Three Essays on Macroeconomics and Trade

by

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A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs in
partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Economics

Carleton University

Ottawa, Ontario

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Abstract

This thesis includes three essays on empirical macroeconomics and trade. In the second chapter, we estimate returns-to-scale at the industry level using the longest consistent dataset available for the U.S. economy. Focussing on the data since the late 1980s, the average estimate is 1, implying constant returns. An intuitive identity linking returns to scale, the markup, and the profit rate, gives a small implied average gross and value-added markups of approximately 5 and 10 percent, respectively, given our measure of the profit rate, over the past 30 years. This gross markup estimate is significantly less than the average gross markup estimates in the recent literature ranging from 30 – 40 percent during this period. Put differently, given our estimated profit rate, large markups imply strongly increasing returns, which are not evident in the aggregate data.

The third chapter studies the effect of Free Trade Agreements (FTAs) on the dollar value of already exported products (the intensive export margins) as recent literature documents an ambiguous impact. I develop a framework that explains the source of ambiguous effects of FTAs on intensive export margins. I use 6-digit bilateral trade data and five FTAs to estimate the dynamic effects of the agreements on Canadian exports to its FTA partners. I divide the pre-agreement export basket into two groups, i.e., products at positive and negative intensive margins. My difference-

in-differences estimates show that (i) the export value of both groups of products increases significantly in the short- and long-term for developed FTA partners. (ii) In cases where FTA partners are emerging markets, the impact is insignificant or negative in both the short- and long-term. Regression Discontinuity Design estimates also suggest that the impact of FTA on the export value of products at intensive margins depends on whether the FTA partners are emerging or developed markets.

The final chapter estimates tariff pass-through to the dollar value of imports and unit prices of steel products and its subsequent effect on domestic markets. Recent studies report that the overall burden of tariffs has entirely passed to U.S.firms and consumers in terms of higher import prices. However, using 10-digits import data from U.S. Customs for 2018-2019, I find that import prices of steel products behaved differently: First, foreign exporters have gradually decreased their prices, sharing almost 50 percent of the burden of increased tariffs for all steel products mostly determined by industrial supplies and materials. Second, the price and import elasticities for consumer steel products are substantially higher at 5 and - 8, respectively. Third, the immediate increase in prices of industrial supplies was near 100 percent, which decreased to slightly below 50 percent in the long run. The elasticity of imports increased over time to near 1 in the long run. The imports of steel products, which have moved in tandem with domestic steel consumption over the last ten years, exhibited a diverging trend after the imposition of tariffs. The steel imports had declined from 34.5 in 2017 to 26.3 million metric tons in 2019. During the same period, domestic production increased from 81.6 to 87.9 million metric tons, almost equal to the peak production the U.S.achieved in 2012 and 2014.

Acknowledgements

First and foremost, I would like to express my sincere gratitude to my supervisor, Professor Hashmat Khan, for his invaluable guidance, support, and encouragement throughout the dissertation process. He taught me to be determined and motivated in following a research project to its end. Without his guidance, assistance, and knowledge, this thesis would not have been possible.

Special thanks also go to my committee members, Professor Minjoon Lee (Carleton University) and Professor Lilia Karnizova (University of Ottawa), for their comments and advice along the way. I would also like to thank Professor Patrick Coe (Carleton University), external examiner, Professor Loretta Fung (Tsinghua University, Taiwan) and internal examiner, Professor Yanling Wang (Carleton University) for their helpful comments and suggestions. My thanks are also due to Professor Susanto Basu (Boston College), Professor Paul Beaudry (University of British Columbia), Makoto Nakajima (Federal Reserve Bank of Philadelphia), and the participants at the 4th Annual Carleton Macro-Finance Workshop (2019) and Waseda University (Tokyo) for their discussion and helpful comments on the first chapter. Many thanks to Professor Lynda Khalaf (Carleton University), Professor Christopher Gunn (Carleton University), and Derek Mikola (Carleton University) for their insightful comments and suggestions on the second chapter.

I am grateful to Professor Scott Lynch (Memorial University), Professor C. Michael Wernerheim (Memorial University) and Professor Nikita Lyssenko (Memorial University), for guiding me so many times in the past and encouraging me to start a Ph.D. degree in the first place.

I am thankful to many faculty members and the administrative staffs at the Department of Economics, Carleton University. I am also grateful to my fellow classmates and colleagues, especially Shafiullah Qureshi, Joshua Brault, Jamil Sayeed, Derek Mikola, Farzaneh Davarzani, Samira Hasanzadeh and Abdallah Zalghout, for their effective feedback and reflective questions and sharing experiences.

I am deeply grateful to my parents, Khursheeda Begum and Jan Muhammad, for their love and support throughout my life. I also wish to thank my sisters, brothers, brothers-in-law, sisters-in-law, and parents-in-law and all the relatives.

Finally, I will forever be thankful to my caring wife, Durdana Saher. She encouraged me to fulfill my dream, supported the family, and inspired me in this long journey. None of this would be possible without her endless support and patience. Thanks to my dearest daughters, Haleema and Rania, for their love and patience.

To my dear parents, Khursheeda Begum and Jan Muhammad,
to my wonderful wife, Durdana Saher,
and to our lovely daughters, Haleema and Rania,
for their love, inspiration and support.

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Chapter 1

Introduction

This thesis consists of three essays on macroeconomics and trade. The motivation for the dissertation stems from several structural changes across the world over the last three decades. These structural changes include rising profit shares and markups, a proliferation of trade agreements, and the Trump administration's unprecedented increase in tariffs. This work examines these changes and their implications for domestic production, employment, and income inequality.

Chapter 2 is co-authored with John Fernald and Hashmat Khan. The key motivation for work in the first chapter comes from recent literature that frames the discussion of inequality in terms of rising profit shares and markups since the late 1980s. Given the rising markups and profit shares, have returns to scale in the U.S. economy changed? What implications does the recent estimate of returns to scale have for aggregate markups and profit share?

To answer the above questions, we estimate returns-to-scale at the industry level using the longest consistent dataset available for the U.S. economy. We find that the average estimate is 1 for the 1987-2016 period, implying constant returns. An

intuitive identity linking returns to scale, the markup, and the profit rate, gives a small implied average gross and value-added markups of approximately 5 and 10 percent, respectively, given our measure of the profit rate, over the past 30 years. This gross markup estimate is significantly less than the average gross markup estimates in the recent literature ranging from 30 – 40 percent during this period. Put differently, given our estimated profit rate, large markups imply strongly increasing returns, which are not evident in the aggregate data.

This chapter contributes to the literature by updating the estimates of returns to scale and profit shares over the last 30 years. These updated estimates and implied markups have important macroeconomic implications: for example, understanding the secular trends in factor income shares, developing macroeconomic models, and designing appropriate regulatory response.

Chapter 3 explores the effect of Free Trade Agreements (FTAs) on the dollar value of already exported products (the intensive export margins). The key motivation for this chapter comes from the recent literature that documents a positive impact on extensive export margins but an ambiguous impact on intensive export margins. The key question addressed in this chapter is whether FTAs affect intensive export margins in the short- and long term.

To answer the above question, I focus on the impact on intensive margins by considering heterogeneous aspects of the FTA partners. Furthermore, I develop a framework that explains the source of ambiguous effects of FTAs documented in the recent literature. The framework differentiates between the products at intensive margins that were already growing (declining) on average in the pre-FTA period. I divide the pre-agreement export basket into two groups, i.e., products at positive and negative intensive margins. My difference-in-differences estimates show that (i) export

value of both groups of products increases significantly in the short- and long-term for developed FTA partners; (ii) In cases where FTA partners are emerging markets, the impact is insignificant or negative in both the short- and long-term. Regression Discontinuity Design estimates also suggest that the impact of FTA on the export value of products at intensive margins depends on whether the FTA partners are emerging or developed markets.

These findings have important policy implications for negotiating and designing FTAs in the future. Since FTAs with emerging economies tend to drive down exports at intensive margins, these FTAs must focus more on increasing the exports at extensive margins. This means that incentives must also be provided to encourage innovation and exports of new products. FTAs with developed economies must focus on intensive margins as the larger destination market size can bring scale economies. Thus, intensive margins can be a key driver in boosting aggregate exports.

The motivation for the final chapter stems from the recent hike in import tariffs by the U.S. In recent history, the world has not seen a significant increase in import tariffs by a large economy. Therefore, it is an interesting test case for international trade theory that explains how import tariffs by a large economy can affect international prices. Recent studies report that the overall burden of tariffs has entirely passed to U.S. firms and consumers in terms of higher import prices. In this context, I analyze the case of steel products that attracted most of the import tariffs. This chapter contributes to the literature by analyzing the impact of tariffs on unit prices and import values of consumer, intermediate, raw-material and capital goods within the steel sector.

The estimates based on 10-digits import data from U.S. Customs for 2018-2019 show that import prices of steel products behaved differently than other products:

First, foreign exporters shared almost half of the burden of increased tariffs for all steel products in the long-run, mostly determined by industrial supplies and materials. Second, the estimated price and import elasticities for final steel products are significantly higher than that reported by literature for other products. Third, the immediate increase in prices of industrial supplies was near 100 percent, which decreased to slightly below 50 percent in the long run. The elasticity of imports increased over time to near 1 in the long run. Finally, the aggregate imports of steel products, which have moved in tandem with domestic steel consumption over the last ten years, exhibited a diverging trend after the imposition of tariffs. Overall, the burden of tariffs disproportionately fell on U.S. consumers and importing firms. However, the U.S. has achieved its intended policy objective by increasing domestic production and achieving peak production to the levels of 2012 and 2014.

Chapter 2

Returns to Scale in U.S. Production, Redux

2.1 Introduction

We revisit an earlier literature that used a production-function-based approach with industry data to estimate returns to scale in the U.S. economy and, from that, inferred estimates of the typical markup of price over marginal cost ([Basu and Fernald \(1997\)](#)).¹ The consensus view that emerged from this literature is that returns to scale in the typical U.S. industry are approximately constant, and imply a relatively small aggregate (gross output) markup of perhaps 10 percent.² Our updated industry estimates in this paper find that these conclusions are only modestly affected, although

¹This literature builds on [Hall \(1988\)](#). Some early contributions are [Hall \(1990\)](#), [Caballero and Lyons \(1992\)](#), [Bartelsman, Caballero and Lyons \(1994\)](#), [Basu and Fernald \(1994\)](#), [Basu and Fernald \(1995b\)](#), [Burnside, Eichenbaum and Rebelo \(1995\)](#), and [Burnside \(1996\)](#).

²The assumption of constant returns to scale is ubiquitous in both theoretical models studying markups and profit shares and also in empirical work that seeks to measure these quantities. See, for example, [Rognlie \(2016, p. 18\)](#), [Barkai \(2020, p. 18-19\)](#), [De Loecker et al. \(2020, p. 23-26\)](#), [Eggertsson, Robbins and Wold \(2018, p. 26\)](#), [Karabarbounis and Neiman \(2018, p. 3\)](#), [Brun and González \(2017, p. 16-27\)](#), [Gutiérrez and Philippon \(2017\)](#), [Traina \(2018\)](#), among others.

profit rates do appear to have risen.

Recently, there has been a growing debate on whether market power—measured as the price-marginal-cost markup—has risen since the late-1980s (De Loecker and Eeckhout (2018a), Syverson (2019), Basu (2019)). Rising market power has implications for a variety of macroeconomics topics, for example, understanding the secular trends in factor income shares, developing macroeconomic models, and designing appropriate regulatory responses. In a widely noted recent paper, De Loecker et al. (2020) show using Compustat data that the average gross-output markup has increased from 20 percent in 1980 to 60 percent by 2016, with an average close to 40 percent since 1987.³ But Traina (2018) finds that when accounting and management expenses are included in the costs, the average gross markup remains flat at approximately 15 percent. The point estimate in Hall (2018), using BLS KLEMS productivity data, finds that the average gross markup grew since 1987 and is about 31 percent.⁴ Unlike the earlier consensus, there is clearly a much wider debated range for aggregate markups.

In this context, updated estimates of aggregate returns to scale are informative for macroeconomists for at least two reasons. First, the data used in previous studies either does not overlap or has a relatively short overlap with the period of the debated increase in the markup. In particular, the sample period is 1958 to 1989 in Basu and Fernald (1997) and 1953 to 1984 in Burnside (1996). Basu, Fernald and Kimball (2006) present the estimates of returns to scale that control for utilization based on the sample period 1949 to 1996.⁵ So it is unclear how the implied markup based on the estimates of aggregate returns to scale in the post-1990 period compares with

³De Loecker and Eeckhout (2018a) find that average global markup increased from 10 percent in 1980 to 60 percent in 2016.

⁴The t -statistic on Hall’s markup trend is only 1.2, so the evidence is not that strong.

⁵Chang and Hong (2006) follow Basu, Fernald and Kimball (2006) specification and estimate returns to scale for the 1958 to 1996 period.

these recent markup estimates.

Second, the rate of pure economic profits in the aggregate business sector has increased in recent decades. By our estimate, this rate averages about 11 percent of business-sector nominal output over the post-2000 period. Our estimate of this profit rate is based on an aggregate approach using a weighted average of the required equity return and the required bond-market return to measure the cost of capital.⁶ Relatedly, the aggregate share of accounting profits in the non-financial U.S. corporate sector measured as the ratio of aggregate profits to gross value added, has increased by 13.5 percentage points from 1984 to 2014 (Barkai (2020)). Previously, Basu and Fernald (1997) estimated a small average profit rate of about 3 percent for a typical industry in the 1958 to 1989 period and noted that “*..economic profits do not appear large in any of our measures*”. They combined this small profit measure with the estimated returns to scale to determine the aggregate markup of 10 percent. Given the increase in estimated profit over the past three decades, however, the magnitude of the implied markup would be different for any particular estimate of the aggregate returns to scale, especially the one over this recent period which is not yet available.

The main contribution of our paper is to fill these gaps in the literature using the longest consistent industry data available for the U.S. economy. In particular, using the estimate based on the data since the late-1980s, along with our new estimates of the profit rate, we then draw implications to inform the ongoing debate on the rise in market power.

Following Basu, Fernald and Kimball (2006), we estimate industry-level returns to scale using an Instrument Variables (IV) approach. Next, we use an intuitive identity in Basu and Fernald (1997) that connects the aggregate production side of the

⁶We present the details in section 2.4.1.

economy with the market structure side to frame the discussion on returns to scale, markups, and the profit share. Let AC , MC , and P denote the aggregate average costs, marginal costs, and the price, respectively. Then we have

$$\frac{AC}{MC} \equiv \frac{P}{MC} \times \frac{AC}{P}$$

$$\text{Returns to Scale} \equiv \text{Markup} \times (1 - \text{Profit Rate}) \quad (2.1)$$

where AC/MC is returns to scale, P/MC is the markup, and AC/P can be expressed as (1-Profit Rate). The expression shown in equation (2.1) can also be derived from cost minimization under the assumptions of monopolistic competition in the product market and perfect competition in the factor markets.⁷ Our estimates of the constant returns to scale along with the 4.5 percent average profit rate, gives implied aggregate (gross-output) markups of approximately 5 percent. Relative to the previous consensus in the literature, the new implied markup is smaller.⁸

Using the three estimates of markups in the recent literature, along with our estimated aggregate profit rate of 4.5 percent for the sample period (in gross output terms), we back out what they imply about returns to scale. This exercise serves as a useful baseline for obtaining returns to scale without any actual estimation using the two-digit industry data. We find that markup estimates in [De Loecker et al. \(2020\)](#) and [Hall \(2018\)](#) imply relatively large increasing returns of 1.34 and 1.24, respectively. The markup estimate in [Traina \(2018\)](#) gives a value of 1.10, implying slightly increasing returns to scale.

⁷This derivation is available upon request.

⁸[Ho and Ruzic \(2017\)](#) use (2.1) to understand manufacturing plant level data. Their estimates show relatively constant markups but *declining* returns to scale in firm level data, thus rationalizing a rising profit rate. [De Loecker and Eeckhout \(2018b\)](#), [Syverson \(2019\)](#), [Basu \(2019\)](#) also use an expression similar to equation (2.1) in their discussion of markups.

Lastly, using our constant returns to scale estimate and the three independent estimates of average markups from the recent literature, we back out the implied profit rates. For the average gross markups in [De Loecker et al. \(2020\)](#), [Hall \(2018\)](#), and [Traina \(2018\)](#) we obtain 28.5 percent, 23 percent, and 13 percent profit rate, respectively. These implied profit rates remain moderate to substantially larger than the 4.5 percent profit rate we estimate for the post-2000 period. Overall, our findings suggest that constant returns to scale in the aggregate economy are consistent with a relatively small aggregate markup in the 1987-2016 period.

The rest of this paper is organized as follows. Section [2.2](#) presents empirical specification and data. Section [2.3](#) presents the results. Section [2.4](#) presents the calculation of the aggregate profit rate and discusses the implications for the aggregate markup. Section [2.5](#) concludes.

2.2 Empirical Specification and Data

2.2.1 Empirical Specification

Following [Basu, Fernald and Kimball \(2006\)](#), the main empirical specification that we estimate as a system of equations for the individual industries is

$$\Delta y_{it} = c_i + \gamma_i \Delta x_{it} + \beta \Delta h_{it} + \epsilon_{it} \quad (2.2)$$

where Δy_{it} is gross output growth, c_i is the industry-specific constant, γ_i is the returns-to-scale parameter, Δx_{it} is a cost-share-weighted sum of input growth, Δh_{it} is growth in hours per worker, and β is an estimated parameter constrained to be common within industry sub-groups as in [Basu, Fernald and Kimball \(2006\)](#). [Basu](#)

and Fernald (1997) estimated equation (2.2) without the $\beta\Delta h_{it}$ term. Basu, Fernald and Kimball (2006) added this term to control for the contribution of variable factor utilization to output. In Basu, Fernald and Kimball (2006)'s dynamic cost-minimizing model, hours per worker are an observable proxy for the intensity with which factors of production are used. The parameter β is a composite of several underlying parameters and elasticities that link this observable proxy to the underlying unobserved variation in factor intensity. With these controls, the residual ϵ_{it} captures technology change.

Cost-share-weighted input growth, Δx_{it} , is defined as

$$\Delta x_{it} \equiv C_{Lit}\Delta l_{it} + C_{Kit}\Delta k_{it} + C_{Mit}\Delta m_{it} \quad (2.3)$$

where Δl_{it} is the growth rate of labor input, Δk_{it} is the growth rate of capital input, and Δm_{it} is the growth rate of intermediate inputs of energy, materials, and services. The cost share of input J is computed as $P_J J/TC$ where P_J is the input price (i.e., its wage or required rental rate or, for intermediate inputs, the purchase price of those inputs) and TC is total cost (revenue less pure economic profits).

For the period 1958-1989, Basu and Fernald (1997) found that pure economic profits were small. In a world with zero pure profits, TC_{it} would equal total revenue, $P_{it}Y_{it}$. As a result, factor shares in cost would equal to factor shares in revenue, and these shares sum to one. Since C_{Lit} and C_{Mit} are observed in the data, we could take C_{Kit} as a residual.

Since we do not impose zero profits, we instead estimate payments to capital by industry. This allows us to calculate cost shares directly. We discuss the implied profit rates in detail in Section 2.4.1. In short, we find that profits are small over the Basu and Fernald (1997) sample, but rise noticeably in recent decades.

The estimates of returns to scale and markups that we produce apply to gross output. In some macroeconomic models with heterogeneity and with a fully specified production function and input-output networks, these may be the relevant estimates. For macroeconomic models with a representative producer, one typically requires estimates converted to a value-added basis (see [Rotemberg and Woodford \(1995\)](#) and [Basu and Fernald \(1997\)](#)). The relationship is

$$\gamma^V = \frac{\gamma(1 - C_M)}{1 - \gamma C_M} \quad (2.4)$$

where γ^V is the average value-added estimate and C_M is the average cost share of intermediate inputs. The relationship for the average gross-output to the average value-added markup is

$$\mu^V = \frac{\mu(1 - S_M)}{1 - \mu S_M} \quad (2.5)$$

where μ^V is the average value-added estimate and S_M is the average revenue share of intermediate inputs.

2.2.2 Data

We estimate equation (2.2) for 32 U.S. industries that together cover essentially the entire private, non-mining, and non-agricultural economy. The dataset is a collaborative effort by the Bureau of Economic Analysis (BEA) and the Bureau of Labor Statistics (BLS) and runs (in levels) from 1947 to 2016; to the best of our knowledge, this is the longest consistent industry dataset available that covers the entire economy. In growth rates, the longest sample we use begins in 1949 because of

the unavailability of growth in hours per worker for some industries for 1948.⁹

Conceptually, the BEA-BLS dataset is an updated version of the U.S. WorldKLEMS contribution (Jorgenson, Ho and Samuels (2017)). The BEA-BLS dataset brings in additional data to inform the construction of consistent industry data (especially important for the earlier years), provides more detail on inputs, extends the sample, and improves the consistency with recent vintages of the U.S. national accounts.

The dataset has greater industry detail for the period 1963-2016 than for the earlier 1947-1963 period. In order to have a consistent and long time series, we aggregate the post-1963 data to match the pre-1964 industries. For each industry, the dataset has nominal and real time-series on gross output, labor, capital and intermediate inputs.¹⁰

In the BEA-BLS dataset, as is standard in KLEMS datasets, nominal capital payments are calculated as residual, assuming zero pure economic profits. That is, nominal capital payments are total nominal gross output less payments to labor and intermediate inputs. We instead allow for pure profits, so we need to estimate required payments to capital. To do so, for each type of capital n , we estimate the rental rate of capital, $R_{n,i}$. Total payments to capital are then $\sum_n R_{n,i} K_{n,i}$.

We allow for 101 types of capital by industry, $K_{n,i}$. Our main data source is the BEA’s fixed asset tables, which include nominal and real stocks of 99 different types of fixed reproducible capital by industry. In addition, we include industry land and

⁹Eldridge et al. (2020) describe the data, which are available for download at https://www.bls.gov/mfp/special_requests/tables_detail.xlsx (accessed November 4, 2020). Output and intermediate inputs are from the BEA’s GDP by Industry accounts and so are consistent with the national accounts, including input-output relationships; labor and capital inputs are carefully estimated by the BLS Productivity program. Relative to the entire private economy, we exclude agriculture and mining because of the weak relationship between output and inputs. We also exclude real estate, where most value added is the service flow from the input of owner-occupied housing; and petroleum and coal products, where some output and inputs are conflated with those of the oil and gas mining industry (see Byrne, Fernald and Reinsdorf (2016)).

¹⁰Because of a lack of data on hours per worker, we also merge rental and leasing services into finance and insurance; and we merge management of companies into professional, scientific, and technical services. Table A1.1 show the industry classifications we use.

inventories from the BLS multifactor productivity capital tables; for the business sector overall, the BLS estimates that land and inventories accounted for about 15 percent of all capital payments from 1988-2016.¹¹ For $R_{n,i}$, we calculate a Hall-Jorgenson user-cost of capital for each type of capital, following Hall (1990), Basu and Fernald (1995b), Barkai and Benzell (2018), and Karabarbounis and Neiman (2018).¹² The equation we implement, following Hall (1990), is:

$$R_{n,i} = (r_i + \delta_n - (\dot{p}_{K,n}^e - \dot{p}_i^e)) \frac{(1 - \kappa_n - \tau d_n)}{(1 - \tau)} P_{K,n} \quad (2.6)$$

In equation (2.6), for industry i and asset n , r_i is a real rate of return, δ_n is the depreciation rate, $\dot{p}_{K,n}^e$ is the expected change in the asset's price, $\dot{p}_i^e$ is expected inflation for the industry's output (so that $(\dot{p}_{K,n}^e - \dot{p}_i^e)$ is real expected capital-gains), τ is the corporate tax rate, κ_n is an asset-specific investment tax credit, d_n is the present value of tax depreciation allowances, and $P_{K,n}$ is the asset's purchase price.¹³

We follow Fernald (2014) and measure expected asset and industry inflation rates as centered moving averages, with three annual lags and three leads. This approach gives relatively smooth user-cost weights while allowing for trends in the relative weights over time.

For the real rate of return, r_i , we take the weighted average of two market returns. The first is a BBB nominal bond rate less expected industry inflation, $\dot{p}_i^e$. That rate

¹¹We take the BLS's estimate of the ratio of payments to land and inventories relative to other capital payments, and apply that ratio to our estimated payments to non-land-and-inventory capital. The land and inventories data from 1988-2016 are available at https://www.bls.gov/mfp/special_requests/cap_details.xlsx. We extend those industry data back to 1947 using aggregate SIC-based land and inventories data from earlier vintages of the BLS capital tables.

¹²Barkai and Benzell (2018), and Karabarbounis and Neiman (2018) did not allow for land or inventories. Nor do they do the calculation by industry.

¹³Note that we can equally use a nominal rate, with the expected capital gains term specified as $\dot{p}_{K,n}^{expected}$. We obtained the tax parameters from Fernald (2014).

incorporates a premium for risk above the yield on long-term Treasuries. The second is the dividend yield on the S&P 500 adjusted for growth. The second approach follows Hall (1990) and Basu and Fernald (1995b).¹⁴ Using a 30 percent weight on debt, and a 70 percent weight on equity (roughly the 1970s weights in corporate securities, according to Hall (2001)), the average pre-1979 profit rate is close to zero. We discuss the profit-rate implications in more detail in Section 2.4.1.

To estimate equation (2.2), we also require data on hours per worker. The BEA-BLS KLEMS dataset has hours, but not workers. So, from 1987-2016, we supplement the BEA-BLS dataset with separate BLS three-digit-industry data on hours/worker.¹⁵ Prior to 1988, we combine the BEA-BLS data on hours by industry with NIPA data on employment by industry; those data are on an SIC basis, but the industry match appears reasonably good with the NAICS industries in the BEA-BLS dataset. We merged datasets on hours per worker using growth rates (log changes). We then detrend using the Christiano and Fitzgerald (2003) band-pass filter. We use the filtered measure of hours-per-worker growth as our measure of dh in equation (2.2).

We estimate equation (2.2) using an IV approach similar to Basu, Fernald and Kimball (2006). We use updated versions of the Ramey-Hall instruments: Shocks to petroleum prices, the growth rate of real government defense spending, and monetary shocks from an identified VAR.¹⁶ The instruments are the sum of quarterly values for

¹⁴The Gordon pricing model assumes dividends grow at rate g and are discounted at rate r . The price, which equals the present value of dividends, is $P = \left(\frac{D}{r-g}\right)$. Thus, the model implies that $r = \left(\frac{D}{P}\right) + g$. Hall (1990) and Basu and Fernald (1995b) simply used the dividend yield, without adjusting for growth. Hence, the real rates they used were lower than what would have been implied by equity prices. See also Farhi and Gourio (2019). We calculate expected growth g using trend real GDP growth estimated from a biweight filter with a smoothing parameter of 12 years. The implied real growth rate slows from about 4 percent in the early post-war years to about 2 percent in recent years.

¹⁵The data on hours and workers 1987 to 2016 were downloaded from https://www.bls.gov/lpc/three_digit_industry_data.csv (Accessed April 21, 2021.)

¹⁶We updated the instrument estimates from Basu, Fernald and Kimball (2006), using their code.

the shocks from the previous calendar year.

2.3 Results

Table 2.1 presents the aggregate estimates of returns to scale in U.S. private industries (Panel A) along with the coefficient indicating the relevance of variable factor utilization to gross output growth (Panel B). Specifically, it shows the IV system estimates of specification (2.2) where γ and β are restricted to be the same for each industry group.

Since our main focus is on how the aggregate estimates have changed since the late-1980s, it is useful to compare the estimates in the third (1949-1986) and fourth (1987-2016) columns, respectively. We find that the returns to scale have remained approximately constant across the two periods. Although the point estimates falls from 1.13 to 1.0, they are statistically not different from one.¹⁷ Looking at the industry sub-groups, we find that estimates for manufacturing, both durables and non-durables, present evidence of approximately constant returns as well. The point estimate for non-manufacturing does decrease in the latter sub-sample, but the null of constant returns is not rejected.

The results for the 1987-2016 sample period, therefore, do not change the previous consensus in the literature following Basu and Fernald (1997). In the full sample (1949-2016), however, the point estimates imply slightly increasing returns for the private economy. This estimate is similar to Flynn, Gandhi and Traina (2019)'s estimate of 1.04 on the annual firm-level Compustat data for 1951-2017 period. Looking at the industry groups, the picture is mixed. While durable manufacturing estimate

¹⁷Figure A2.1 shows that the average (median) estimate of returns to scale based on the industry-specific estimates for the 1987-2016 period is quite similar, 0.98 (0.99) to the restricted coefficient specification results for the private economy in Table 2.1. Figure A2.2 shows the time variation in the industry-specific estimates returns to scale across the two sub-samples.

implies slightly increasing returns, the estimates for non-durable manufacturing and non-manufacturing are not statistically different from one.

Turning to the estimates of β , we find that, with the exception of non-durable manufacturing, the values in the 1987-2016 sample are much larger than the 1949-1986 period and are statistically significant. These findings indicate the increased relevance of variable factor utilization to gross output growth.

2.4 Implications

In this section we use equation (2.1) and the returns to scale estimates for the post-1990 period to draw implications for the aggregate markup. A key input in doing this using equation (2.1) is the profit rate. We discuss how the profit rate has changed over time. Our benchmark profit estimates use a weighted average of the bond rate and an equity rate. The two rates separately give somewhat different answers for the early sample, but consistently yield much larger profits since around 2000.

2.4.1 How large are profits?

A fundamental accounting identity says that a firm's revenues are paid out as income payments to someone. Some or all of those payments cover the costs of hiring inputs. Anything left over is paid as pure profits to the owners of the firm, Π_i . Omitting time subscripts, the accounting identity for industry i is:

$$P_i Y_i = W_i L_i + \sum_j P_j M_{i,j} + \sum_n R_{n,i} K_{n,i} + \Pi_i \quad (2.7)$$

In this equation, W_i is the wage, L_i is labor input, and $M_{i,j}$ is the use in industry i of inputs from industry j . $\sum_n R_{n,i} K_{n,i}$ is total payments to capital, as discussed in section 2.2.2.

To calculate capital rental rates, $R_{n,i}$, we used a weighted average of two measures of the real interest rate. Figure 2.1 shows those two rates, smoothed as 5-year moving averages. We also plot, as the bold blue line, the zero-profit internal real rate from Fernald (2014). With that rate, payments to capital, labor, and materials exhaust revenue, so that economic profits are zero period by period. We show the aggregate, though each industry will have its own estimate. The red line shows the real BBB rate, in terms of the overall business deflator. The orange line shows the real rate implied by the S&P 500 dividend yield.

While all three approaches are defensible, the rates themselves are typically quite different. Early in the sample, the implied equity return from the dividend yield is quite high, close to 10 percent. The reason is that the dividend yield itself was very high in the late 1940s and early 1950s, peaking at 7.5 percent in July 1950. Moreover, expected growth at the time was around 4 percent. In contrast, the real BBB rate was quite low, close to zero.¹⁸ The internal zero-profit rate was intermediate between the equity and bond rate, and typically remained in that range until about 1980.

After 1980, the BBB rate rises sharply. Indeed, it rises above the equity-implied rate. From the mid-1980s on, however, the BBB rate and the equity rate remain relatively close together and fall steadily over time. In contrast, the internal rate bottoms out in the early 1980s and then rises fairly steadily to the 2000s and remains quite high in recent years.

¹⁸Reinhart (2012) argues that financial regulations during the 1940s-1970s period held down real interest rates. Although Reinhart's focus is on the implications for government debt yields, the same forces presumably held down other bond yields.

In the user-cost formula, if we use an external real rate that is below the internal zero-profit rate, then the estimated profits will be positive. In contrast, if we use a rate that is above the internal zero-profit rate, then estimated profits will be negative. It is clear from the figure that the profit rate will depend on the specific sample used. Profits are very sensitive to this choice because the nominal capital-to-output ratio in the business sector, $\sum_n P_n K_n / P^V V$, averages 2.7 percent over the 1947-2016 period.¹⁹

Figure 2.2 shows the implied aggregate profit rates from using the BBB rate and the equity rate. Specifically, for each industry, we calculate profits Π_i using the assumed external rate, and then sum those profits across industries. We then divide by aggregate value added: $s_\Pi = (\sum_i \Pi_i) / P^V V$. In both cases, the profit rates are very high at the end of the sample — 6 to 9 percent of business-sector value added in the post-crisis period.

In the early post-war decades, however, the patterns are quite different. The equity real rate systematically implies negative profits until the mid-1990s. In contrast, the BBB rate implies very large pure profits until the late 1970s, then very large losses until the mid-1990s.

Hence, two plausible alternatives yield seemingly implausible estimates of profit rates. It seems unlikely that firms had large losses prior to the 1980s, as implied by the equity return. And it seems unlikely that firm profits were really as large in the 1950s as implied by the BBB rates.²⁰ Barkai and Benzell (2018) and Karabarbounis and Neiman (2018) use a 10-year Treasury rate, which is uniformly lower than the BBB rate. These papers also omit land and inventories from the capital stock. Since the nominal value of land and inventories amounts to about 3/4 of GDP, they omit a

¹⁹The nominal ratio varies over time, but there is little apparent trend. Excluding land and inventories, the ratio averages a little below 2.

²⁰The BBB profits series is qualitatively similar to the results in Barkai and Benzell (2018) and (the case-II) in Karabarbounis and Neiman (2018).

sizeable category of capital payments. Using the 10-year Treasury rate, and omitting land and inventories, leads to a profits picture similar to their Figure 2. Notably, with a lower required rate and a smaller stock of capital, the apparent losses in the early 1980s are much smaller.

In our benchmark approach, we followed a method with a long history in corporate finance, and used a weighted average cost of capital. The weighted-average cost of capital (WACC) column of Table 2.2 is less than 10 percent for most samples other than the post-2000 period. That column used a 30 percent weight on the BBB rate (debt), and a 70 percent weight on S&P dividend yield (equity), as suggested by Hall (2001).

However, since both the equity and bond returns imply negative profits in the 1980s, the weighted average also implies losses in that period. Similarly, the weighted average implies a sizeable positive profit rates since the 2000s. As a baseline, we consider 4.5 percent profit rate in gross output terms in Table 2.3.

2.4.2 How large is the aggregate markup?

Our estimated returns to scale value of 1 for the post-1987 period and the approximately 4.5 percent aggregate profit share, imply an aggregate gross markup of 4.7 percent, and a value added markup of 10.3 percent. For the 1949-1986 period, the returns to scale estimate (1.13) and the profit rate in gross terms (1.45 percent) imply a gross markup of approximately 15 percent. Thus, the industry level evidence points to lower markup since the late-1980s.

Now using the three estimates of markups in the recent literature, along with the average profit rate of 11 percent, we back out what they imply about returns to scale. This exercise serves as a useful baseline for obtaining returns to scale without

any actual estimation using the two-digit industry data. Column three in Table 2.3 presents the results. We find that markup estimates in De Loecker et al. (2020) and Hall (2018) imply relatively large increasing returns of 1.32 and 1.23, respectively. The estimate in Traina (2018) of 1.09, on the other hand, implies moderate increasing returns.

We now use our estimated value for the aggregate returns to scale of 1 and the three independent estimates of markups to back out the implied profit shares. These are shown in column 4 of Table 2.3. For the estimated markups in De Loecker et al. (2020), Hall (2018), and Traina (2018) we obtain profit rates of 28.57 percent, 23.08 percent, and 13.04 percent, respectively. The implied profit shares are moderate to substantially larger than the our measured rate of 4.5 percent.

2.5 Conclusion

With the background of the much debated increase in market power in the U.S. since the late 1980s, we revisit an earlier literature on production-function based estimation using two-digit industry data and provide fresh estimates of aggregate returns to scale in the U.S. economy for the post-1990 period. The new estimates allow us to infer an implied markup and inform the ongoing debate.

Using the longest consistent industry-level dataset, we estimate constant return at the aggregate level in the 1949-1986 and 1987-2016 periods in the U.S. economy.

Using an intuitive identity linking returns to scale, markups, and profit shares, we obtain an implied markup of approximately 4.7 percent, significantly smaller than the estimates from the recent literature ranging from 15 to 40 percent. Put differently, given our estimated profit rate, large markups reported in the literature imply strongly

increasing returns, which are not evident in the data. Our results confirm the previous consensus in the literature that returns to scale are approximately constant for the post-1980 period. Our implied aggregate markup, however, is smaller than both the previous consensus of 10 percent, and significantly smaller relative to recent estimates in the data.

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Table 2.1: Aggregate Estimates

	1949 - 2016	1949 - 1986	1987 - 2016
	A. Returns-to-Scale (γ)		
Private Economy	1.09* (0.04)	1.13 (0.09)	1.00 (0.04)
Non-manufacturing	1.10 (0.07)	1.10 (0.07)	0.89 (0.07)
Manufacturing (D)	1.07* (0.04)	1.04 (0.04)	1.07 (0.06)
Manufacturing (ND)	0.97 (0.05)	0.96 (0.08)	1.03 (0.05)
	B. Growth in Hours per Worker (β)		
Private Economy	0.67** (0.29)	0.47 (0.28)	1.76*** (0.46)
Non-manufacturing	0.51** (0.20)	0.38* (0.20)	1.26** (0.52)
Manufacturing (D)	0.26 (0.24)	0.18 (0.24)	0.75*** (0.27)
Manufacturing (ND)	1.04** (0.50)	1.04** (0.46)	0.06 (0.41)

NOTES: The table shows the IV system estimates of the specification shown in equation (2.2) estimated in STATA using the `ivregress 2sls` command. Both γ and β are restricted to be the same for each industry group. The instruments are oil price increases, growth in real defense spending, and VAR monetary innovations. The robust standard errors are clustered at the industry level. The statistical significance is denoted by ***, **, and * represent p -value less than 1%, 5%, and 10% respectively for $H_0 : \gamma = 1$ against $H_A : \gamma \neq 1$. β is constrained to be equal within the private economy and sectors with the ***, **, and * indicating a p -value 1%, 5%, and 10% respectively for $H_0 : \beta = 0$ against $H_A : \beta \neq 0$. ‘D’ and ‘ND’ indicate ‘durable’ and non-durable, respectively.

Table 2.2: **Profit Shares**

	BBB (bond)	Dividend yield (equity)	Weighted avg. (WACC)
1949-2016	11.01%	5.62%	7.24%
1949-1986	13.83%	2.90%	6.18%
1987-2016	7.44%	9.07%	8.58%
2000-2016	11.30%	12.60%	12.21%

NOTES: Entries are percent of business-sector output, averaged over different sample periods. The real rates on BBB bonds is the nominal rate less a smooth moving average of log changes in the business-sector deflator. The dividend yield rate is the dividend yield on the S&P 500 plus a smoothed trend in real GDP growth (estimated with a biweight filter with a parameter of 48 quarters). The weighted average uses a weight of 30 percent on the BBB rate and 70 percent on the dividend yield.

Figure 2.1: **Real Rates of Returns**

Table 2.3: **Returns to Scale and Aggregate Markups**

(1)	(2)	(3)	(4)
	Estimated Markup (μ)	Implied Returns to Scale (γ) (Estimated: $S_\pi = 4.5\%$)	Implied Profit Share (Estimated: $\gamma = 1$)
	Gross Markup		
De Loecker et al. (2020)	40%	1.34	28.57%
Hall (2018)	30%	1.24	23.08%
Traina (2018)	15%	1.10	13.04%
This paper	Aggregate Markup 1987-2016		
Gross ¹	4.70%		
Value-Added ²	10.34%		

NOTES: ¹Obtained using industry level profit estimates with a baseline of 4.5% profit rate in gross output terms. ²Obtained using the baseline gross markup and the average revenue share of intermediate input of 52% over the 1987-2016 period. The numbers in columns 3 are obtained using equation (2.1) and expressed in terms of gross output. In column 3, the profit rate is expressed in terms of gross output and is almost half of the value-added profit rate of 8.58% from Table 2.2. The implied value-added markup is obtained using equation (2.5).

Figure 2.2: **Profit Rates (Percent of Business Value Added) Under Different Assumptions About Real Returns**

Appendix: Chapter 2

Figure A2.1: Estimates of Returns to Scale in U.S. Industries

(a) 1949-2016

(b) 1987-2016

NOTES: The horizontal red(blue) line indicates the average (median) returns to scale, 1.11 (1.08) and 0.98 (0.99) over 1949-2016 and 1987-2016 periods, respectively.

Figure A2.2: Time variation Returns to Scale Estimates: Full sample versus post-1987

NOTES: Of the 32 industries, the number of industries below the red dashed 45 degree line is 19.

Table A1.1: **Industry Classification**

No	Industry Description (1947-1963)	Industry Description (1963-2016)
6	Utilities	Utilities
7	Construction	Construction
8	Wood products	Wood products
9	Nonmetallic mineral products	Nonmetallic mineral products
10	Primary metals	Primary metals
11	Fabricated metal products	Fabricated metal products
12	Machinery	Machinery
13	Computer and electronic products	Computer and electronic products
14	Electrical equipment, appliances, and components	Electrical equipment, appliances, and components
15	Motor vehicles, bodies and trailers, and parts	Motor vehicles, bodies and trailers, and parts
16	Other transportation equipment	Other transportation equipment
17	Furniture and related products	Furniture and related products
18	Miscellaneous manufacturing	Miscellaneous manufacturing
19	Food and beverage and tobacco products	Food and beverage and tobacco products

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Table A1.1 – *Continued from previous page*

No	Industry Description (1947-1963)	Industry Description (1963-2016)
20	Textile mills and textile product mills	Textile mills and textile product mills
21	Apparel and leather and allied products	Apparel and leather and allied products
22	Paper products	Paper products
23	Printing and related support activities	Printing and related support activities
24	Petroleum and coal products	Petroleum and coal products
25	Chemical products	Chemical products
26	Plastics and rubber products	Plastics and rubber products
27	Wholesale trade	Wholesale trade
28	Retail trade	Retail trade
29-36	Transportation and warehousing	Air transportation
		Rail transportation
		Water transportation
		Truck transportation
		Transit and ground passenger transportation
		Pipeline transportation
		Other transportation and support activities

Continued on next page

Table A1.1 – *Continued from previous page*

No	Industry Description (1947-1963)	Industry Description (1963-2016)
		Warehousing and storage
		Publishing industries, except internet (includes software)
		Motion picture and sound recording industries
37-40	Information	Broadcasting and telecommunications
		Data processing, internet publishing, and other information services
		Federal Reserve banks, credit intermediation, and related activities
		Securities, commodity contracts, and investments
41-44	Finance and insurance	Insurance carriers and related activities
		Funds, trusts, and other financial vehicles
46		Rental and leasing services and lessors of intangible assets
		Legal services
47-49	Professional, scientific, and technical services	Computer systems design and related services
		Miscellaneous professional, scientific, and technical services
50	Management of companies and enterprises	Management of companies and enterprises
		Administrative and support services
51-52	Administrative and waste management services	

Continued on next page

Table A1.1 – *Continued from previous page*

No	Industry Description (1947-1963)	Industry Description (1963-2016)
		Waste management and remediation services
53	Educational services	Educational services
54-56	Health care and social assistance	Ambulatory health care services
		Hospitals and Nursing and residential care
		Social assistance
57-58	Arts, entertainment, and recreation	Performing arts, spectator sports, museums, and related activities
		Amusements, gambling, and recreation industries

Chapter 3

New Products or More of the Old? Estimating the Impact of Canadian Free Trade Agreements on Exports

3.1 Introduction

Free Trade Agreements (FTAs) are increasing in numbers and reach. As of 2020, there are 324 trade agreements in-force with all the World Trade Organization (WTO) members part of some regional trade agreements (RTAs)¹. In line with this trend, Canada's RTAs and bilateral FTAs have also increased over the years. As of 2020, Canada had 15 FTAs in-force with partners ranging from different regions and development levels. These agreements are meant to benefit the signatory countries, and most of the literature ([Baier and Bergstrand 2007](#); [Baldwin 2008](#); [Freund et al 2010](#)) also unequivocally shows that FTAs positively impact aggregate trade. This strand

¹See Appendix Figure [B2.1](#) and [B2.2](#)

of literature ignores the fact that export performance of sectors may differ following the implementation of FTA. Some sectors may perform better in terms of increase in exports of new products (*the extensive margins or the new product margins*) and some others may perform better in terms of increase in exports of products already being exported to the FTA partners (*the intensive margins or old product margins*). Even within a sector, some firms may contribute to exports more than others by exporting the existing products more intensively or start exporting new products (Subramanian and Wei 2007).² Following Melitz (2003), the models of new trade theory that account for sectoral and firm level heterogeneity predict that trade liberalization affects firms differently even within a sector. The empirical literature also shows that all firms within a sector do not equally contribute to value of exports as a result of trade liberalization (Bernard et al 2003; Bernard and Jensen 1999).

The theoretical literature explaining the impact of trade liberalization at intensive and extensive margins (Chaney 2008; Helpman and Melitz 2008; Melitz 2003) has high-income over the last two decades, but it has not been tested adequately. Most of the theoretical models—despite their different set of assumptions regarding firm heterogeneity, fixed cost of entry, and constant markups – predict that trade liberalization positively impacts both intensive and extensive margins. The empirical literature, however, is divided on whether trade liberalization has a positive impact on both the margins. For instance, in line with theoretical literature, Baier, Bergstrand and Feng (2014) found that trade liberalization has a positive impact on both intensive and extensive margins. On the other hand, Foster and Stehrer (2011), for a large number of agreements, found positive impact only on extensive margins. Similarly, Chen and

²According to Dutt et al (2013) when firms produce differentiated products, these firm-level margins translate into product-level margins. From hereafter in this paper, the terms “extensive margin” and “intensive margin”, refer to the product-level margins.

[Voia \(2018\)](#) analyzed the impact of Canada-Chile Free Trade Agreement (CCFTA) and found that value of exports mostly increased at the extensive margins while intensive margins decreased in the long-term. They argue that, after CCFTA, the number of exporting firms increases in products at intensive margins. This increased competition in the destination market brings the long-term effect of intensive margins to zero. However, both [Foster and Stehrer \(2011\)](#) and [Chen and Voia \(2018\)](#), used a relatively small time-window before and after the agreements. Their results cannot be compared to the literature that analyzes fairly long time periods after the agreements as trade agreements can take 10-15 years to have their full impact on aggregate trade flows ([Baier and Bergstrand 2007](#)). Also, [Baier, Bergstrand and Feng \(2014\)](#) show that both intensive and extensive margins are affected positively and further found that the impact of trade agreement on intensive margins starts sooner than extensive margins.

Overall, the existing empirical findings do not entirely conform with predictions of the theoretical models, even though if considered that intensive and extensive margins might respond differently in the short-term and long-term. Most of the previous empirical literature has found positive impacts of FTAs on extensive margins. Still, a consensus has not reached in case of intensive margins. Some studies have even reported negative impact on intensive margins and others have reported positive or ambiguous impact ([Baier, Bergstrand and Feng 2014](#); [Foster and Stehrer 2011](#); [De Lucio et al 2011](#) and [Chen and Voia 2018](#).)

Given the factors explained above, I focus on the impact of FTAs only on intensive margins where the intensive margins are differentiated in terms of negative and positive exports growth in pre-FTA period. This distinction between negative and positive intensive margins is relevant mainly because the impact of FTAs on the two types of intensive margins may cancel out each other, thus explaining the ambiguous impact of

FTAs on intensive margin generally found in earlier literature. Furthermore, I use a larger set of Canada's free trade agreements to determine their short-term and ³ impact on intensive margins of exports. The selected FTAs cover middle-income economies like Costa Rica, Columbia, and Peru. Additionally, they cover high-income economies, such as Chile, and Norway, Iceland, and Switzerland in case of European Free Trade Association (EFTA). Furthermore, contrary to the recent literature, I restrict the analysis to a basket of products at intensive margins in the pre-FTA period, further divided into two groups, i.e., products at positive and negative intensive margins on the basis of average change in value of these margins. The data includes the same products in the post-FTA period. The impact of other export products are, therefore, excluded from the analysis, making it more of a longitudinal study design. One of the key motivations to study the impact of FTA's on export performance of these products in the short- and long term is to identify the source of ambiguous effects of FTAs on intensive margins as documented in recent empirical literature.

I use difference-in-differences (DID) approach to conduct the empirical analysis. The control countries are selected on the basis of a similar development stage and geographic location. The results indicate that, in cases where FTA partners are middle-income markets, the impact is negative on value of exports at intensive margins. The impact of FTAs on export value of products (both at positive and negative margins) significantly improves only in case of high-income economies, i.e, Chile and EFTA economies. Therefore, the impact of FTA on export value of products at intensive margins depends on whether the FTA partner is an middle-income market or high-income.

My paper makes four key contributions to the literature on impact of FTAs on

³Long-term is considered more than 3 years before and after the implementation of free trade agreements.

trade margins. First, the heterogeneous impact of FTA's is observed: positive impact on exports of products at positive and negative intensive margins in case FTA partners are high-income economies, and negative impact in case of middle-income economies. Second, overall the results show that in case of middle-income FTA partners, the intensive margins do not drive the positive impact of FTAs that is generally seen in aggregate exports. Third, contrary to the recent empirical literature on the impact of FTAs that intensive margins increase in the short-term and become ambiguous in the long-term, I find that intensive margins are affected negatively in both short-term and long-term in case FTA partners are middle-income markets. Moreover, in EFTA, i.e., the high-income economies, the impact on both groups of products (at negative and positive intensive margins) is positive. Fourth, in line with DID estimates, the results of RDD also show that there is discontinuity or FTA treatment effect on intensive margins both in case of high-income and middle-income economies. Moreover, the treatment effect is negative in case of middle-income economies and positive in case of high-income economies.

The rest of the paper is organized as follows. Section 3.2 discusses data including details on Canada's FTA's with a set of middle-income and high-income economies. Section 3.3 presents the methodology used to analyze Canada's FTAs and sample selection. Section 3.4 presents estimates of the impact of FTAs on exports of products at positive and negative intensive margins. Section 3.5 concludes.

3.2 Data

The primary data source I use in this paper comes from World Integrated Trade Solutions (WITS) for the period 1989-2018. It covers the exports of HS-6 digit

products and bilateral tariffs. Figure 3.1 shows that during sample period, Canada's total exports increased steadily and peaked at \$475 billion in 2014 after which it declined consecutively for two years by \$67 billion in 2015 and \$30 billion in 2016. After 2016, it recovered and reached at \$450 billion in 2018. The 2008 financial crisis also adversely affected Canadian exports which declined by \$140 billion during 2008-09.

In 1997 and 2011, Canada put into force Free Trade Agreements with Chile and Colombia respectively. After the agreement, Canadian exports to these FTA partners increased significantly. Canada's exports to Peru and EFTA partners also increased after the agreements were put into force in 2009. Only exports to Costa Rica and Iceland did not show any noticeable increase after enforcement of the free trade agreements (See Figure 3.2).

3.2.1 Partner Economies: High-income and middle-income

This study includes Canada's FTA with a group of middle-income⁴ economies, i.e., Peru, Colombia, Costa Rica and high-income economies, i.e., Chile, Iceland, Norway and Switzerland in case of EFTA. The FTA with Chile and Costa Rica was signed in 1997 and 2002, respectively. The FTA with Peru and EFTA were signed in 2009. The lag between signing and enforcement of agreements is not more than one year—except the case of Colombia, therefore the impact of expectations (signing of FTA) cannot be captured in annual data. Appendix Table B1.6 shows that the coverage of FTAs in term of key sectors is similar for Peru, Chile, and Colombia. The key sectors in case of Costa Rica were construction and infrastructure, and power sector. While in case of EFTA, agriculture, agri-food sector and industrial products were key sectors

⁴Upper-middle income economies based on world bank's classification, 1987-2020

included in FTA.

In general the trends in exports of the key sectors included in FTAs increased following the agreement. Since, FTAs are implemented over several years depending on the modalities agreed by partners countries, exports may take time to pick-up growth. For instance, Appendix Figure B2.3 shows that the FTA with Chile was implemented in 1997 but the impact on exports of key sectors, included in the agreement, started to show consistent growth after 2003. Appendix Figure B2.4 shows the overall number of export products increased following the implementation of agreements, in case of Chile, Peru and Costa Rica. However, in case of EFTA and Columbia the increase in number of export products following the agreement is not as pronounced as in the case of other FTAs.

3.3 Methodology

In order to explain the change in total exports taking place at different margins, I decompose it into different sets of products. Following the methodology in Kehoe and Ruhl (2013) and Brenton and Newfarmer (2007), the decomposition of the change in exports is given as:

$$\text{Change in total exports} = \begin{cases} \text{Change in exports of existing products} \\ + \text{Increase in exports of new products} \\ - \text{Extinction of exports of existing products} \end{cases} \quad (3.1)$$

Let K_0 be the set of products exported by the home country in the base year, and K_T define the set of products exported in the terminal year. The value of these sets

are defined as follows:

X_{K_0} = value of exports (USD) in year $t = t_0$

X_{K_T} = value of exports (USD) in year $t = t_T$

Now, the variation in value of exports between these two year can be decomposed as:

$$\Delta EXP = \underbrace{\Delta X_{K_0 \cap K_T}}_{\text{Intensive Margins}} + \underbrace{X_{K_T \setminus K_0}}_{\text{Extensive Margins}} - \underbrace{X_{K_0 \setminus K_T}}_{\text{Exit Margins}} \quad (3.2)$$

where:

$K_0 \cap K_T = \{k_i \in K_0 \text{ and } k_i \in K_T\}$; set of products in the base year that also belongs to terminal year

$K_T \setminus K_0 = \{k_i \notin K_0 \text{ and } k_i \in K_T\}$; relative complement of K_T with respect to K_0

$K_0 \setminus K_T = \{k_i \in K_0 \text{ and } k_i \notin K_T\}$; relative complement of K_0 with respect to K_T

3.3.1 Extension to the Framework

I further extend this framework by dividing the products at intensive margins into positive and negative intensive margins in order to identify the products within those margins as follows:

$$\Delta EXP = \underbrace{\Delta X_{K_0 \cap K_T}^{+\text{ve}} + \Delta X_{K_0 \cap K_T}^{-\text{ve}}}_{\text{Intensive Margins}} + \underbrace{X_{K_T \setminus K_0}}_{\text{Extensive Margins}} - \underbrace{X_{K_0 \setminus K_T}}_{\text{Exit Margins}} \quad (3.3)$$

The first term on the right-hand side shows the value of exports for products in which Canada was already exporting in the base year t_0 and it continued exporting a

higher value in terminal year t_T —the positive intensive margins. The second term shows the value of exports for products in which Canada was already exporting in the base year t_0 and it continued exporting, but value of exports decreased in terminal year t_T —the negative intensive margins. The third term shows that value of exports in products which Canada was not exporting in the base year t_0 but started exporting in later year t_T —the new product margins or extensive margins. The fourth term contains the reduction in value of exports because Canada ceased to export some products in terminal year t_T which it was exporting in base year t_0 —the exit margins. Also note that by construction, these categories make up overall change in total value of exports.

$$1 = \frac{\Delta X_{K_0 \cap K_1}^{+ve}}{\Delta EXP} + \frac{\Delta X_{K_0 \cap K_1}^{-ve}}{\Delta EXP} + \frac{X_{K_T \setminus K_0}}{\Delta EXP} - \frac{X_{K_0 \setminus K_T}}{\Delta EXP} \quad (3.4)$$

I use equations 3.3 and 3.4 to decompose the change in Canada's overall exports into positive and negative intensive margins and also to analyze the impact of FTA on exports of products at these two margins of exports. Most of the literature in international trade that analyze the impact of FTA use aggregate bilateral trade between partner countries. Recent literature has also analyzed the impact of FTA on intensive and extensive margins at product level but it does not differentiate between the positive and negative intensive margins.

Figure 3.3 shows how the overall change in Canada's total exports can be divided between exports to FTA partner and the rest of the world. Then both the change in exports to FTA partner and to rest of the world are decomposed further into extensive, intensive and exit margins of trade. The change in exports taking place in products at intensive margins are further divided into negative intensive margins (decrease in

export value of already⁵ exported products) and positive intensive margins (increase in export value of already exported products). In order to analyze the impact of FTAs on products at positive and negative intensive margins with FTA partner, it can be compared with the rest of the world or a control group economies. Furthermore, some of the change in exports may take place because of trade diversion, highlighted by arrows, resulting from FTAs that must be controlled.

3.3.2 Sampling Strategy

The sample is restricted to the products at intensive margins and further divided into groups that showed on average positive and negative change in value of exports in the pre-FTA period. The selected products at intensive margins (both positive and negative intensive margins) are then tracked in the post-FTA period. Therefore, any new products (that appear for the first time in post-FTA period) are excluded from the sample—thus making it a strictly longitudinal analysis. For example, the number of products at positive intensive margins with Costa Rica were 196 in 2002, the year when FTA was implemented; most of these products remained part of the export basket as the least count of products is 147 in year 2010 (See Appendix Table B1.7).

Tables 3.1 and 3.2 give the summary of change in product level exports at positive and negative intensive margins by FTA partner and corresponding change in exports to the control economy. For all the countries, the average change in exports of products at positive intensive margins is positive by construction. Similarly, the average change in exports at negative intensive margins is negative, particularly in the pre-FTA period. In some cases, the average change in exports at negative intensive margins have turned positive in post-FTA period which indicates positive change on average in exports of

⁵Moment in time is defined as FTA enforcement date.

products that had negative growth in pre-FTA period.

3.3.2.1 Control Group Economies

To ensure that the control groups are comparable with FTA partners, they are selected on the basis of similarities in geographic region, and development ranking. For instance, according to World Economic Outlook database (IMF 2018), Colombia is ranked at fourth position while Chile has fifth economic ranking among the Latin American and Caribbean countries.⁶

It is also pertinent to mention that there are limited number of economies available to serve as control group if criteria of geographical location, and development ranking is applied. Therefore, we have used Columbia as control economy in two cases as it serves the purpose because its FTA was implemented in 2011 which provides fairly long period for comparison purposes and similar sectors included in the FTA.

3.3.2.2 Export Basket at Positive and Negative Intensive Margins

As discussed earlier, I restrict the analysis to products at intensive margins and further divided those products into groups that showed on average positive and negative change in value of exports in the pre-FTA period. Figure 3.4 shows that the number of products that had positive change at intensive margins remained more or less the same after the implementation of FTAs. In other words, most of the products that had positive change at intensive margins in pre-FTA period remained in Canada's export basket after the trade agreements. For example, Chile had 516 products in positive intensive margins in 1996. This number increased to 988 products in 1997. For the remaining post-FTA period however, these products remained around 575.

⁶According to the International Monetary Fund's estimates in the October 2018 World Economic Outlook database.

Additionally, a considerably large number of these products were also being exported to Colombia, which is considered to be the control-group case. In the case of other agreements, similar trends in product count at negative and positive intensive margins further reassures our selection of control group economies. Figure 3.5 shows that the number of products that had negative growth at intensive margins. Although the number of products at negative intensive margins are considerably small relative to positive intensive margins, these products also remained part of Canada's export basket to FTA partners and control group economy for long-term in post-FTA period. It is pertinent to mention that there is considerable difference in number of products for Columbia the first two cases. It is mainly because the products are selected on the basis of growth in pre-FTA period, the same products are selected from control economy and tracked in the post FTA period.

Furthermore, these economies have similar export trends in the pre-FTA period (See Figure 3.6). This also implies that common trends assumption holds between treatment and control economies which is required to get unbiased estimates from difference-in-differences approach. Thus indicating that the selected control economies can serve as reasonable comparison groups.

The trends in Canada's exports to FTA partners show that the overall exports increased following the implementation of FTAs. The exports trends in case of FTA partners diverged from the control groups cases—except the case of Chile. Canada's exports to Chile and Colombia remain quite the same and followed virtually the same trend throughout the entire period. However, at the dis-aggregated product level, the variations at the intensive and extensive margins level cannot be the same. My particular interest is to explore the impact of FTAs on export performance of promising (on average positive intensive margins in the pre-FTA period) and not-promising (on

average negative intensive margins in the pre-FTA period) products.

3.3.3 Empirical Specification

In order to analyze the impact of FTAs on products at positive and negative intensive margins with FTA partner, it can be compared with the rest of the world or a control group economy. Although FTA affects exports at extensive margins as well, in this study I restrict the analysis to positive and negative intensive margins (see Figure 3.3). Furthermore, some of the change in exports may take place because of trade diversion resulting from other FTAs that must be controlled. For this reason, I considered the difference-in-differences (DID) approach to estimate the effect of the free trade agreements. This approach has become widespread for analyzing the impact of a policy change (Card and Krueger 1994; Di Tella and Schargrotsky 2004; Galiani et al 2005), and more recently it has been used in literature on international trade to analyze the impact of trade agreements and policies (Behrens et al 2013).

Considering I have data at country (c) product level (i) over time period before and after the implementation of FTAs, the DID specification would be:

$$EXP_{ict} = \beta_1 + \beta_2 COUNTRY_c + \beta_3 AFTER_t + \delta (COUNTRY_c \times AFTER_t) + \theta_i + \epsilon_{ict} \quad (3.5)$$

where:

EXP_{ict} = the natural logarithm of export of product i to country c in year t

$COUNTRY_c$ = 1 if exports are made to FTA partner country and zero otherwise

$AFTER_t$ = 1 if exports are made after FTA is put into force and zero otherwise

$\beta_1 = \text{constant}$

$\theta_i = \text{product fixed-effects}$

$\epsilon_{ict} = \text{random error}$

I consider the outcomes of following different conditions, i.e., exports to FTA partner and control economies in pre- and post-FTA period using equation (3.5).

Exports of product i to FTA partner country before free trade agreement :

$$EXP_{i10} = \beta_1 + \theta_i + \beta_2 \cdot 1 + \beta_3 \cdot 0 + \delta \cdot 1 \cdot 0 + \epsilon_{i10} \quad (3.6)$$

Exports of product i to control country before free trade agreement :

$$EXP_{i00} = \beta_1 + \theta_i + \beta_2 \cdot 0 + \beta_3 \cdot 0 + \delta \cdot 0 \cdot 0 + \epsilon_{i00} \quad (3.7)$$

Exports of product i to FTA partner country after free trade agreement :

$$EXP_{i11} = \beta_1 + \theta_i + \beta_2 \cdot 1 + \beta_3 \cdot 1 + \delta \cdot 1 \cdot 1 + \epsilon_{i11} \quad (3.8)$$

Exports of product i to control country after free trade agreement :

$$EXP_{i01} = \beta_1 + \theta_i + \beta_2 \cdot 0 + \beta_3 \cdot 1 + \delta \cdot 0 \cdot 1 + \epsilon_{i01} \quad (3.9)$$

Change in exports to FTA partner over time = (3.8) – (3.6):

$$\begin{aligned}
EXP_{i11} - EXP_{i10} &= \beta_1 + \theta_i + \beta_2 \cdot 1 + \beta_3 \cdot 1 + \delta \cdot 1 \cdot 1 + \epsilon_{i11} \\
&\quad - (\beta_1 + \theta_i + \beta_2 \cdot 1 + \beta_3 \cdot 0 + \delta \cdot 1 \cdot 0 + \epsilon_{i10}) \\
&= (\theta_i - \theta_i) + \beta_3 + \delta + (\epsilon_{i11} - \epsilon_{i10})
\end{aligned} \tag{3.10}$$

Change in exports to control country over time = (3.9) – (3.7):

$$\begin{aligned}
EXP_{i01} - EXP_{i00} &= \beta_1 + \theta_i + \beta_2 \cdot 0 + \beta_3 \cdot 1 + \delta \cdot 0 \cdot 1 + \epsilon_{i01} \\
&\quad - (\beta_1 + \theta_i + \beta_2 \cdot 0 + \beta_3 \cdot 0 + \delta \cdot 0 \cdot 0 + \epsilon_{i00}) \\
&= (\theta_i - \theta_i) + \beta_3 + (\epsilon_{i01} - \epsilon_{i00})
\end{aligned} \tag{3.11}$$

The average treatment effect (or the DID impact) = (3.10) – (3.11)

$$\begin{aligned}
EXP_{i11} - EXP_{i10} - \{EXP_{i01} - EXP_{i00}\} &= \beta_3 + \delta + (\epsilon_{i11} - \epsilon_{i10}) \\
&\quad - \{\beta_3 + (\epsilon_{i01} - \epsilon_{i00})\} \\
\text{DID Impact or average FTA effect} &= \delta + \epsilon^*
\end{aligned} \tag{3.12}$$

Equation 3.12 implies that the assumptions needed to infer causality from DID design is that the error term must have a distribution with mean 0, so that ϵ^* is distributed with zero mean. Furthermore, it is assumed that the time-variant differences in the treatment and control groups are equal, so that they cancel out each other. Notice that in estimating equation 3.5 the number of products at negative or positive intensive margins are fairly stable, therefore products that exit the export basket should not be a cause of concern. Also, in terms of share of intensive and

exit margins, Table 3.3 shows that intensive margins have considerably large share of above 75 percent in most years—explaining significant variations in overall exports.

In equation 3.5, the coefficient attached to the interaction term, δ , is the differences-in-differences parameter which captures the pure impact of FTA on exports to FTA partner. Following Meyer’s (1995) suggestions that control group should include countries that are “similar” to the treatment group, I select the control group countries that have similar level of economic development, size and geographical location as discussed in data section. Equation 3.5 is estimated with the time varying product level average tariffs and other FTAs signed by Canada to control for import restrictiveness and possible trade diversion, respectively, as source of omitted product and country level trends. Equation 3.5 is estimated using 1-year, 2-year, 3-year, and all-year windows to capture the short- and long-run impacts. Firstly, as Trefler (2004) shows that there are short-run adjustment costs associated with implementation of FTA and large productivity gains in the long-run. Secondly, because FTAs are implemented over several years depending on the tariff concession modalities agreed by partners countries. Hence, short- and long-run analysis is necessary to capture the full impact of FTAs.

3.4 Results and Discussions

3.4.1 Difference-in-differences Estimates

As discussed before, most of the products at intensive margins (both positive and negative intensive margins) before implementation of FTAs remained part of Canada’s export basket for long-term following the implementation of agreement. Despite this, in the case of FTAs with middle-income economies exports at positive and negative

intensive margins either declined or remained insignificant in both the short- and long-term. Negative impacts of FTA on intensive margins indicate that the products that were growing at intensive margins before the agreement did not derive the increase in exports observed at the aggregate level. Table 3.4 reports the estimates of average FTA impact for each agreement. In case of middle-income economies, in long term the adverse impact of FTA on negative intensive margins ranges approximately between 12.2 percent⁷ for Colombia to 54.6 percent for Costa Rica. For the same window, the impact of FTA on positive intensive margins is also negative but it is relatively small ranging between 11.3 percent for Colombia to 33 percent for Costa Rica. The possible reason is the increase in entry of exporting firms into products at intensive margins—as reported by [Chen and Voia \(2018\)](#)—thus increasing competition and deriving down export value because of dominant price effect than demand volume. This is more likely in the case where FTA partners are middle-income economies reflecting weak demand conditions.

Contrary to the middle-income economies, in the case of FTA with Chile and EFTA economies, the FTA has positive impact on both negative and positive intensive margins. The long term impact of FTA on negative intensive margins is approximately 35 percent for EFTA economies and 33.6 percent for Chile. For the same FTAs the long-term impact on positive intensive margins is also positive at 15 percent for EFTA and 17.4 percent for Chile.

Since EFTA member countries are high-income and relatively larger economies compared to middle-income FTA partners. The strong demand in these economies could be a reason the volume effect dominated relative to the price effect and export value increased following the implementation of FTA. The other FTAs analyzed in

⁷Exact percentages are calculated using $(e^{\delta} - 1) \times 100\%$.

this study belongs to a group of middle-income and relatively smaller economies. Therefore, expansion of exports at intensive margins is relatively smaller if the FTA partner has a smaller economy, and thus reflecting weak demand as the price effect dominates and drives down the overall value of exports.

Figure 3.7 shows a visible discontinuity in the value of Canadian exports to its middle-income and high-income FTA partner economies, in the year FTAs enforced. To compare the pre-FTA and post-FTA exports, the FTA implementation years are centered around zero. The aggregate exports of middle-income economies before and after the agreement. In the next section I estimate the impact of FTA on exports using Regression Discontinuity Design (RDD) for products at intensive margins.

3.4.2 Estimates from Regression Discontinuity Design

In the previous section the impact of FTA using DID method could be driven by the selected control group economy. Although the selected control group economies have similarities with the FTA partners in terms of geographic region and development ranking but it can be argued that trends in treatment and control group economies are not strictly parallel or the identification assumption is implausible. Furthermore, FTA could affect trade between FTA partner and control group economy because both belong to the same region. This may lead to biased DID estimates. To avoid this issue of selection of control group, in this section, I use RDD method. Instead of worrying about control group economies as in DID, RDD model utilize exogenous policy rules, making a comparison of products before and after a fixed cutoff point. The source of discontinuity is change in tariffs i.e., the products that were included in the FTA or products on which tariff declined following the implementation of FTA.

The direction of impact on negative and positive intensive margins is found to

be same in the DID estimates. Therefore, this section focuses on the impact of FTA on exports to middle- and high-income economies without dividing products into negative and positive intensive margins. The results found through RDD are qualitatively similar to DID method showing positive impact on intensive margins in case of high-income economies and negative in case of middle-income economies.

I use sharp regression discontinuity design as the treatment variable goes from 0 to 1 at the cutoff value of assignment variables. The treatment variable is defined using time-to-FTA ($TFTA_{ct}$) and change in tariffs as assignment variables. The treatment variable take value of 1 if change in tariff is negative and agreement is enforced, i.e., ($TFTA_{ct} \geq 0$) . Precisely, I model exports at intensive margins as follows:

$$EXP_{ict} = \alpha + \theta_i + \delta TREATMENT_{ict} + \beta_1 \Delta TARIFF_{ict} + \beta_2 YEAR_t + \beta_3 \Delta TARIFF_{ict} \times TREATMENT_{ict} + \epsilon_{ict} \quad (3.13)$$

where

$$TREATMENT_{ict} = \begin{cases} 1, & \text{if } \Delta TARIFF_{ict} < 0, YEAR_t [TFTA_{ct} \geq 0] \\ 0, & \text{otherwise} \end{cases} \quad (3.14)$$

where:

EXP_{ict} = the natural logarithm of export of product i to country c in year t

$\Delta TARIFF_{ict}$ = change in tariff on exports of product i to country c in year t

$YEAR_t$ = time variable

$TFTA_{ct}$ = country c 's time (years) from implementation of FTA in year t

θ_i = Product fixed-effects

ϵ_{ict} = Random error

In equation 3.14, the coefficients of interest are δ and β_3 that give the main and interaction effect of FTA respectively.

Table 3.5 presents estimates from the RDD. The estimates show that there is discontinuity or treatment effect in case of both middle-income and high-income economy. The Average Treatment Effect (ATE) is negative in case of middle-income economies which shows that exports at intensive margins decline following the agreement. However, in case of high-income economies the ATE is positive which shows that exports at intensive margins increase following the implementation of agreement. The interaction terms further indicate that the responsiveness of exports to change in tariffs increases in case of middle-income economies but slightly decreases in case of developing economies.

Figure 3.8 gives a graphical presentation of findings based on RDD estimates, where in case of middle-income economies the downward shift in regression line at the cutoff point indicates the main average treatment effect of FTA and upward rotation of the regression line in post FTA represents the interaction effect. Similarly, in case of high-income economies the discontinuity or interaction effect is represented by upward shift in regression at the cutoff point and slightly downward rotation indicates the interaction effect.

3.5 Conclusions

I evaluate the impact of Canada's FTAs on its exports at the intensive margins of exports. To date, a large number of studies that have documented positive impacts

of FTAs on aggregate trade assume that effects are common across similar types of FTAs. In contrast recent literature has documented heterogeneous impact of even similar types of FTAs on bilateral trade as well extensive and intensive margins. Most of the existing empirical literature found a positive impact of FTAs on extensive margins in case of Canada and other countries. However, the empirical literature is divided on intensive margins. Some have reported positive impacts. Others have reported negative or even insignificant impacts on intensive margins. Contributing to the existing theoretical and empirical literature, I analyzed the heterogeneous impact of FTAs on positive and negative intensive margins.

The analysis presented in this paper is based on Canada's free trade agreements with middle-income economies (Latin American Countries), i.e., Columbia, Costa Rica, and Peru, and a group of high-income economies, i.e., Chile, and Norway, Switzerland, and Iceland in EFTA. A standard differences-in-differences specification is used to analyze the impact of FTAs on exports of products at positive and negative intensive margins. Similar economies are selected as control countries in terms of development stage, size of economy and geographic location. Furthermore, the analysis includes 1-Year, 2-Year, 3-Year and All-Years windows to estimate the relatively short-term and long-term impact of FTAs.

These results have important policy implications. Since FTAs with smaller economies tend to drive down exports at intensive margins, these FTAs must focus on increasing the exports at extensive margins. This means that incentives must also be provided to encourage innovation and exports of new products. FTAs with high-income economies must also focus on intensive margins as the larger destination market size can bring scale economies and thus intensive margins can also drive the increase in aggregate exports.

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Figure 3.1: Canada's Total Exports (USD Billions)

Data Source: Trade Analysis Information System (TRAINS) database

Figure 3.2: Total exports to FTA partners

Data Source: Trade Analysis Information System (TRAINS) database

Figure 3.3: Framework for Impact Analysis of FTA on Export Margins

Source: Author’s own depictions

Table 3.1: **Positive Intensive Margins (USD Millions) by Country and Period**

Country	Period	Observations	Mean	Std. Dev.	Min	Max
Colombia [†]	Before	651	186.35	1958.43	-14450.80	35030.48
	After	6,176	9.45	1835.40	-79756.05	41274.36
Chile*	Before	1,014	202.32	1319.06	-12171.7	15597.26
	After	12,992	17.45	1671.02	-54543.45	41012.99
Argentina [†]	Before	6,748	49.35	1,136.79	-22,548.38	43,703.32
	After	4,175	7.42	5,148.45	-184,396.90	240,921.30
Colombia*	Before	8,169	74.56	1,861.11	-52,526.01	49,627.96
	After	6,029	2.80	1,682.31	-28,449.80	62,034.84
Colombia [†]	Before	5,542	96.35	1942.47	-50956.03	49627.96
	After	4,178	29.66	2123.53	-52526.01	62034.84
Peru*	Before	5,010	51.18	1221.03	-54150.3	74046.10
	After	4,013	49.36	1351.39	-25530.58	39986.10
Ecuador [†]	Before	787	26.51	375.29	-6401.57	4849.79
	After	1,936	11.34	797.26	-11410.92	16470.44
Costa Rica*	Before	1,489	31.95	450.72	-6606.06	7444.75
	After	3,671	14.45	535.98	-14571.78	11799.52
EU [†]	Before	25,581	835.87	22119.29	-775894.8	2330043
	After	20,336	-83.43	35888.12	-1917919	1506051
EFTA*	Before	17,748	158.11	15190.58	-1002530	1615788
	After	16,233	0.89	17057.26	-971719.1	1141781

Notes– *FTA partner, [†] Control economy

Table 3.2: **Negative Intensive Margins (USD Millions) by Country and Period**

Country	Period	Obs.	Mean	Std. Dev.	Min	Max
Colombia [†]	Before	491	-165.19	2947.26	-47088.91	27480.4
	After	4,678	6.25	2669.81	-105334	67729.84
Chile*	Before	604	-117.19	696.34	-11284.06	2637.55
	After	4,840	12.90	1535.52	-44658.64	69636.48
Argentina [†]	Before	5,296	-50.51	1153.78	-31401.23	27109.38
	After	2,629	-20.37	4521.17	-152747.8	152891.3
Colombia*	Before	4,235	-100.13	3007.30	-105334	67729.84
	After	2,604	-3.19	1244.18	-20569.14	41274.36
Colombia [†]	Before	3,610	-71.06	2794.36	-105334.00	67729.84
	After	1,781	-23.80	1014.25	-17273.80	15193.35
Peru*	Before	3,945	-42.37	1732.39	-54150.31	51622.40
	After	2,070	-9.53	688.31	-22224.54	8142.20
Ecuador [†]	Before	604	-6.62	1725.76	-17080.84	28082.58
	After	1,295	62.36	2560.26	-35885.52	43552.88
Costa Rica*	Before	1,094	-14.97	252.53	-3799.46	2812.61
	After	2,899	2.79	216.61	-4599.13	4714.81
EU [†]	Before	18,636	-192.94	13667.65	-439300.00	783903.80
	After	14,768	353.80	71961.45	-1669316.00	6650726.00
EFTA*	Before	13,230	-23.77	1090.23	-50383.23	23838.53
	After	12,074	15.46	2045.33	-68122.30	144426.30

Notes– *FTA partner, [†] Control economy

Figure 3.4: **Products at Positive IMs: FTA partners and control group economies**

Data Source: Trade Analysis Information System (TRAINS) database

Figure 3.5: Products at Negative IMs: FTA partners and control group economies

Data Source: Trade Analysis Information System (TRAINS) database

Figure 3.6: Exports to FTA partners and control group economies

Data Source: Trade Analysis Information System (TRAINS) database

Table 3.3: **Average Shares (%) of Intensive, Extensive and Exit Margins**

Years	Intensive	Intensive		Extensive	Exit	Total
		Positive	Negative			
Chile						
1992-2000	84.17	152.44	-68.27	31.65	-15.82	100.00
2001-2010	96.70	107.64	-10.94	28.87	-25.57	100.00
2010-2019	67.33	136.70	-69.36	45.52	-12.85	100.00
Columbia						
1992-2000	67.24	109.08	-41.84	48.87	-16.11	100.00
2001-2010	85.76	114.40	-28.64	22.24	-8.00	100.00
2010-2019	67.37	81.74	-14.36	35.48	-2.85	100.00
Costa Rica						
1992-2000	59.21	71.30	-12.09	53.13	-12.34	100.00
2001-2010	71.83	123.61	-51.77	45.08	-16.92	100.00
2010-2019	44.02	89.48	-45.47	72.95	-16.96	100.00
Peru						
1992-2000	76.46	109.74	-33.28	28.84	-5.30	100.00
2001-2010	57.78	148.96	-91.18	44.12	-1.90	100.00
2010-2019	3.06	101.92	-98.86	103.85	-6.91	100.00
EFTA						
1992-2000	84.05	153.65	-69.60	34.44	-18.49	100.00
2001-2010	97.78	107.88	-10.10	12.78	-10.56	100.00
2010-2019	83.98	92.42	-8.45	24.60	-8.58	100.00

Source: Author's calculations

Table 3.4: **FTA Impact Estimates on Exports to Partner Economies**

	Positive Intensive Margins				Negative Intensive Margins			
	1-Year	2-Year	3-Year	All Years	1-Year	2-Year	3-Year	All Years
Dependent Variable: EXP_{ict}								
CHILE $\times$ AFTER	0.011 (0.09)	0.23*** (0.08)	0.16** (0.08)	0.16** (0.08)	0.69*** (0.13)	0.56*** (0.11)	0.70*** (0.12)	0.29** (0.12)
COLOMBIA $\times$ AFTER	0.085 (0.10)	-0.065 (0.09)	-0.13 (0.09)	0.12 (0.07)	-0.36* (0.20)	-0.35** (0.17)	-0.35** (0.16)	-0.13 (0.13)
PERU $\times$ AFTER	0.07 (0.09)	0.02 (0.08)	-0.08 (0.08)	-0.20*** (0.07)	-0.23* (0.13)	-0.28** (0.11)	-0.23** (0.11)	-0.29*** (0.09)
COSTA RICA $\times$ AFTER	0.17 (0.12)	-0.42*** (0.11)	-0.52*** (0.11)	-0.40*** (0.11)	-0.96*** (0.20)	-1.16*** (0.15)	-0.95*** (0.14)	-0.79*** (0.12)
EFTA X AFTER	0.23*** (0.06)	0.15*** (0.05)	0.16*** (0.05)	0.14*** (0.04)	0.14* (0.07)	0.13** (0.06)	0.17*** (0.06)	0.30*** (0.05)
Tariff	YES	YES	YES	YES	YES	YES	YES	YES
Product fixed-effects	YES	YES	YES	YES	YES	YES	YES	YES
Other Agreements	-	YES	YES	YES	-	YES	YES	YES

Notes – Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The detailed DID estimates are reported in Appendix of Chapter 1, [B1.1–B1.5](#). The results for intensive margins (without splitting into negative and positive intensive margins) were inconclusive as reported by most of the literature. The test of differences between coefficients using [Dupont and Plummer \(1998\)](#) shows that the coefficients in case of positive and negative intensive margins are statistically different thus justifying the grouping.

Figure 3.7: **Linear trend in exports**

(a) High-income Economies

(b) Middle-income Economies

Table 3.5: **Regression Discontinuity Design Estimates**

	Middle-income	High-income
<i>TREATMENT</i>	−0.584*** (0.043)	0.231*** (0.034)
$\Delta TARIFF$	−0.028* (0.015)	−0.127*** (0.035)
YEAR	−0.007*** (0.001)	0.031*** (0.001)
$\Delta TARIFF \times TREATMENT$	−0.184*** (0.012)	0.097*** (0.031)
Constant	2.636*** (0.031)	1.999*** (0.028)
Product fixed-effects	Yes	Yes
Observations	56504	68697
R^2	0.56	0.49

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 3.8: **Regression Discontinuity: FTA Treatment and Interaction Effect**

Appendix: Chapter 3

Table B1.1: **FTA impact estimates on exports to Chile**

	Positive Intensive Margins				Negative Intensive Margins			
	1-Year	2-Year	3-Year	All Years	1-Year	2-Year	3-Year	All Years
Dependent Variable: EXP_{ict}								
CHILE	0.68*** (0.10)	0.61*** (0.09)	0.74*** (0.09)	0.72*** (0.09)	0.16 (0.22)	0.30* (0.18)	0.25 (0.18)	0.19 (0.16)
CHILE $\times$ AFTER	0.01 (0.09)	0.23*** (0.08)	0.16** (0.08)	0.16** (0.08)	0.69*** (0.13)	0.56*** (0.11)	0.70*** (0.12)	0.29** (0.12)
AFTER	-0.05 (0.07)	-0.22*** (0.06)	-0.14** (0.06)	-0.041 (0.06)	-0.081 (0.10)	-0.22*** (0.08)	-0.36*** (0.09)	-0.06 (0.09)
TARIFF	-0.048*** (0.02)	-0.047*** (0.01)	-0.035*** (0.01)	0.00 (0.01)	-0.02 (0.04)	0.01 (0.02)	-0.003 (0.02)	-0.072*** (0.01)
CONSTANT	3.79*** (0.22)	3.79*** (0.18)	3.44*** (0.17)	2.82*** (0.13)	2.97*** (0.47)	2.75*** (0.29)	2.93*** (0.29)	3.79*** (0.14)
N	3998	6168	8406	16285	1752	2923	3458	12089
R^2	0.85	0.77	0.72	0.63	0.8	0.72	0.69	0.57

Notes— Robust standard errors in parentheses. Control economy: Colombia. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B1.2: **FTA impact estimates on exports to Colombia**

	Positive Intensive Margins				Negative Intensive Margins			
	1-Year	2-Year	3-Year	All Years	1-Year	2-Year	3-Year	All Years
Dependent Variable: EXP_{ict}								
COLOMBIA	0.0098 (0.12)	0.19* (0.11)	0.22** (0.10)	-0.12* (0.07)	0.54** (0.25)	0.71*** (0.22)	0.76*** (0.21)	0.59*** (0.17)
COLOMBIA $\times$ AFTER	0.09 (0.10)	-0.07 (0.09)	-0.13 (0.09)	0.12 (0.07)	-0.36* (0.20)	-0.35** (0.17)	-0.35** (0.16)	-0.13 (0.13)
AFTER	0.40*** (0.06)	0.55*** (0.06)	0.52*** (0.06)	0.78*** (0.06)	-0.22** (0.11)	0.01 (0.09)	0.02 (0.10)	0.13 (0.09)
TARIFF	-0.020* (0.01)	-0.012 (0.01)	-0.012 (0.01)	-0.0091* (0.01)	-0.059** (0.03)	-0.050*** (0.02)	-0.040** (0.02)	-0.001 (0.01)
CONSTANT	3.61*** (0.16)	3.31*** (0.16)	3.31*** (0.13)	2.95*** (0.09)	2.71*** (0.37)	2.42*** (0.28)	2.34*** (0.26)	1.86*** (0.16)
Product fixed-effects	YES	YES	YES	YES	YES	YES	YES	YES
Other Agreements	-	YES	YES	YES	-	YES	YES	YES
N	4005	6708	9446	30106	1768	3038	4351	10198
R^2	0.81	0.76	0.75	0.61	0.8	0.76	0.75	0.65

Notes— Robust standard errors in parentheses. Control economy: Argentina. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B1.3: **FTA impact estimates on exports to Peru**

	Positive Intensive Margins				Negative Intensive Margins			
	1-Year	2-Year	3-Year	All Years	1-Year	2-Year	3-Year	All Years
Dependent Variable: EXP_{ict}								
PERU	-0.43*** (0.16)	-0.44*** (0.11)	-0.39*** (0.10)	-0.098 (0.07)	-0.42 (0.32)	-0.60*** (0.17)	-0.72*** (0.16)	-0.40*** (0.10)
PERU $\times$ AFTER	0.07 (0.09)	0.02 (0.08)	-0.08 (0.08)	-0.20*** (0.07)	-0.23* (0.13)	-0.28** (0.11)	-0.23** (0.11)	-0.29*** (0.09)
AFTER	0.08 (0.06)	0.21*** (0.05)	0.37*** (0.05)	0.91*** (0.05)	-0.62*** (0.09)	-0.38*** (0.08)	-0.31*** (0.07)	0.08 (0.07)
TARIFF	-0.02 (0.01)	-0.025*** (0.01)	-0.032*** (0.01)	-0.019*** (0.01)	-0.04 (0.03)	-0.067*** (0.01)	-0.071*** (0.01)	-0.033*** (0.01)
CONSTANT	3.64*** (0.18)	3.58*** (0.11)	3.48*** (0.11)	2.78*** (0.07)	3.18*** (0.37)	3.34*** (0.17)	3.33*** (0.16)	2.79*** (0.09)
Product fixed-effects	YES	YES	YES	YES	YES	YES	YES	YES
Other Agreements	-	YES	YES	YES	-	YES	YES	YES
N	3988	6859	8289	22559	2683	4637	5658	14563
R^2	0.8	0.77	0.75	0.63	0.77	0.72	0.7	0.61

Notes– Robust standard errors in parentheses. Control economy: Colombia. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B1.4: **FTA impact estimates on exports to Costa Rica**

	Positive Intensive Margins				Negative Intensive Margins			
	1-Year	2-Year	3-Year	All Years	1-Year	2-Year	3-Year	All Years
Dependent Variable: EXP_{ict}								
COSTA RICA	-0.21 (0.24)	0.13 (0.22)	0.26 (0.22)	0.16 (0.17)	-0.04 (0.36)	-0.25 (0.28)	-0.26 (0.25)	-0.04 (0.16)
COSTA RICA $\times$ AFTER	0.17 (0.12)	-0.42*** (0.11)	-0.52*** (0.11)	-0.40*** (0.11)	-0.96*** (0.20)	-1.16*** (0.15)	-0.95*** (0.14)	-0.79*** (0.12)
AFTER	0.44*** (0.09)	0.66*** (0.08)	0.57*** (0.08)	0.42*** (0.09)	-0.70*** (0.14)	-0.14 (0.11)	-0.18* (0.10)	-0.035 (0.09)
TARIFF	0.00 (0.03)	0.01 (0.02)	0.00 (0.02)	-0.028** (0.01)	0.04 (0.04)	0.00 (0.03)	-0.01 (0.03)	0.00 (0.01)
CONSTANT	2.21*** (0.34)	2.07*** (0.29)	2.05*** (0.29)	2.34*** (0.21)	1.83*** (0.47)	2.17*** (0.38)	2.23*** (0.33)	2.11*** (0.16)
Product fixed-effects	YES	YES	YES	YES	YES	YES	YES	YES
Other Agreements	-	YES	YES	YES	-	YES	YES	YES
N	1719	2939	4106	9501	1362	2296	3186	7877
R^2	0.84	0.74	0.68	0.57	0.79	0.68	0.63	0.55

Notes– Robust standard errors in parentheses. Control economy: Ecuador. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B1.5: **FTA impact estimates on exports to EFTA**

	Positive Intensive Margins				Negative Intensive Margins			
	1-Year	2-Year	3-Year	All Years	1-Year	2-Year	3-Year	All Years
Dependent Variable: EXP_{ict}								
EFTA	-5.12*** (0.09)	-5.01*** (0.08)	-4.97*** (0.07)	-4.84*** (0.06)	-4.79*** (0.12)	-4.60*** (0.11)	-4.57*** (0.11)	-4.39*** (0.09)
EFTA $\times$ AFTER	0.23*** (0.06)	0.15*** (0.05)	0.16*** (0.05)	0.14*** (0.04)	0.14* (0.07)	0.13** (0.06)	0.17*** (0.06)	0.30*** (0.05)
AFTER	-0.084*** (0.03)	-0.070** (0.03)	-0.048* (0.03)	0.20*** (0.03)	-0.71*** (0.05)	-0.65*** (0.04)	-0.61*** (0.04)	-0.68*** (0.04)
TARIFF	-0.16*** (0.02)	-0.14*** (0.01)	-0.12*** (0.02)	-0.097*** (0.01)	-0.041 (0.03)	-0.028 (0.02)	-0.035 (0.03)	-0.034** (0.01)
CONSTANT	7.13*** (0.06)	6.96*** (0.06)	6.81*** (0.06)	6.30*** (0.05)	5.57*** (0.13)	5.45*** (0.11)	5.43*** (0.12)	5.40*** (0.07)
Product fixed-effects	YES	YES	YES	YES	YES	YES	YES	YES
Other Agreements	-	YES	YES	YES	-	YES	YES	YES
N	9919	16815	23510	61936	7736	13297	18564	57603
R^2	0.83	0.81	0.79	0.75	0.8	0.76	0.74	0.68

Notes– Robust standard errors in parentheses. Control economy: EU. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B1.6: Coverage of Canadian Free Trade Agreements

Key sectors	Partner:	Chile	Peru	Colombia	Costa Rica	EFTA*
	Date of Signature:	Dec-1996	May-2008	Nov-2008	Apr-2001	Jan-2008
	Date of Implementation	July-1997	Aug-2009	Aug-2011	Nov-2002	Jul-2009
		Covers both trade in goods and services as well as investments. A 2017 update addresses sanitary and phytosanitary measures, government procurement, technical barriers to trade and investment rules.	Eliminates tariffs on 95% of traded products. It is supported by accords on environmental and labour co-operation.	Reduces or eliminates tariffs on most of traded products and ensures equitable treatment for investment.	Concentrates on trade in goods and does not cover areas such as services, investment and government procurement. Negotiations are underway to eliminate agricultural and industrial tariffs, increase market access and broaden the agreement to other areas.	The EFTA covers only goods and doesn't apply to services, investment or intellectual property.
Agriculture and agri-food				Yes		Yes
Construction and infrastructure		Yes	Yes	Yes	Yes	
Environmental infrastructure and waste-water		Yes	Yes	Yes		
Mining and metals		Yes	Yes	Yes		
Power		Yes	Yes		Yes	
Oil and gas			Yes	Yes		
Forestry (lumber, pulp and paper)		Yes				
Industrial products						Yes

Notes—*European Free Trade Association consists of Norway, Iceland, Liechtenstein, Switzerland.

Source: <https://www.international.gc.ca/trade-commerce/trade-agreements-accords-commerciaux/agr-acc/index.aspx?>

Table B1.7: Costa Rica: Sample restrictions and change in product frequency across positive IMs over time

time	total	first	last	sing	stay	mover	fmover	rmover
1996	88	88	9	9	0	0	0	0
1997	91	38	3	3	0	53	53	0
1998	120	42	11	7	0	78	78	0
1999	131	40	4	4	0	91	91	0
2000	153	40	4	2	0	113	113	0
2001	204	50	22	13	0	154	154	0
2002	196	34	4	4	0	162	162	0
2003	178	0	8	0	0	178	178	0
2004	197	0	9	0	0	197	197	0
2005	193	0	5	0	0	193	193	0
2006	188	0	8	0	0	188	188	0
2007	186	0	24	0	0	186	186	0
2008	168	0	12	0	0	168	168	0
2009	150	0	8	0	0	150	150	0
2010	147	0	9	0	0	147	147	0
2011	167	0	26	0	0	167	167	0
2012	166	0	166	0	0	166	166	0

Notes: **total** - total number of products at time t (total=firs+stay+mover)

first- product count at t that shows up for the first time

last - product count at t that shows up for the last time

singleton - product count at t that shows up only that time

stayer - product count at t that were present at the same category of IMs

since their last observation

mover - product count at t that were present at a different category of IMs

since their last observation (mover=fmover+rmover)

fmover - product count at t that are for the first time at that category of IMs

rmover - number of movers at t that are returning to a category of IMs

Figure B2.1: RTAs currently in force (by year of entry into force), 1948 - 2020

Source: World Trade Organization Secretariat 2020

Figure B2.2: RTAs in force, participation by region

Source: World Trade Organization Secretariat 2020

Figure B2.3: Exports of selected products to EFTA (USD)

Figure B2.4: Exports of selected products to middle-income economies (USD)

Figure B2.5: Product Count with FTA Partners

Chapter 4

Tariff Pass-through and Implications for Domestic Markets: Evidence from U.S. Steel Imports

4.1 Introduction

A recent increase in tariffs by the United States (U.S.) against its major trading partners has reinvigorated the literature on the impact of tariffs on economic outcomes. An increase in tariffs of this magnitude by a large economy is unheard-of in recent history. This has provided the opportunity to test the predictions of trade theory in this context. However, contrary to the predictions of the trade theory, most recent studies have found that the U.S. tariffs have been entirely passed on to U.S. domestic consumers and producers ([Amiti et al. 2019](#); [Fajgelbaum et al. 2020](#); [Flaaen et al. 2020](#); [Amiti et al. 2020](#)). [Amiti et al. \(2020\)](#) also find that only in the case of the steel sector the U.S. tariffs caused foreign exporters to substantially lower prices in

the U.S. market—bearing close to 50 percent of the burden of tariffs. They argue that the fall in prices by exporters caused the import volumes to remain relatively higher compared to other sectors.

Tariffs directly affect the prices of imported goods which impact domestic production and consumption. The extent of changes in prices depends on how the producers of domestic substitutes, downstream industries, and consumers respond as the effects of tariffs permeate through the economy. Three potential channels through which tariffs affect prices are as follows: First, in the case of tariffs on steel products by the U.S., domestic consumers face higher prices due to increased tariffs, leading to a decrease in demand depending on consumers' price sensitivity. Second, a decline in the domestic demand for relatively expensive imported goods may benefit competing U.S. producers as they charge higher prices ([Amiti et al. 2019](#)). Third, U.S. producers that use imported steel content in their production in downstream industries may lose profits and charge higher prices because of the increased cost of production—leading to a contraction in these industries.

Moreover, the competitiveness of exporting firms that use imported steel supplies in the production process may decrease because of the increased cost of production, leading to a decrease in their exports. Particularly, when there is a sizable increase in tariffs, as in the case of recent U.S. trade war, the downstream firms tend to relocate their supply chains to destinations with relatively small tariffs. Although it is risky as well as costly to renegotiate, search and relocate supply chains ([Grossman and Helpman 2020](#)), firms do so for maintaining their competitiveness. In addition to the direct industry-level effects of tariffs, tariffs also have indirect effects on other industries in the local economy, owing to backward and forward linkages with other industries. [Huang et al. \(2019\)](#) analysed the indirect effect of tariffs in the case of U.S.

and China trade war through exposure to global value chains and competition.

In this context, it is pertinent to analyze the short- and long-term impact of tariffs on prices and import values of steel products as well as the production of the same products. I confine this analysis to direct impact of tariffs on unit prices and dollar value of imports and domestic production of steel products. This will help in presenting a better picture by explaining the extent of the impact on the domestic market for steel products. The case of steel imports is interesting in the sense that most of the tariff hikes were in this sector—as the tariffs increased from 0.7% to over 10% on steel imports during February 2018 to September 2019 compared to overall increase in tariff from 1.6 to 5.4 percent during the same period.

[Amiti et al. \(2020\)](#) find that contrary to other sectors steel sector behaved differently in response to increased tariffs as exporters absorbed about 50 percent of the burden of tariffs via decreasing their prices in the long-term. For the same reason, as results of increase in tariffs the decline in exports of steel products is not as high as in other sectors. I find that these results were driven mainly by industrial supplies. Furthermore, the negative impact of tariffs on import values of consumer goods was considerably higher than other steel products. The insignificant effect of tariffs on import prices and values of capital products indicates that capital decisions are not much affected by tariffs.

4.2 Data

The U.S. trade war started based on a particular legal rationale that imports are threat to national security. Initially, safeguard tariffs were imposed on solar panels and washing machines in January 2018 based on findings of the U.S. International

Trade Commission (USITC) that imports of solar panels and washing machines are hurting domestic industries. It was followed by imposition of tariffs on various other products based on national security investigations by USITC, steel and aluminium being the key products that attracted U.S. tariffs. This resulted in three times higher average tariffs on overall imports, increasing from 1.6 percent at the end of 2017 to 5.4 percent in September 2019 ([Amiti et al. 2020](#)). Although coverage of products increased over time, much of this increase in tariffs was on steel products. Figure 4.1 that the trade war resulted in import weighted tariffs increasing from 0.7% to over 10% from February 2018 to September 2019.

The data on import values and volumes of about 16000 products at a 10-digit level comes from U.S. Customs, the same data used by [Amiti et al. \(2020\)](#). The data on production and consumption of steel products comes from [Department of Commerce \(2020\)](#). The unit import prices, computed on the basis of import values and volumes, depict foreign export prices. I compute tariff inclusive import prices faced by importers by using import values and volumes of steel products. To explore heterogeneity across different categories within steel sector I separate HTS 10-digit products in chapters 72-73 and categorize those products by their end-use category using concordance tables, i.e., consumer goods, capital goods, and industrial supplies and materials.

4.3 Methodology

I use an event-study regression model to analyze the impact of U.S. tariffs on steel import values and unit prices. The data comes from U.S. Customs department, which includes products at HTS10 digit and country-level information on monthly import

values and volumes. The products are further categorised by end- use categories i.e, capital, consumer, and industrial supplied and materials, according to the US Census Bureau classification. However, contrary to [Amiti et al. \(2020\)](#), the control product categories are also steel products on which tariffs were unchanged. [Clarke and Schythe \(2020\)](#) proposed an event study regression model to estimate the response to a quasi-experimental policy or event. I adopt a similar regression model to estimate the tariff pass-through on import values and unit prices, given as follows.

$$IMP_{ijt} = \lambda_{ij} + \sum_{s=-T}^{\bar{T}} \delta_s \left(\Gamma_{ijs} \times \ln \left(\frac{1 + \tau_{ijs}}{1 + \tau_{ij0}} \right) \right) + \gamma_{jt} + \mu_{it} + \epsilon_{ijt} \quad (4.1)$$

where

IMP_{ijt} = the natural logarithm of import values or unit ¹ prices of product i, from country j at month t

λ_{ij} = country-product fixed effects

Γ_{ijs} = treatment month indicator variables

$\ln \left(\frac{1 + \tau_{ijs}}{1 + \tau_{ij0}} \right)$ = log change in tariffs between month s and the last untreated month

γ_{jt} = HTS10-time fixed effects

μ_{it} = country-time fixed effects

The final month consist of observations for periods longer than 12 months. The treatment month indicator variables indicate that a particular product is a given number of periods away from imposition of tariff in the respective month. Each of the coefficients ($\delta's$) is a difference-in-differences estimator, based on the period before

¹The products for which units changed during the sample period were dropped from the analysis

and after implementing the tariffs. (μ_{it}) and (γ_{jt}) are country-time fixed-effects and product-time fixed effects to control for country specific time-varying and other factors such as exchange rate affecting imports and unit prices. The country product fixed effect controls for quality or comparative advantage across countries in untreated months. I estimate the regression for all steel products combined and each end-use category of steel products.

4.4 Results and Discussions

Figure 4.2 shows estimates of elasticities for tariff inclusive unit import prices for 12 months before and after impositions of tariffs. The results for overall steel goods show that pass-through is near 100 percent as the elasticity coefficients (δ 's) are a little less than 1. However, the tariff pass-through gradually falls to about 50 percent after eight months. For the subcategories of steel inputs and industrial supplies and materials, the tariff pass-through is virtually identical to results of overall steel products. Although insignificant, there is a disproportionate increase in unit import prices of consumer steel products after fifth and sixth month. The key reason for insignificant coefficients in case of consumer and capital goods is their considerably small share in steel imports as Table 4.1 shows that share of consumer and capital steel products are at 8-10 percent compared to 80 percent share of industrial supplies and materials.

Figure 4.3 gives tariff elasticities of import values. For overall steel products and individual categories, the elasticity coefficients are negative and increase in magnitude over time, except for capital products. Furthermore, in the case of steel consumer products, I find them to be significantly negative although typically insignificant elasticities range between four and five. The elasticity coefficients for capital goods do

not show any trend following the change in tariffs. U.S. Department of Commerce also reports that the import volumes from the top 10 sources decreased between the 56 percent from Russia to 3 percent from Mexico.

How did tariff pass-through on unit prices and imports affect the domestic steel industry? Figure 4.4 shows that the overall steel production increased from 81.6 million metric tonnes (mmt) in 2017 to 86.6 mmt in 2018. It further increased to 87.9 in 2019. The gap between domestic steel demand and production declined from 22.4 mmt to 19.2 mmt during 2018-19. Import penetration (share of imports in steel demand) has always moved in tandem with domestic consumption. However, the trend in import penetration of steel products diverged following 2017 as it decreased from 32.6 percent in 2017 to 28.3 percent in 2018, further declining to 24.5 percent in 2019 (See Figure 4.4).

In addition to the burden of higher tariffs borne by U.S. consumers and producers, some of the burden is absorbed by exporters, but the decline in import value mainly because of declined volumes have provided the domestic steel industry some room to increase capacity utilization. It is also evident from the increase in domestic production from 81.6 to 87.9 million metric tonnes—almost equal to the peak production the U.S. achieved in 2012 and 2014. The firms, especially those in competition with foreign exporters, got some boost with increased demand and lesser competition but at some cost. Further research is needed to estimate the welfare cost for domestic consumers and producers.

4.5 Conclusions

Recent studies have found that U.S. firms and consumers have to bear the entire burden of tariffs. In this study, I analyzed steel products—one of the main sectors that attracted U.S. tariffs. I find that tariff pass-through to import prices decreased over time. As [Amiti et al. \(2020\)](#) reported, the immediate impact of tariffs on prices was near 100 percent. Still, it gradually reduced to 50 percent in the long term. It indicates that foreign exporters have gradually decreased their prices and shared almost 50 percent of the burden of increased tariffs on steel products. Although statistically insignificant, I observe the highest impact of tariffs in the case of consumer steel products. The price and import elasticities for consumer steel increased substantially to 5 and -8, respectively. The immediate increase in prices of industrial supplies and materials was also near 100 percent, which decreased to slightly below 50 percent in the long term—indicating industrial supplies and materials mainly drove that trend observed in imports of overall steel products. Furthermore, the insignificant results in the case of unit import prices and import values of capital steel products indicate that capital decisions are not much affected by tariffs.

On the external side, higher tariffs have caused an increase in unit prices and a decrease value of imports. In addition, steel imports declined from 34.5 in 2017 to 26.3 million metric tonnes in 2019. On the domestic side, production increased from 81.6 to 87.9 million metric tonnes (7.7 percent growth)—that almost equals the peak production the U.S. achieved in 2012 and 2014. Moreover, the imports of steel products that over the last 10 years moved in tandem with domestic steel consumption exhibit diverging trend after the imposition of tariffs, and import penetration declined to 24.5 percent in 2019 from 32.6 percent in 2017. Overall, these findings show that an increase in tariffs has served the purpose of increasing domestic production. However,

U.S. manufacturing firms and consumers have shared most of the burden of tariffs.

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Table 4.1: Average Import Shares by Categories

	2018	2019
Consumer	5.7 (8.48)	5.4 (10.5)
Industrial Raw-materials and Supplies	55.5 (81.64)	41.7 (79.99)
Capital	6.7 (9.87)	5.0 (9.56)
Total	67.9 (100)	52.1 (100)

Notes: Values are in USD Billions.
Shares are in parenthesis.

Figure 4.1: Average U.S. Tariff on Steel Production During 2018-19

Note: Dashed lines indicate the implementation of tariffs on steel products during 2018-2019. The associated import values are headline numbers from 2017 which are little lower. Source: Author's calculations based on data from U.S. Census Bureau, U.S. International Trade Commission; tariffs on HTS 10 product code by country, weighted by 2017 annual import values

Figure 4.2: **Tariff pass-through: Log import prices of steel products (inclusive of tariffs)**

Note: Points correspond to estimated tariff elasticity of import values (δ 's)

Source: Author's estimations based on data from U.S. Census Bureau, U.S. International Trade Commission

Figure 4.3: **Tariff pass-through: Log import values of steel products**

Notes: Points correspond to estimated tariff elasticity of import values (δ 's)

Source: Author's estimations based on data from U.S. Census Bureau, U.S. International Trade Commission.

Figure 4.4: U.S. Production, Consumption and Import Penetration of Steel Products

(a) Production, Consumption and Imports

(b) Consumption and Import Penetration

Note:

Domestic consumption is domestic production plus steel imports minus exports. Import penetration is ratio of imports to consumption

Source: U.S. Department of Commerce, International Trade Administration