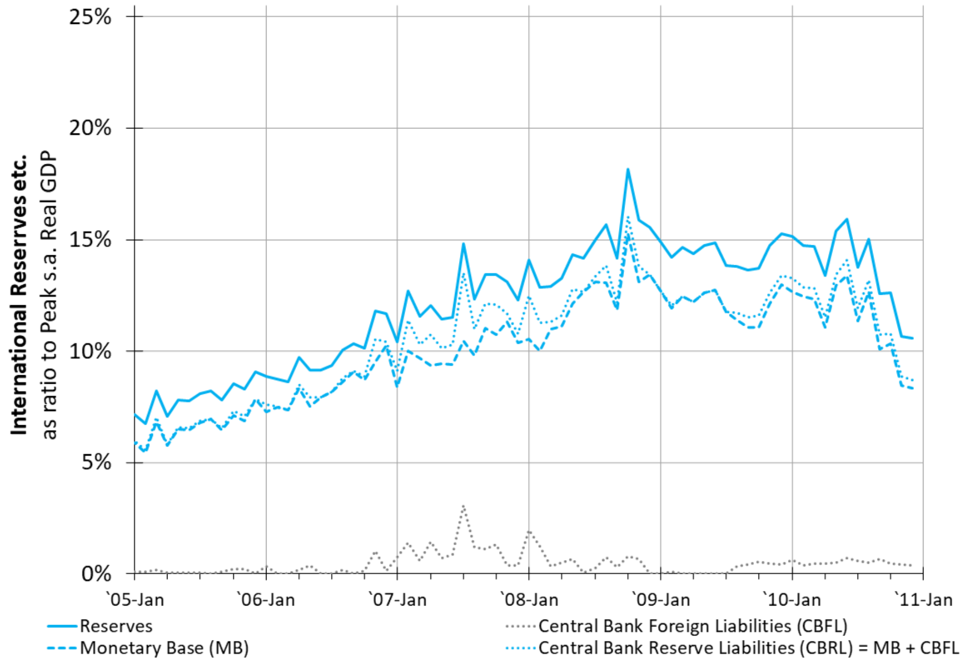
Source: IMF IFS, author's calculations.

Figure 4C.16. Reserves Adequacy Components: Belarus



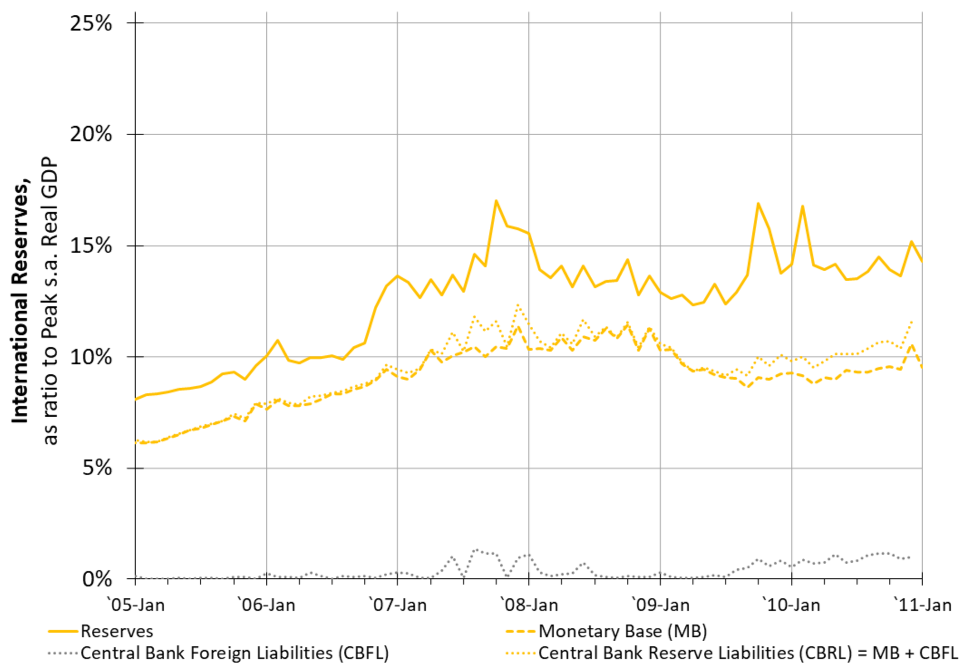
Source: IMF IFS, author's calculations.

Figure 4C.17. Reserves Adequacy Components: Estonia



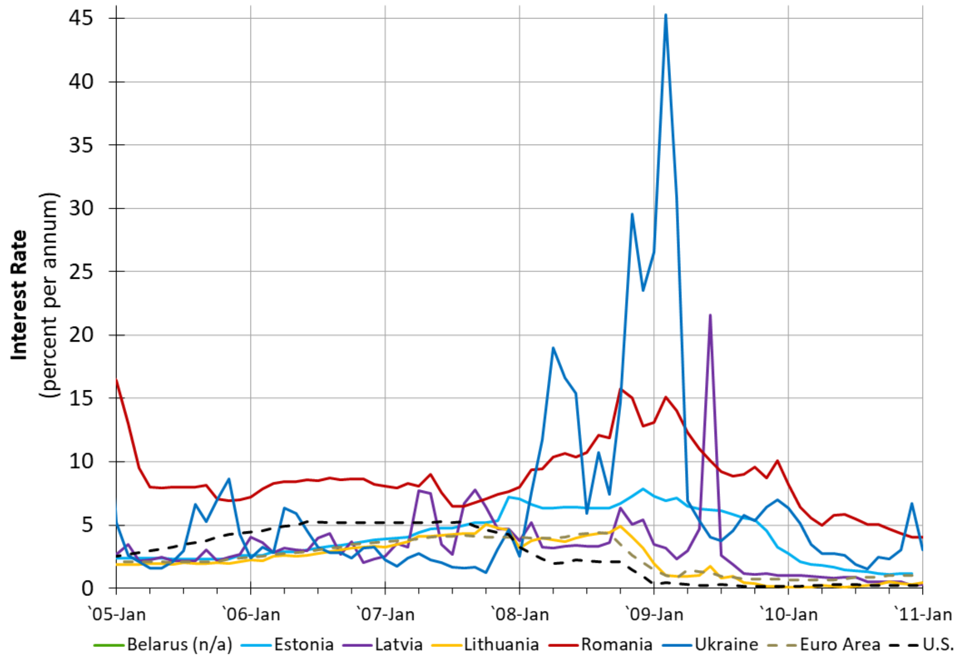
Source: IMF IFS, author's calculations.

Figure 4C.18. Reserves Adequacy Components: Lithuania



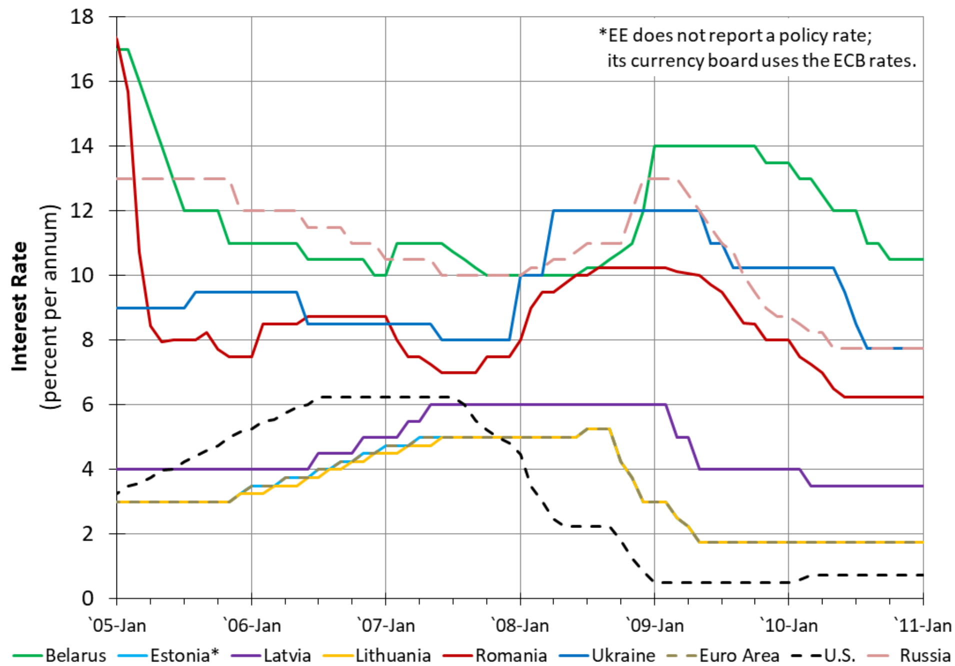
Source: IMF IFS, author's calculations.

Figure 4C.19. Money Market Interest Rates (Nominal)



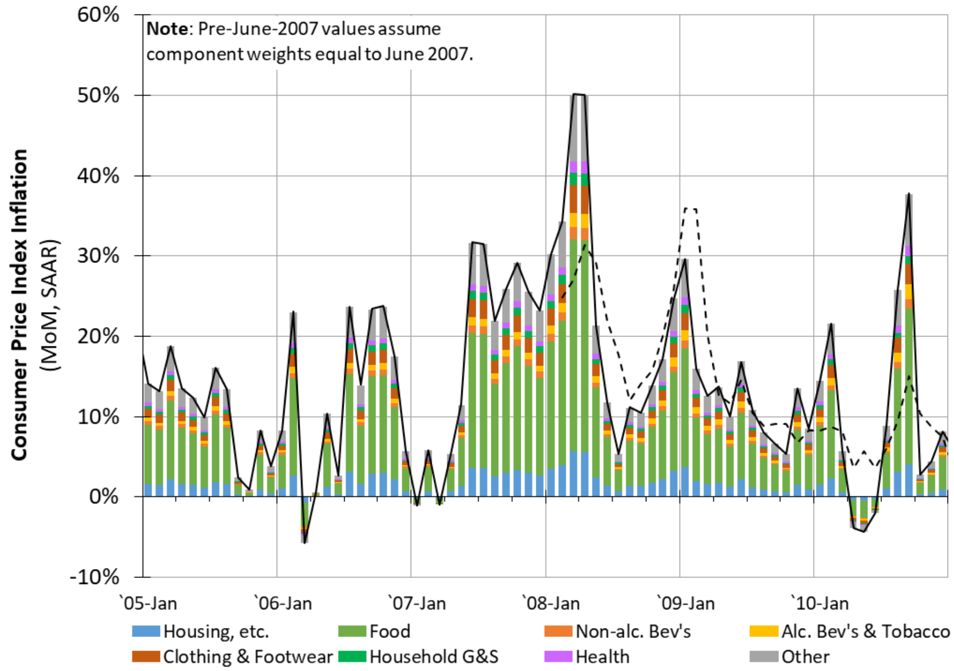
Source: IMF IFS.

Figure 4C.20. Central Bank Policy Interest Rates (Nominal)



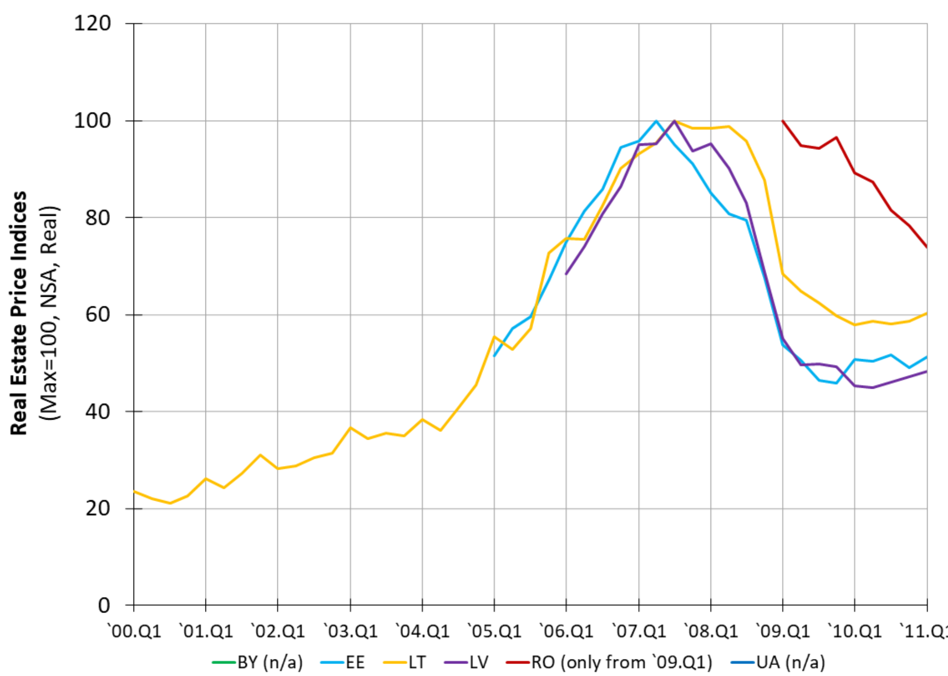
Source: IMF IFS.

Figure 4C.21. Ukrainian inflation (%) and Component Contributions (pp)



Source: State Statistics Service of Ukraine (via Haver Analystics), author's calculations.

Figure 4C.22. Real Estate Price Indices



Source: BIS, author's calculations.

Appendix 4D: Vulnerabilities from the Literature

As a first step in examining the cases and case pairs at hand, vulnerabilities identified in the case study literature are considered further. This includes re-examining the credit boom term (already in the Chapter 3 model) as well as its credit level (as per cent of GDP) counterpart, and level and boom versions of the current account, inflation, foreign debt (and its portfolio and other investment components) and "offshore deposits" (deposits by foreigners into domestic banks, as ratio to domestic deposits), as well as measures of foreign bank ownership (FBO: per cent of domestic banking system assets owned by foreign banks) and foreign bank claims (FBC: outstanding loans from foreign banks to domestic borrowers, as per cent of GDP). Following Chapter 3, the "boom" versions of these measures are calculated as CAGR 2003–2007 (and 2005–2007 for FBO due to data limitations), save with the current account and inflation variables, for which—because they can take on negative values—the "boom versions" are calculated as percentage point (pp) changes over 2003–2007.

Figure 4D.1 to Figure 4D.17 plot the depth residual against each of these variables, illustrating the general lack of significant relationship over the Chapter 3 model sample, also confirmed through testing each of these variables added to the Chapter 3 model. This lack of significance indicates that these measures do not reflect vulnerabilities that apply generally to most countries (at least not in a straight-forward additive manner). If they do help explain the differential residual outcomes of the cases at hand, then they do so through more complex dynamics.

First revisiting the credit boom relationship, Figure 4D.1 shows the non-relationship on the model sample, reflecting the credit boom term's existing inclusion in the model. Considering the case pairs comparatively, no relationship is seen between Ukraine and Romania or between Latvia and Belarus precisely because they were chosen (during case pair selection) to have similar IV values, and thus are roughly vertically aligned in this chart. For the level of credit (credit from banks and other financial institutions to the private sector, 2007 per cent of GDP) in Figure 4D.2, all of the cases show only low to moderate credit levels—that is, with only Latvia and Estonia approaching the higher levels seen in developed countries. While the Latvia-Belarus relationship is consistent with the expectation that higher levels of credit (relative to the size of the economy) could generate vulnerability to deeper contractions—as are the Latvia-Lithuania and Lithuania-Belarus relationships—the relationship is less clear for Ukraine-Romania, with more-similar credit levels (and a much steeper slope), and even less clear for Latvia-Estonia (nearly vertical).

Comparing case-pair relationships against the expected relationship for each vulnerability, Table 4D.1 summarizes the findings. Only two of the measures—portfolio debt liabilities boom and foreign bank ownership—show relationships between each pair that are consistent with theoretical expectations for the two main pairs considered (LV-BY and UA-RO). For the portfolio debt liabilities boom term (representing the boom in the portfolio debt portion of foreign debt liabilities), a larger boom is expected to produce worse outcomes. While it is insignificantly related to contraction depth over the model

Table 4D.1. Summary of Analysis of Vulnerabilities Identified in the Literature

Vulnerability	Exp. Rel.	Model Sample	LV v. BY	EE&LT v. BY	LV v. EE&LT	UA v. RO
Credit Boom	+	already in model	does not explain	does not explain	does not explain	does not explain
Credit Level	+	insig.	fits weakly	fits weakly	LT: ~fits; EE: vertical	fits weakly (~vertical)
Current Account	−	insig.	fits	fits	fits	contradicts (opposite)
Current Account Boom-period Change	−	insig.	contradicts (~vertical)	contradicts (opposite)	fits weakly	fits weakly (~vertical)
Foreign Debt Liabilities	+	insig.	fits	fits	fits (EE: weakly)	contradicts (~vertical)
Foreign Debt Liabilities Boom	+	insig.	fits	fits weakly	contradicts (~vertical)	contradicts (~vert/opp.)
Portfolio Debt Liabilities	+	insig.	fits strongly	fits	contradicts (~vertical)	contradicts (~vertical)
Portfolio Debt Liabilities Boom	+	insig.	fits	fits weakly	contradicts (~vert/opp.)	fits
Other Foreign Invest. Liabilities	+	insig.	fits	fits	fits	contradicts (~vertical)
Other Foreign Invest. Liabilities Boom	+	insig.	fits	fits (weakly)	contradicts (~vertical)	contradicts (opposite)
Offshore Deposits	+	insig.	contradicts (~vertical)	contradicts (~vertical)	contradicts (~vert/opp.)	contradicts (~vertical)
Offshore Deposits Boom	+	insig.	contradicts (~vertical)	fits weakly	contradicts (opposite)	contradicts (opposite)
Foreign Bank Ownership	−(?)	insig.	(may fit?)	fits	fits	fits
Foreign Bank Ownership Boom	−(?)	insig.	contradicts (~vert/opp.)	contradicts (~vert/opp.)	contradicts (~vertical)	contradicts (~vertical)
Foreign Bank Claims	−(?)	insig.	fits weakly	fits weakly	contradicts (~vertical)	no UA data
Foreign Bank Claims Boom	−(?)	insig.	contradicts (~vert/opp.)	contradicts (~vert/opp.)	Fits (EE; LT weakly)	no UA data
Inflation	+	insig.	fits weakly (~vertical)	contradicts (opposite)	fits	fits

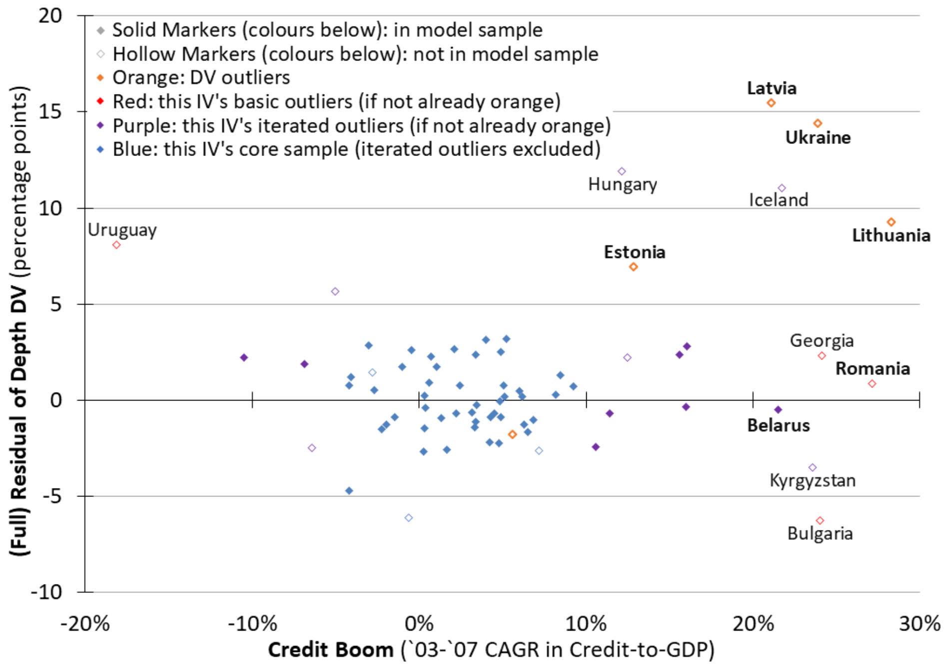
sample, Figure 4D.8 shows that the expected positive relationship is met by BY-LV and UA-RO. However, EE and LT are almost directly below LV, so this “vulnerability” cannot alone explain the differences in those latter relationships.

For foreign bank ownership (FBO), the expectation is initially straightforward, but with policy interventions complicating the potential outcomes during the GFC itself. During the crisis, worse outcomes were expected for countries with greater foreign ownership of their banking system, as foreign banks were expected to withdraw financing from abroad during the crisis, incentivized to “run” from the country as those last-out may not recoup their assets. Yet, as part of the during-crisis response, governments sought commitments from foreign banks—later formalized in the Vienna Initiative—to not withdraw, and to continue supporting their foreign branches and subsidiaries. This complication thus permits the expectation of a simple positive linear relationship, or possibly of a quadratic inverted-U relationship with low-FBO countries facing little vulnerability, and high-FBO countries facing the vulnerability of withdrawal (and even some actual withdrawal), but which was tempered by foreign banks subsequent recommitment to continue financing activities abroad. In this view, countries with middling FBO values could then be caught between some withdrawals and incomplete returns, resulting in worse outcomes. Empirically, Figure 4D.13 shows that the case-pair relationships are not inconsistent with the quadratic interpretation, with BY at low-FBO and EE, LT and RO at high-FBO all showing relatively small residuals compared to mid-FBO LV and UA. Yet the sparsity of other middle-FBO cases—notwithstanding Ireland (IE), Hungary (HU), Peru (PE) and Uruguay (UY)—undermines any confidence that this is a systematic quadratic relationship. Also discernable in Figure 4D.13 is a slightly positive relationship across the model sample, which may account for a small amount of the differences in these non-model sample cases, but the significance of which was not found adequately robust for inclusion in the model from Chapter 3.

Among other measures, several potential vulnerabilities appear consistent with outcomes in the Baltics-BY pairings, but not with UA-RO. Figure 4D.3 shows that the expected current account (CA) relationship—with larger deficits expected to produce deeper contractions—holds well for between the Baltics and Belarus (all lying on roughly the same line), while the UA-RO relationship is inconsistent with that expectation (UA's CA deficit much is smaller than RO's). Likewise, the expectation that a higher (2007) level of "other" foreign debt liabilities—that is, the non-portfolio (and non FDI or derivatives) portion of foreign debt liabilities, consisting largely of debt owed to foreign banks—would produce worse outcomes is consistent for the Baltic-BY pairs, but not for UA-RO (Figure 4D.9). In contrast, the expectation that higher inflation would result in worse outcomes appears consistent only for UA-RO, but not for the Baltic-BY pairs (Figure 4D.17).

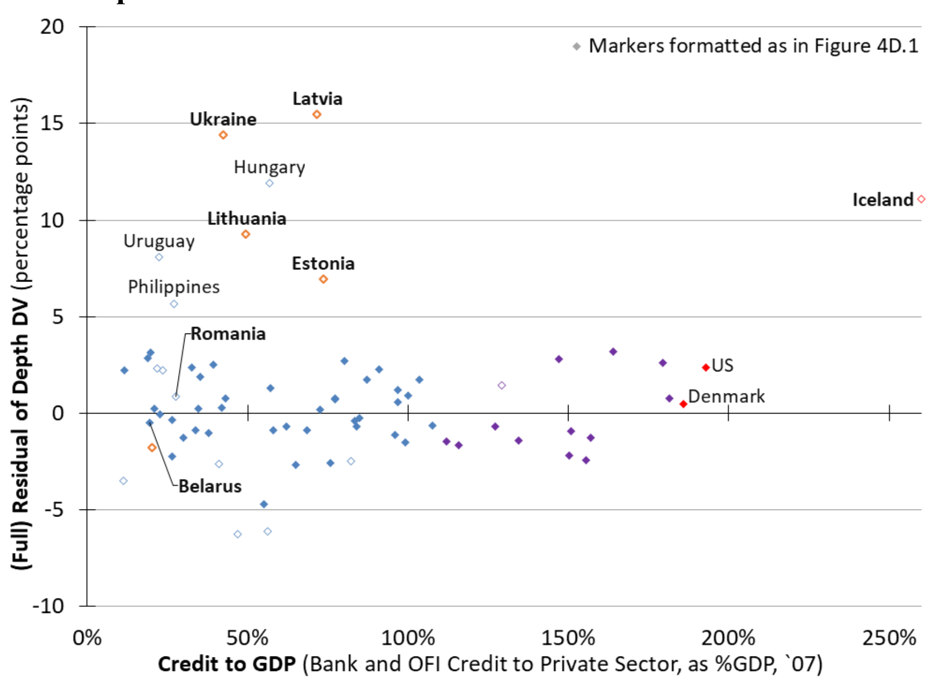
Overall, then, this analysis primarily reinforces that these potential vulnerabilities identified in the case study literature do not apply generally to most countries (i.e., to the model sample). Further, they also do not apply straightforwardly and in the same way across the specific cases under examination here. The current account deficit and "other" foreign debt liabilities appear potentially relevant for the Baltics vs. Belarus, while inflation appears more relevant for Ukraine-Romania. It does, however, seem likely that these potential vulnerabilities are modulated through more complex mechanisms, particularly as they do not appear to apply to other countries more generally.

Figure 4D.1. Depth DV Residual vs. Credit Boom



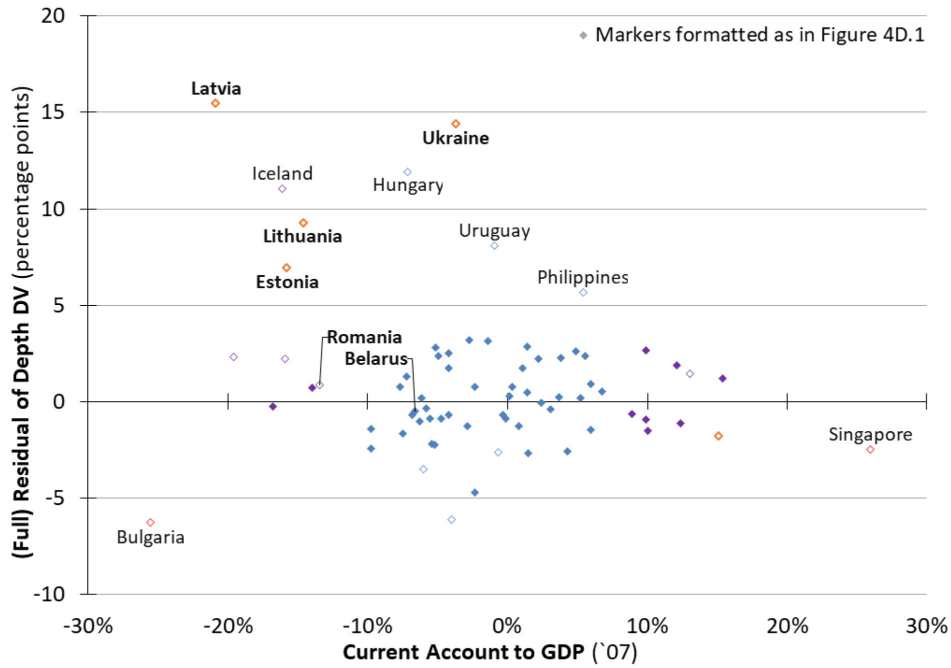
Source: author's calculations.

Figure 4D.2. Depth DV Residual vs. Credit Level



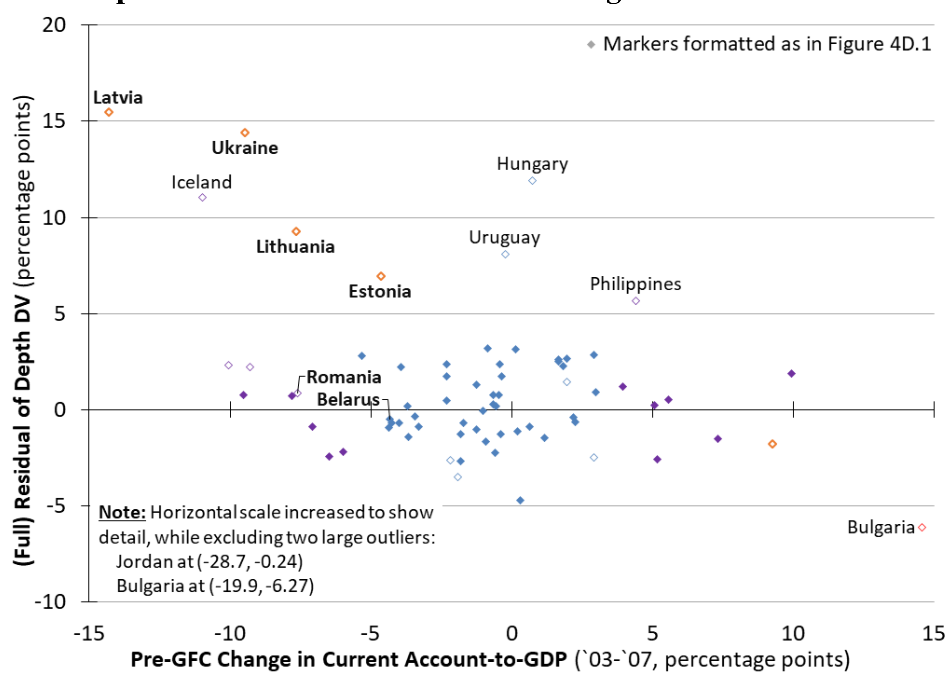
Source: author's calculations.

Figure 4D.3. Depth DV Residual vs. Current Account



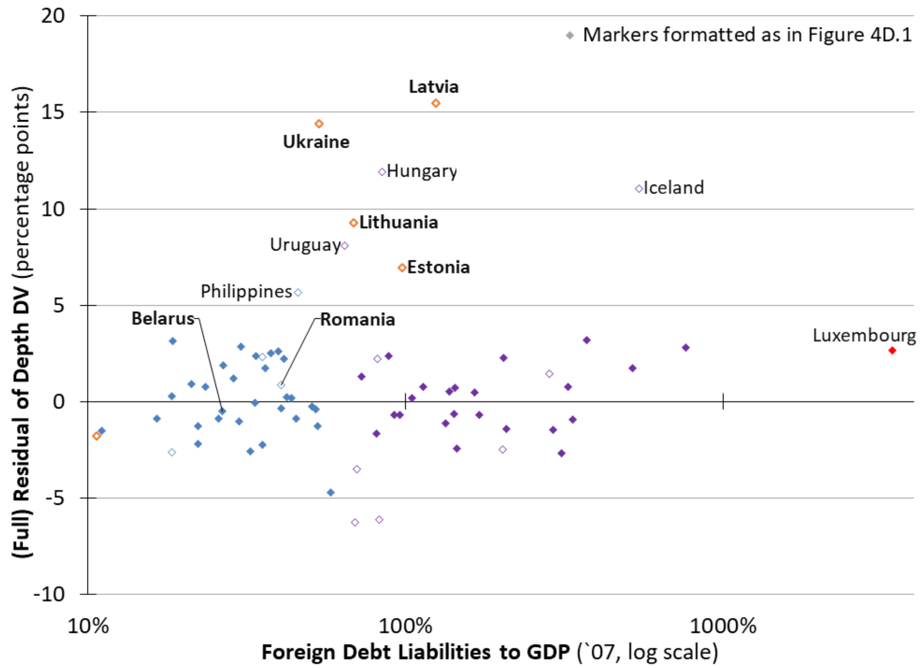
Source: author's calculations.

Figure 4D.4. Depth DV Residual vs. Pre-GFC Change in Current Account



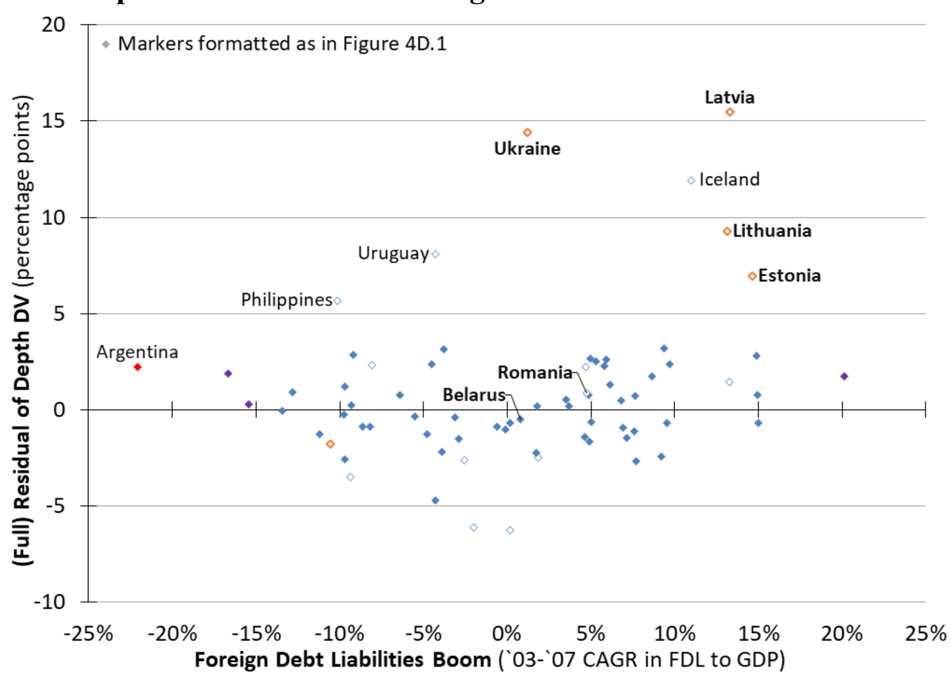
Source: author's calculations.

Figure 4D.5. Depth DV Residual vs. Foreign Debt Liabilities



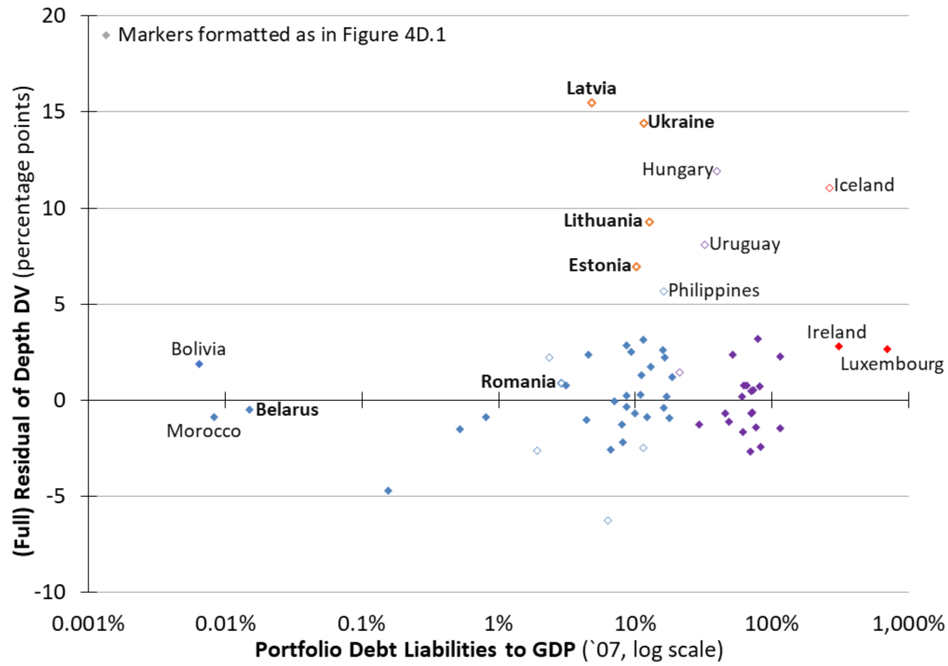
Source: author's calculations.

Figure 4D.6. Depth DV Residual vs. Foreign Debt Liabilities Boom



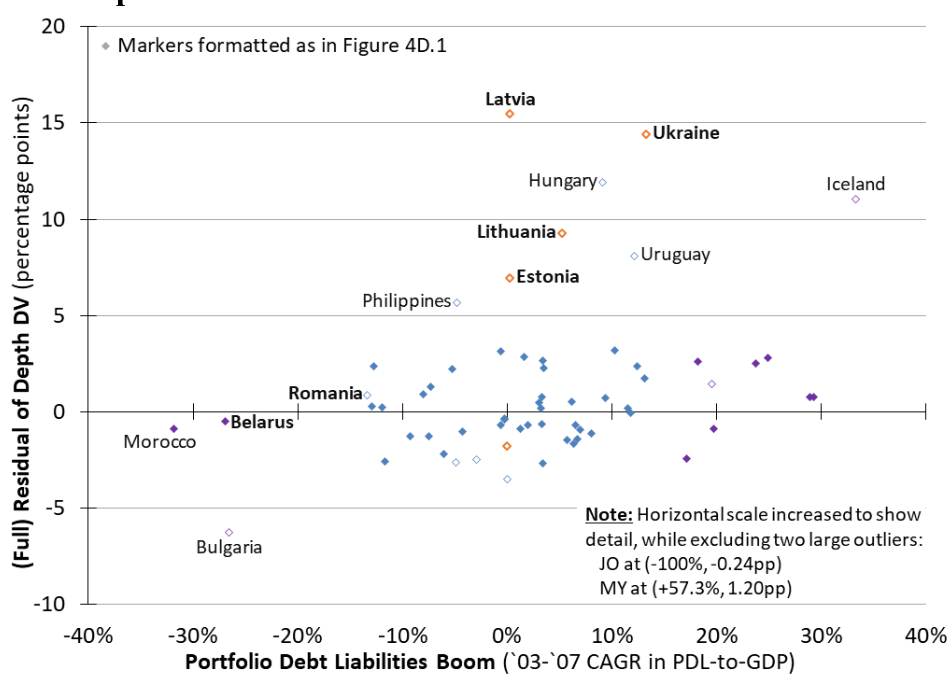
Source: author's calculations.

Figure 4D.7. Depth DV Residual vs. Portfolio Debt Liabilities



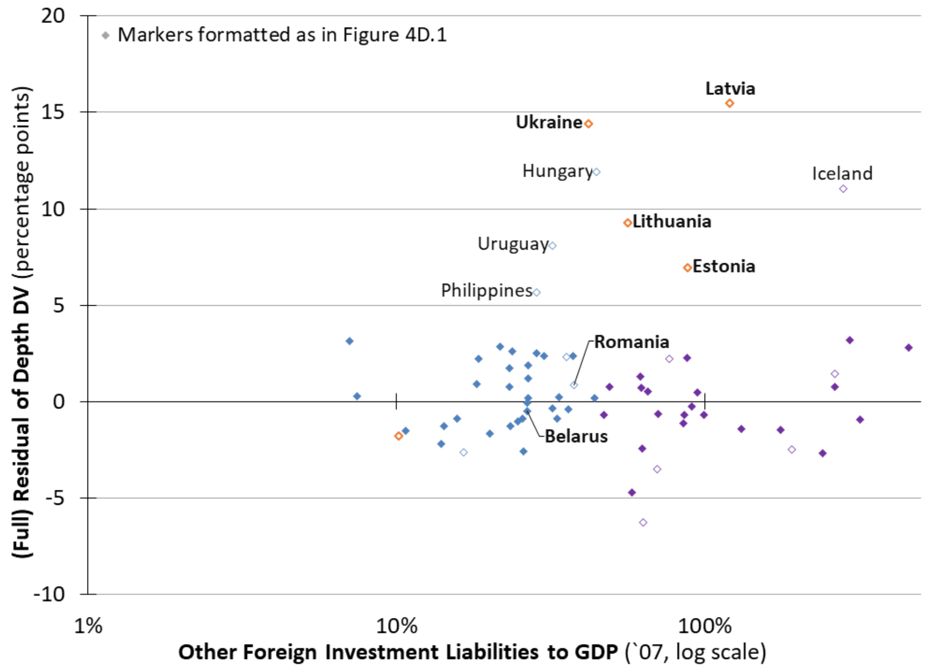
Source: author's calculations.

Figure 4D.8. Depth DV Residual vs. Portfolio Debt Liabilities Boom



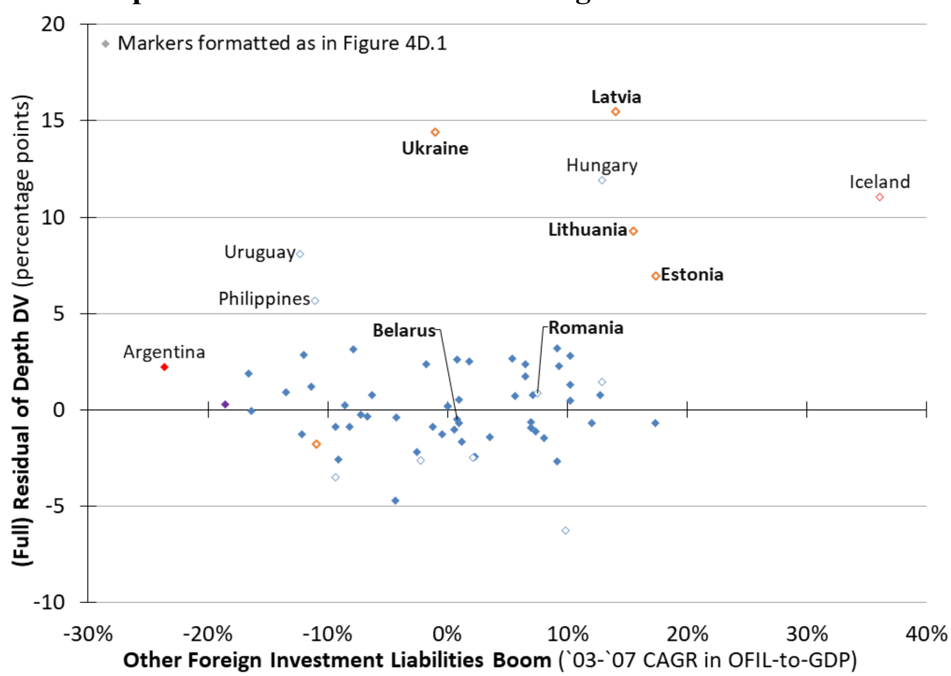
Source: author's calculations.

Figure 4D.9. Depth DV Residual vs. Other Foreign Investment Liabilities



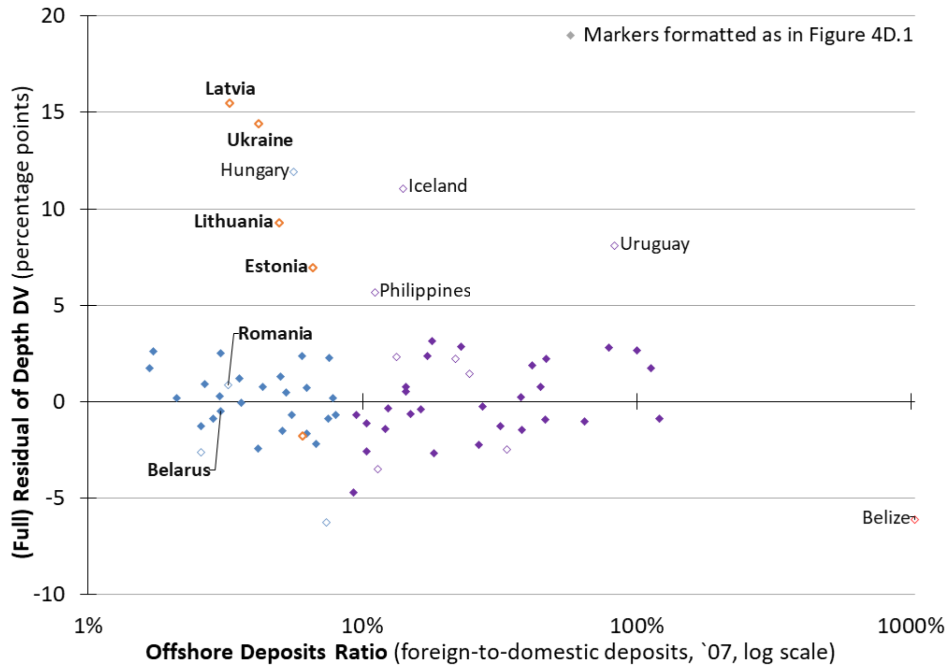
Source: author's calculations.

Figure 4D.10. Depth DV Residual vs. Other Foreign Investment Liabilities Boom



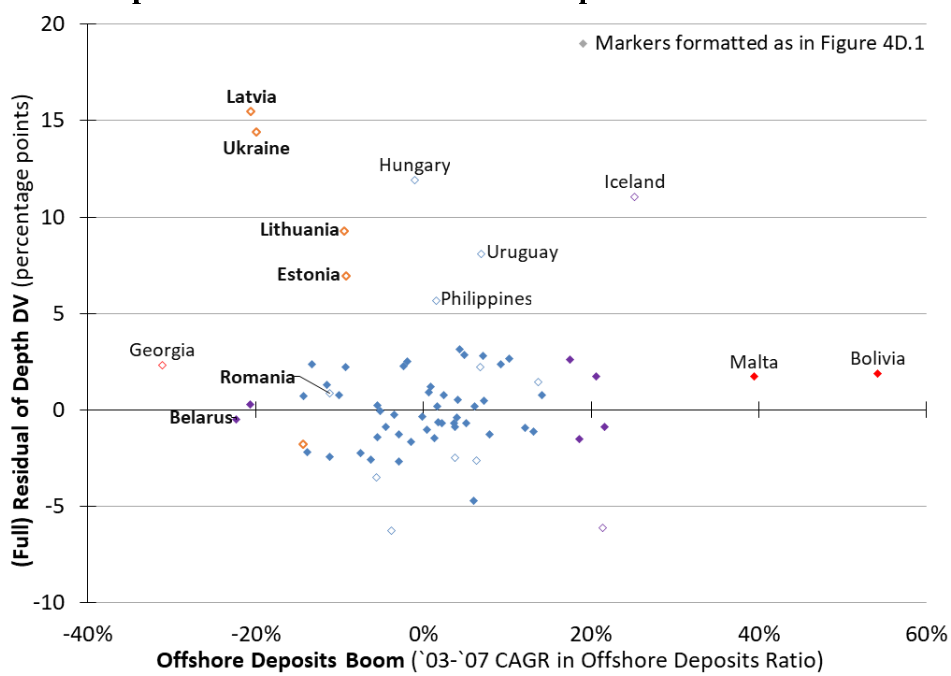
Source: author's calculations.

Figure 4D.11. Depth DV Residual vs. Offshore Deposits



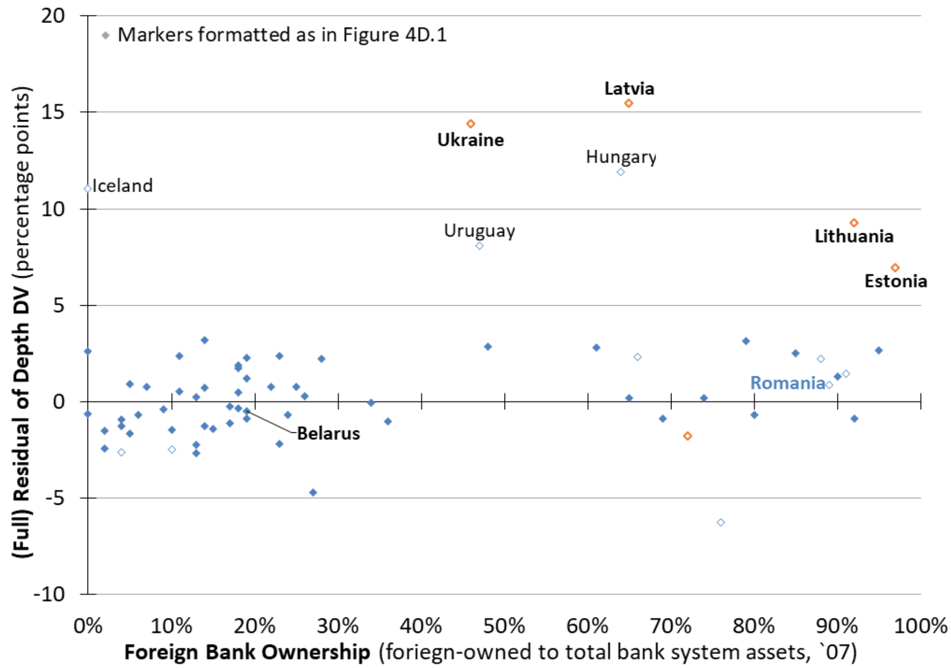
Source: author's calculations.

Figure 4D.12. Depth DV Residual vs. Offshore Deposits Boom



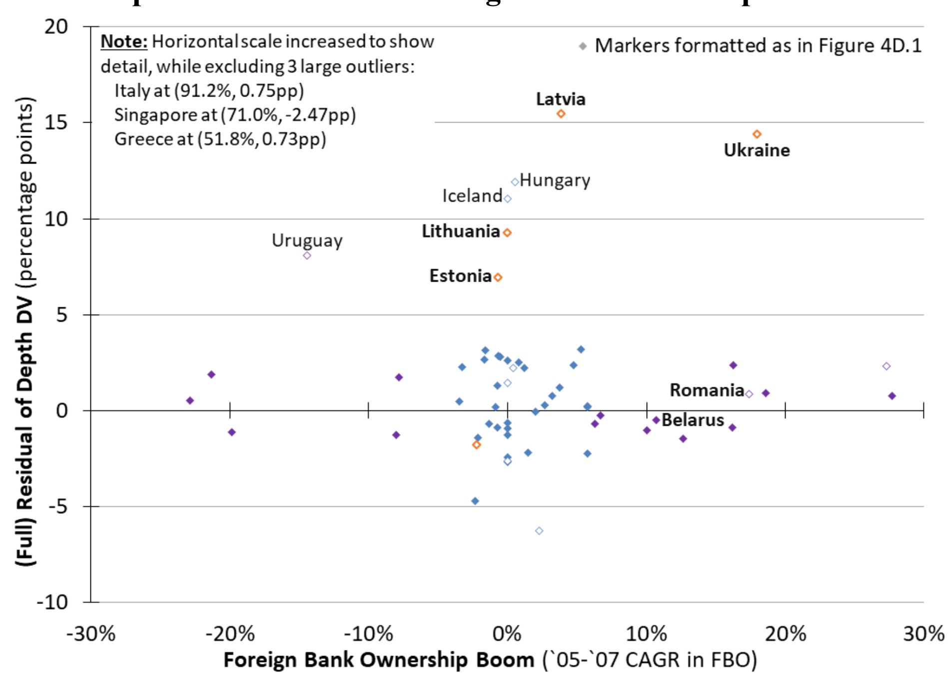
Source: author's calculations.

Figure 4D.13. Depth DV Residual vs. Foreign Bank Ownership



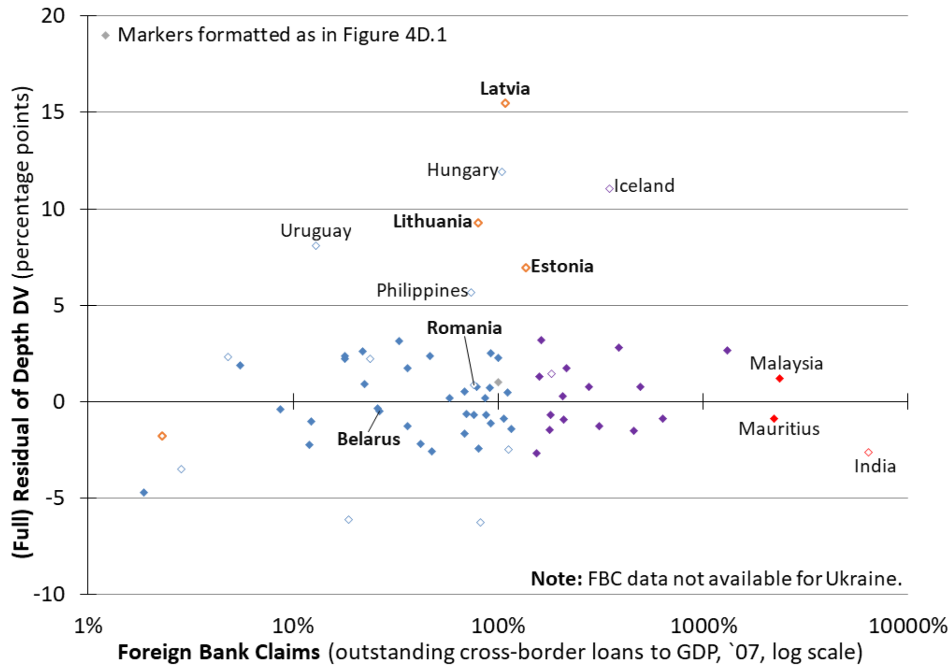
Source: author's calculations.

Figure 4D.14. Depth DV Residual vs. Foreign Bank Ownership Boom



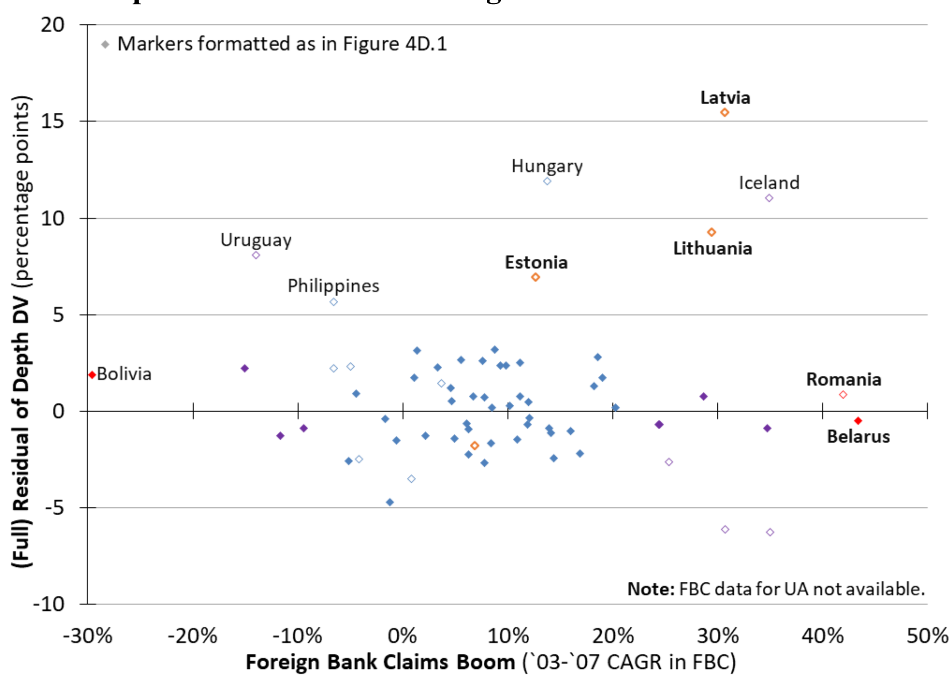
Source: author's calculations.

Figure 4D.15. Depth DV Residual vs. Foreign Bank Claims



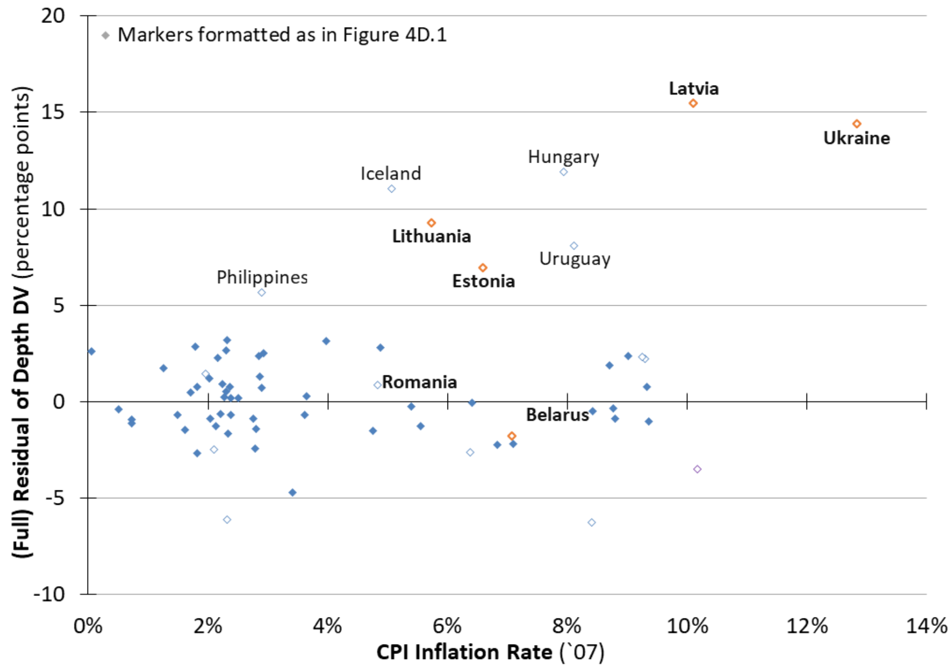
Source: author's calculations.

Figure 4D.16. Depth DV Residual vs. Foreign Bank Claims Boom



Source: author's calculations.

Figure 4D.17. Depth DV Residual vs. Inflation



Source: author's calculations.

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Appendix 4E: AA-DD Analysis

As per Krugman, Obstfeld and Melitz (2012), in AA-DD analysis, output (Y) is plotted on the horizontal axis and the exchange rate (E) is plotted on the vertical axis in direct terms—units of local currency per unit of foreign currency—so that depreciation corresponds with increasing index values. In this chapter, output and the exchange rate are each measured as indices, with values set to 100 in the quarter of peak GDP, providing a common "origin" of (100,100) for each case. The upward-sloping "DD" curve represents combinations of output and exchange rate values at which aggregate demand is in equilibrium. The downward-sloping "AA" curve represents combinations of output and exchange rate values at which money markets and foreign exchange markets are in equilibrium. Positive (or negative) shocks to aggregate demand shift the DD curve rightward (or leftward), while financial and monetary easing (or tightening) or higher (or lower) expected exchange rates shifts the AA curve rightward (or leftward).

The analysis in this chapter assumes that the AA-DD curves are all linear, and that there is a common slope across these cases for the AA lines (calibrated to the Romanian case) and for the DD lines (calibrated to the Estonian case). Specifically (see Figure 4.13), the slope for the linear AA curves is chosen to match that of AA_0, defined as passing through Romania's observed outcome in '09Q1 and the common origin of (100,100) for all countries. Because of the common slopes and origins, this AA_0 curve is the same for all countries. The slope for the DD lines then is chosen to match that for $DD^{EE}{}_1$, defined as passing through Estonia's actual trough outcome in '09Q4 (observed Y^{EE} and E^{EE}) and the

Estonian counterfactual under a floating exchange rate, with output as predicted by the model in Chapter 3 ($\hat{Y}^{EE}$), and with the exchange rate reaching equilibrium ($\hat{E}^{EE}$) where $Y=\hat{Y}^{EE}$ crosses AA_0.[51] DD_0 is then defined as the line with slope identical to $DD^{EE}{}_1$ passing through the point (100, 100), and represents the common initial DD curve for all countries.

For each other country "XX", the $DD^{XX}{}_1$ line is defined with the same slope as DD_0 and passing through the counterfactual point where $Y=\hat{Y}^{XX}$ crosses AA_0. The point ($\hat{Y}^{XX}$, $\hat{E}^{XX}$) thus represents the predicted outcome for each country to the shocks captured in the Chapter 3 model under a floating exchange rate. The point ($\tilde{Y}^{XX}$,100) is then defined for each country as where $DD^{XX}{}_1$ crosses the E=100 axis, and represents each country's predicted outcome to the shocks captured in the Chapter 3 model with full external adjustment under a (credible) fixed exchange rate (i.e., with no additional capital flight). Other AA and DD curves ($AA^{XX}{}_2$ and $DD^{XX}{}_3$, $AA^{XX}{}_3$ and $DD^{XX}{}_3$, etc.), are also shown for some countries, passing through the output and exchange rate values actually observed in particular quarters of interest discussed in the text, including the quarter of trough GDP.

[51] Note that $\hat{Y}^{EE}$ (and corresponding $\hat{Y}^{XX}$ values for other countries) are calculated as the predicted output value from the model in Chapter 3, specifically excluding any contribution from the Flexible Exchange Rate Regime IV, so as to represent the value predicted under a floating exchange rate.

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Chapter 5: Conclusions: Summary, Policy Advice and Further Research

This dissertation set out to understand the causes of the cross-country differential real impact of the Global Financial Crisis (GFC); that is, to explain why different countries experienced different depths and durations of output contraction over 2007–2010. In particular, it seeks to unpack and explain the apparent "Advanced Economies (AE) Nature" of the GFC, in which richer countries experienced worse real economic outcomes with deeper and longer contractions. This final chapter summarizes the results of Chapters 2–4, discusses policy advice arising from those results, and considers areas for future research.

5.1 Summary of Results

Chapter 2 presented a simple empirical examination of the depth and duration of GFC-related recessions. The primary result is that cross-country GFC outcomes are best characterized by a discrete differentiation between lower-middle-income countries (LMICs) on the one hand, and upper-middle- and high-income countries (UMICs and HICs) on the other. On average, HICs and UMICs experienced statistically significantly and economically meaningfully deeper and longer contractions than did LMICs. No robust continuous relationship—linear, quadratic or even cubic—with income (as logged per capita GDP) is discernable within or between the three groups. The result in the literature, that contraction severity is linearly related to income, does not hold. Instead, a "step-function" emerges, with LMICs showing moderate contractions, while UMICs and HICs experienced worse outcomes. This is not to suggest that country classification definitions have actual explanatory power, but rather that there appears to be a significant change in economic characteristics that coincides with the transition from LMIC to UMIC status.

Chapter 3 seeks to "explain away" the LMIC step-function regularity found in Chapter 2, identifying economic characteristics that help explain why the GFC had a differential impact on countries in different income groupings. Using a non-automated, step-wise iterated model-selection process, the analysis identifies the "best" regression models for the contraction depth and duration dependent variables (DVs), which are robust to heteroscedasticity, multicollinearity, and the addition of a wide-variety of alternative independent variables (IVs). The selection process also avoids false positive and false negative results due to outliers, and identifies "deviant cases" that are not well-explained by each model. After testing a very large set of potential explanatory variables, remarkably parsimonious models emerge for each DV (Table 5.1). Both models also dominate any alternative version that includes income-related variables, demonstrating that the differential GFC outcomes reflect countries' underlying economic characteristics rather than income levels. The LMIC step-function relationship identified in Chapter 2 emerges as a result of these economic variables' mild correlations with the LMIC binary indicator.

With the AE Nature of the GFC well-explained by Chapter 3, Chapter 4 turns to comparative case studies of Ukraine and Latvia as "deviant" cases, not well-explained by the depth model (i.e., showing large depth DV residuals). Romania and Belarus are chosen as comparators that appear well-explained by the model (i.e., with small depth DV

Table 5.1. Summary of Results

IV Category		Depth Model (+: higher value → *deeper* contraction)	Duration Model (+: higher value → *longer* contraction)
Domestic Situation	Financial	+ **Bank and OFI Credit Boom** (2003–2007 CAGR in %GDP)	+ **Bank Assets Boom** (2003–2007 CAGR in %GDP)
	Fiscal	− **Government Expenditures Boom** (2003–2007 CAGR in ratio-to-GDP)	
International Linkages	Trade	+ **Manufacturing Exports** (logged 2007 %GDP)	
		+ **FFM Exports Boom** (2003–2007 CAGR in share of exports)	
	Financial	− **FDI Assets Boom** (2003–2007 CAGR in %GDP)	+ **Foreign Debt Liabilities** (logged 2007 %GDP)
	Exchange Rate	− **Flexible Exchange Rate Regime** (binary dummy)	

residuals), and which are otherwise as similar as possible to Ukraine and Latvia respectively, with respect to the IVs included in the depth model. In addition to some country-specific contributors, the main result of this analysis is a single main driver for the worse-than-modeled Ukrainian and Latvian outcomes. That main driver is the countries' different experiences of and policy choices relating to the BoP crises faced during the GFC-acute phase, in particular the extent of their abilities to undertake internal adjustment.

Where Romania undertook full external adjustment, allowing its flexible exchange rate to "absorb" the shocks, the others all sought to maintain their pegs, "magnifying" the output shocks.[1] In contrast, Ukraine was unable to defend its conventionally pegged

[1] Estonia and Lithuania are also considered secondarily, as less-extreme deviant cases similar to Latvia, and for which Belarus is also the best "well-explained" comparator. Under highly credible currency boards supported by more-than-adequate reserves, Estonia and Lithuania successfully defended their fixed exchange rates. This internal adjustment magnified their output shocks, but they did not face the expected exchange rate changes and additional capital flight shocks experienced by Latvia, Belarus and Ukraine.

arrangement, especially after allowing reserves adequacy to erode over 2008. Mutually reinforcing capital flight and an expected end to the peg further accelerated reserves loss and provided an additional shock to demand, also magnified by internal adjustment. With IMF support to prevent the worst outcomes, Ukraine floated the hryvnia, allowing it to depreciate freely, thereby ending the period of magnified contraction. This failed attempt at internal adjustment, followed by external adjustment—as well as further internal adjustment after the devaluation—results in a much deeper contraction than if Ukraine had initially undertaken full external adjustment (e.g., as did Romania). The idiosyncratic start to Ukraine's GFC-period contraction further contributes to its extremely deep GFC-period contraction, with additional depth reflecting the Q2 2008 reversal of a large increase in consumption experienced in Q1 as Ukraine experienced near-hyperinflation.

Latvia also faced an expected end to its conventionally pegged exchange rate, and thus the same accelerating reserves loss and additional, magnified shock to demand as Ukraine. Until October 2008, Latvia had maintained very-adequate levels of reserves, and was increasingly treating its peg like a currency board, which might have prevented the loss of confidence. It was the government and central bank's decision to save the creditors of failing Parex Bank that struck a blow to reserves adequacy and brought Latvia clearly into danger of an outright currency crisis. However, IMF and especially European Commission financial support permitted Latvia to defend its peg against the euro, albeit at the cost of an even deeper contraction.

Chapter 4 also shows that Belarus as not actually a good pairing for Latvia. While chosen as “similar” but “well explained” match, closer examination finds Belarus only “coincidentally” well-explained. Where Latvia (and others) experienced major changes in credit dynamics—associated with the 2007 pullback of financing by Western parent banks, and then with the GFC acute phase—Belarus saw only very small changes in its credit trajectory. Belarus’s continued strong credit growth reflects its un-liberalized economy, including limited exposure to international (and especially Western) capital flows and significant government control over domestic credit allocation. Belarus thus seems not to have experienced the effects associated with the credit boom IV in the model from Chapter 3. The resulting reduction in contraction depth then appears to be countered by Belarus’s BoP experience of devaluation followed by external adjustment in the face of capital flight. In contrast to Ukraine’s partial internal adjustment, followed by depreciation and full external adjustment, Belarus traded off a somewhat deeper contraction for less devaluation; but in contrast to Latvia’s full internal adjustment, Belarus traded off some devaluation for a shallower contraction. However, even when magnified under partial internal adjustment, the Belarus’s smaller base shocks to output only result in a contraction depth “coincidentally” in-line with that predicted by the depth model in Chapter 3.

5.2 Policy Advice

There are a variety of policy implications from this research, primarily arising from the analysis in Chapters 3 and 4. Chapter 2 has only one key policy lesson: it is important to understand the fundamental nature of crises rather than simply accept simple associations between variables. The observation that the GFC was primarily an AE phenomenon obscures the fact that the severity of the downturn did not monotonically worsen as income levels increased, but instead reflected economic fundamentals that appear to shift as countries graduate from LMIC status.

5.2.1 Domestic Financial

The direct policy advice coming out of the Chapter 3 results regarding the credit and bank assets booms model-IVs largely supports mainstream economic views about business cycle management. Primarily the results find that the most important factors influencing both contraction depth and duration are within the domestic financial system: bigger pre-crisis credit booms robustly correlate with deeper output contractions, and larger pre-crisis expansions of bank system assets robustly correlate with longer contraction durations. Thus, managing the boom-period accumulation of domestic credit and bank assets is likely to help mitigate crisis-related contractions—consistent with the mainstream advice that the central banks undertake counter-cyclical monetary policy—that is, "taking away the punch just as the party is getting started".

Importantly, this advice is country-specific, meaning that regardless of what other countries are doing—for example, allowing the boom to proceed unchecked—an individual country can take action to mitigate crisis fallout within its own economy. Other countries may choose not to—or may simply neglect the possibility of—mitigating future problems this way, thereby contributing to a global and not just domestic credit boom, but the individual country can gain benefits from resisting that temptation. Further, if enough countries—or at least, enough systemically important countries—did proactively mitigate domestic credit booms, such a global boom and apparently inevitable bust might not even emerge. Such an optimistic possibility does, however, ignore the political economy of counter-cyclical policy. Interested groups are likely to pressure the government and even a relatively independent central bank, to allow the credit/punch to flow and the boom/party to continue—including through legitimate advocacy and supported-but-potentially-biased research papers, or through means deemed less-legitimate in an idealized view of how (political-)economic decisions are actually made.

5.2.2 Domestic Fiscal

The Chapter 3 result regarding government expenditures is the one outcome that potentially challenges mainstream policy advice. The result finds that countries with larger boom-period increases in government expenditures experienced shallower GFC contractions. This result is not inconsistent with the theoretical expectation that government expenditures can stimulate output and may do so especially with a lag, explaining how pre-crisis spending could mitigate the during crisis contraction; however, it does not align well with mainstream policy advice, recommending counter-cyclical fiscal policy to temper swings in total demand by reducing spending during the boom and increasing it during the bust. Nevertheless, it does not seem to make sense to actually recommend increased spending during a boom-period based solely on this result, whether or not one would also recommend either increased spending during the bust, potentially leading to a “spend all the time” recommendation, or potentially-pro-cyclical decreased spending during the bust. It also seems unlikely that pro-cyclically-timed fiscal policy is actually counter-cyclical overall, but this could conceivably be the case, particularly given lags in implementation. Clearly further research into this result is needed, including as discussed below, before any policy advice can be given here.

5.2.3 International Trade Linkages

Chapter 3 finds that countries with greater manufacturing exports (relative to GDP) suffered deeper contractions, as would be expected due to reduced external demand for manufactured goods as other countries weathered the GFC. Here the naïve policy implication—to reduce export dependence on manufactured goods—seems unwarranted, given the broad theoretical basis and empirical evidence in support of export-oriented growth. A less naïve view may be more warranted: that some countries may wish to consider encouraging greater diversification in their exports base. With no differential effect identified with respect to the levels of primary agricultural products or tertiary services, maintaining overall exports while decreasing the share of manufactures could mitigate the outcomes of future crises. Such consideration would, however, need to be made with trade-offs in mind, including the benefits of exporting more manufactured goods during the boom-period, and the benefits of specialization under comparative advantage.

Chapter 3 also found that a bigger boom-period shift in the composition of exports toward food, fuels and mining (FFM) products corresponded with a deeper contraction. This vulnerability is most robustly associated neither with the level of FFM exports, nor with the boom-period increase in FFM exports as a simple share of GDP, but with the boom-period increase in the exports share of FFM. That is, countries that not just increased exports of FFM during the boom-period, but that did so at the expense of other kinds of exports (i.e., raw non-food agricultural goods) fared worse during the GFC period. This outcome coincides with the August 2008 crash in prices for oil and other commodities, which may be somewhat independent of the GFC itself.

The direct policy recommendation here is that countries should consider policies that would moderate the shift in their economies toward the export of assets that are experiencing global price booms; during the pre-GFC boom, this included food, fuels and mining products, but which could be different in different boom-periods. This advice again represents “slowing the party before it gets out of hand”, and could face significant political backlash in the exuberance of the boom, but could also help countries better whether subsequent storms. By ensuring that only firms that can produce when an unsustainable price bubble eventually bursts, a country may mitigate the hit to its overall economy and to the newly expanding resource sector itself. It is, however, a characteristic of periods of exuberance that the identification of the unsustainability of booms is difficult, and subject to a variety of cognitive biases and political economic pressures. Consideration should be given to the balance of benefits in expanding rapidly during the boom-period versus mitigating outcomes during the bust, while recognizing that the bust is usually only seen as "inevitable" after the fact. Despite the political economic pressures of the moment, policy makers would do well to internalize the inevitability of the bust following a boom, despite the hope that booms (and subsequent busts) can be reduced, and despite the recognition that policy makers change with time, so that such conclusions become hard to remember during a euphoric boom-period.

5.2.4 International Financial Linkages

Pre-crisis international financial linkages also played a significant role in determining during-crisis outcomes, with similar policy recommendations resulting for both sources and destinations of financial flows. Source countries that saw greater pre-crisis booms in the domestic accumulation of FDI assets abroad tended to have shallower (but not shorter) contractions, suggesting policies that encourage FDI transactions during the boom would provide the home country with resilience during a subsequent bust. On the other side, recipient countries owing higher levels of debt to foreign creditors experienced longer (but not deeper) contractions, suggesting that policies to discourage high levels of foreign debt liabilities—including, but not limited to the accumulation thereof during a broad boom-period—would help the domestic economy shorten the contraction period, hopefully then allowing a faster move into recovery.

In both cases, the source and recipient countries are encouraged to incentivize longer term forms of foreign investment, consistent with the mainstream economic view of the dangers of shorter-term, "hotter" flows. Of course, and again, there are trade-offs to be considered, with hotter flows providing better short-term returns for investors—and thus perhaps for the source economy more generally—and with longer term flows (like FDI) likely not available for many important projects in destination countries, due to higher risk requiring higher return. While the individual recipient country can choose to act independently toward mitigating future risks, particularly at the margin, it does so at the risk of not obtaining needed financing at all, let alone in the short-term. In contrast, source countries may be better placed to incentivize longer term flows, although they may also face greater political pressures to not do so, including from wealthier investors.

5.2.5 Exchange Rate Regimes and BoP Crises

Countries' choice of exchange rate regime also played a significant role in determining GFC contraction depth. Countries with more flexible exchange rates experienced shallower contractions, while those with less flexible rates (including Eurozone members) saw deeper contractions, with no further distinction found for finer classifications within those two broad groups. Countries concerned about external shocks would therefore be advised to consider implementing a floating exchange rate. Nevertheless, there are again trade-offs to be considered in making such a decision—particularly for smaller economies—including the potential role of a fixed exchange rate in promoting trade with a particular large partner, or in a particular commodity (such as oil, traded globally traded using the U.S. dollar), or in providing an anchor against inflation.

The case studies in Chapter 4 also broadly support those conclusions. The main policy advice toward minimizing contraction depths during a BoP crisis is the mainstream advice to allow full external adjustment through a flexible exchange rate, as for Romania. On the other hand, if the choice is made to fix the exchange rate, further mainstream advice continues to hold: undertake a highly credible fixed arrangement, such as a legally binding currency board, supported by more-than-adequate reserves, as for Estonia and Lithuania. Here though, the external shocks that would be "absorbed" by a flexible exchange rate are magnified by maintaining the peg. So, the decision to fix should recognize that large-enough shocks, with a deep-enough contraction and resulting social distress, could still create enough political pressure to abandon the currency board, though this did not occur for Estonia or Lithuania during the GFC. The Ukrainian and Belarussian cases reinforce this basic point, that exchange rate pegs should be made credibly, and that seemingly adequate reserves (e.g., FXR>MB) are inadequate if allowed to decrease without a corresponding reduction in the monetary base (MB), as required under a currency board.

The Latvian case reinforces the point, with further details and complexity. Initially, it appeared as though Latvia's non-currency-board exchange rate peg would survive the main GFC shocks due to adequate reserves and the choice to follow increasingly currency-board-like behaviour. Counterfactually, such an outcome might have been interpreted as showing that an actual currency board arrangement was unnecessary, with high reserves adequacy making up for lower credibility; but as the crisis worsened, and as political pressures increased to save Parex bank, the absence of the currency board's legal constraints permitted actions on the part of the government and central bank that triggered the BoP crisis. On the other hand, if Latvia had a currency board in place, the resulting stability and pre-commitment may well have provided credibility to its bank system and fixed exchange rate, preventing the additional challenges Latvia faced beyond those experienced by credibly pegged Estonia and Lithuania, including the mutually reinforcing increasing expectation of currency devaluation, speculative attacks and bank failures.

An additional point of advice for countries choosing less-flexible exchange rates is to ensure that outside financial support will be available when needed. With external help, Ukraine, Latvia and Belarus all avoided outright currency collapses—that is, with their currencies becoming worthless in relation to other currencies. Ukraine only had support from the IMF, and that support came under the condition that Ukraine undertake external adjustment, thereby alleviating the contractionary pressures. Belarus had financial support from Russia as, helping it negotiate a partial devaluation plan with the IMF, mitigating the contraction somewhat at the cost a moderately weaker ruble. Latvia, in-turn, had political and financial support from the European Commission for maintaining the lats-euro peg, convincing the IMF to allow it to attempt full internal adjustment.

The Ukrainian and Belarussian experiences also highlight that the relative value of major currencies can vary dramatically in a crisis, and become unsustainable very quickly. As a result, decision makers choosing a fixed exchange rate should understand that pegging to a single major currency at an undervalued level is no guarantee of the sustainability of that peg, particularly if the country trades significantly with other economies not also tied to the same major currency (e.g., Ukraine and Belarus trading significantly with both

Europe and Russia, while pegged to the U.S. dollar). This, of course, reflects one condition under which a fixed exchange rate is more feasible: when a country trades predominantly with one other large country, or at least in one other major currency. Otherwise, countries choosing a fixed exchange rate should consider carefully whether to peg to a single currency, or to a trade-weighted basket of the currencies of their major trading partners.

5.3 Areas for Further Research

A primary avenue for further research is further examination of the causal mechanisms underpinning the correlational relationships identified in Chapter 3, between the depth and duration DVs on the one hand, and their corresponding model-IVs on the other. Such analysis could proceed via comparative case analysis, focusing on pairs of cases that are both (ostensibly) well-explained by the model in Chapter 3, and which differ primarily on the model-IV of interest, but which are otherwise quite similar with respect to the other model-IVs. For each model-IV-DV relationship, such deeper understanding could help develop more precise and useful policy recommendations, toward helping prevent or mitigate the fallout of busts, while allowing better overall economic outcomes across the boom-bust cycle. Of particular interest is the result indicating that greater boom-period expansion in government expenditures helps mitigate during-crisis output contractions. At face value, this result contradicts the mainstream advice to undertake counter-cyclical fiscal policy—that is, to save during the boom, and spend during the bust—but these results are not yet understood well-enough to warrant abandoning part (or all) of that advice.

Further study could also deepen our understanding of each of the cases considered in Chapter 4. These results peel back a layer of the onion, but leave many questions open. Further examination of the political economics at play in each country could reveal further similarities or divergences between these cases, and how circumstances may have played out differently. For example, central to the Latvian story is the rescue of Parex bank, with outstanding questions including how the decision was reached, whether it was made in full knowledge that it would trigger a BoP crisis, and what expectations were in choosing to not rescue it. Further research could help better understand how to manage and mitigate future crises, and perhaps even prevent them.

Future research could also examine more closely the trade-offs inherent in the suggested policy recommendations. For example, the results here support the mainstream advice to manage booms through counter-cyclical monetary policy, which may mean forgoing the benefits of higher boom-period growth to avoid the disadvantages of the bust, either in absolute or relative terms. It is not a priori clear that the drawbacks of the bust necessarily outweigh the benefits of the boom, with the country (or especially some groups therein) further ahead after the bust than if the boom had never occurred—either in absolute terms (i.e., counterfactually in relation to themselves) or in relative terms (compared to other countries or groups at home or abroad). This question is not addressed by this research, and forms an important avenue for further consideration, addressing the widely-held assumption that a volatile business cycle is necessarily “bad”, while also considering the political economic questions of for whom it is bad and for whom it might be good.

Chapter 5: Conclusions

Deeper analysis of the relationship between credit booms and bank assets booms, and how the two relate to contraction depth and duration respectively, may also prove fruitful: the bank assets boom-duration relationship itself may reflect a credit boom component as well as a regulatory component that alters how the overall credit boom relates to the assets boom within the bank system. If so, then mitigating the credit boom would help with both depth and duration, while additional regulatory actions might help further shorten the contraction duration, potentially hastening the recovery.

Latvia's experience shows that it is at least possible for countries with adequate external support to maintain their fixed exchange rates during BoP crisis; but further research into the conditions under which this is possible is needed before recommendations can be made supporting (or denying support to) a particular country facing a BoP crisis. In Latvia's case, the domestic public willingness to undertake the necessary internal adjustment—including magnified output loss and associated increase in unemployment—may have been unusually strong, including due to the broad political desire to align more fully with the West against the threat of neighboring Russia. Latvia, and the other Baltics, also had a clear medium term "exit strategy", in which the exchange rate peg needed only to be sustainable until they could formally join the Eurozone, committing even more fully—that is, beyond even a strict currency board arrangement—to not using monetary policy for domestic purposes. Other countries with pegged exchange rates may not have such a clear "exit strategy", thereby requiring an arrangement that is credibly sustainable in the longer run—such as through an adequately backed currency board.

Chapter 5: Conclusions

In addition to delving deeper into the specific results obtained here, further research could investigate important topics outside the immediate scope of this dissertation. Of central importance is the role of fiscal and monetary policies in mitigating the real impact of the crisis. Chapter 3 focuses specifically identifying on pre-crisis conditions and characteristics that help predict during crisis outcomes. Due to methodological constraints of the cross-sectional multivariate regression analysis Chapter 3 does not consider how monetary, fiscal or other policies were used directly to mitigate outcome, either through automatic stabilizers or active policy decisions. Indeed, while models obtained in Chapter 3 do explain a large portion of the cross-country variation in depths and durations of GFC-contraction, in both cases moderate portions of that variability remain unexplained—around 25 per cent for the depth DV and 54 per cent for the duration DV—which could reflect during-crisis dynamics and policy responses.

Also worthy of further investigation is the relationship between the pre-GFC global commodities and credit booms. The novel inclusion in this dissertation of IVs for boom-period changes in different ratios (to GDP, to total exports) of different commodities, and the specification selection method choosing between them, indicates a more important (and more precise) role than previously considered in influencing the GFC's differential impact. But this result also raises questions concerning the interplay between the booms. Did the global credit boom drive the global commodities price boom, or vice versa, or were they mutually reinforcing? Did the commodities price-bust trigger, or contribute to triggering, the Lehman event, and thus the GFC acute phase? What triggered the commodities price collapse itself: price dynamics relatively independent of the on-going global financial turmoil, or some other trigger connected with that turmoil?

Recognizing the limits of empirical research and the opportunities identified above for future research to refine and clarify the results obtained in this dissertation, policy makers would benefit from following advice regarding making use of this research, and research more generally:

- Question research results; ensure that policy advice follows results understood at an appropriate level of explanation (e.g., not just from empirical regularities).
- Be careful applying regression results to particular cases: while they suggest general tendencies, the magnitude of effect is an average only and may not apply directly, even to apparently well-explained (low-residual) cases.
- Consider the trade-offs involved in advice supported by novel research.
- Remember that research is a process, with further research potentially clarifying or correcting conclusions reached at earlier stages.

5.4 Conclusion

Overall, a relatively small number of pre-crisis conditions and characteristic help explain a large portion of the cross-country differential real impact of the 2008–2009 Global Financial Crisis. Those results suggest the following recommendations for policy makers seeking to mitigate the impact of similar crises in the future:

- Manage credit booms, bank assets booms, and other major boom-period changes in the economy (e.g., relating to changes in trade dynamics).
    - That is, “take away the punch bowl just as the party is getting started”.
- Encourage long-term financial flows, both inward and outward:
    - Source Countries: encourage long-term outward financial flows,

especially in the form of FDI during the boom-period; and

  - Recipient Countries: reduce reliance on short-term inward financial flows, especially in the form of debt liabilities.

- Maintain a flexible exchange rate; but if a less-flexible regime is chosen:
  - Use a legally binding currency board arrangement, backed with (more-than) adequate reserves to fix the exchange rate.
  - Fix the exchange rate to a basket of currencies representing (and weighted by) your major trading partners.
  - Recognize that an exchange rate peg can rapidly become unsustainable, due to external economic forces.
  - Consider longer term exit strategies implement a more exchange rate flexibility, or commit fully to inflexibility (e.g., via a currency union).

Further research is warranted toward better understanding the relationships identified between pre-crisis country characteristics and conditions and during-crisis outcomes. Such research could provide more direct policy advice concerning how to reduce the vulnerabilities identified, and what trade-offs might occur in doing so. Future research should also examine more closely the role of during-crisis policy responses and automatic stabilizers, not fully considered in this dissertation.