Impact of Research on Economics Professors' Compensation

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Abstract

The purpose of this paper is to study the observable effects research quantity and quality have on the salary compensation a professor receives. This paper aims to assess which bibliometric variable best measures research, and how that research is rewarded through salary received. Other determinants of salary, as well as institutional conditions, will be analysed so that the structure of salary can be determined. The subject of study is tenured and tenure-track economics professors in Ontario for 2015. The results indicate that for the top professors, quality of research was rewarded. For most professors, research made modest contributions to salary, with the best measure of research incorporating both quantity and quality of publications. Years of experience was the largest determinant of salary. Whether a university was unionized or not had an impact on salary, while the research intensity of the institution was not significant.

Table of Contents

Index of Tables

Index of Figures

1 Introduction

The purpose of this paper is to study the observable effects research quantity and quality have on the salary compensation a professor receives. Research occupies a significant portion of a professor's time (Jonker and Hicks, 2014), and faculty salaries take up a large portion of university budgets (Chant, 2005). With the role of universities constantly being discussed and with many institutions starting to shift priorities (Vajoczki, Fenton, Menard, and Pollen, 2011), the interaction between salary and research presents an interesting area of study. This paper conducts a cross-sectional study for the 2015 calendar year, using tenured and tenure-track economics professors in Ontario, to assess which bibliometric variable best measures research, and how that research is rewarded through salary received. To study research, other determinates of salary must be included. Individual characteristics such as years of experience and gender are combined with research to create a model which estimates the interaction these variables have with salary. Institutional characteristics, the university's unionization status, and research intensity are included to observe both their salary effect as well as their interaction with individual characteristics.

The literature review in Section 2 provides context for this paper. There are three literatures which are relevant. The first consists of other studies which have examined the relationship between salary and research for professors. This literature provided background and aided in variable selection and model building. This paper replicates portions of past papers, as well as uses alternative models to expand on past work. The second literature relates to the institutional conditions of universities in Ontario, and provides perspective on the environment in which this study was completed. Institutional conditions include unionization and research intensity of different universities in Ontario, as well as both the contractual benefits and obligations a tenured or tenure-track professor has. The final literature relates to bibliometric measures of research. There are three broad categories of proxy variables which attempt to capture research output. The first relates to quantity of research output, publication of articles, papers, and books. The second looks at measures which try and capture quality of research. Number of citations received is often seen as an indicator of quality; high quality work continues to be used in

other research. The final bibliometric indicators are calculated variables which incorporate both quantity and quality of research output.

This paper uses three data sources to build its frame and to populate the regression models used. The exact specifications and linkage methodology are detailed in Section 3. Basic information for all economics professors in Ontario was collected from departmental websites. This provided a very high quality population to work with. Salary information was obtained through the Ontario Ministry of Finance, which releases data on all public servants earning $100,000 or more. 91% of professors were able to be linked to financial data. While other studies have been done related to Ontario economics professors and salary, none have been conducted for the 2015 reference year. Finally, bibliometric data was obtained through the *CitEc* economic database. The database uses various scraping algorithms to obtain reference data for articles and papers, and then links authors and publications to create a network of publications and citations.

Section 4 describes the variables used in this study and their specifications, provides a preliminary examination of the data, and builds the models which were used for regression analysis. The descriptive statistics of the data help finalize the frame as well as indicate what parameters the models used should follow. The modeling section uses past literature and economic theory to build a human capital model that incorporates both specialized and general human capital.

The analysis and results of the conducted regression models are presented in Section 5. Professors at the extreme tails of salary distribution behaved differently from the majority of professors. Most professors had the majority of salary increases come from years of experience, with research making up a modest portion of salary. For these professors, a combination of quantity and quality of research was what was most rewarded. The top 5% of professors had significant returns for quality of research, which may be related to their ability to switch to a higher-paying university. Whether the school was unionized or not had an impact on salary, this effect was primarily led by the University of Toronto. The research intensity of the university was not a significant determinant of salary.

2 Literature Review

There are three literatures which are relevant to this paper's study of salary and research. The first relates to a set of econometric research which examines the earning functions of university professors. There is an extensive literature on determinates of a professor's salary for the United States and Europe, and a smaller body of work which studies the relationship in Ontario. Studies on populations outside of Ontario are thematically similar to this paper, but the data sources and methodologies have significant differences. The studies conducted on Ontario professors use the same salary data source as this paper, though differ with respect to the source of bibliometric data and methodology.

As the focus of this paper is Ontario economics professors, the second set of literature relates to institutional conditions in Ontario. This includes if underlying economic conditions have been found to affect salary, the research intensity and structure of Ontario universities, and contractual obligations between faculty and universities.

The final literature relevant to this paper relates to the measurement of research output. Traditional measures of research output tend to be based on a quantity measure such as number of publications, or a proxy for quality such as citations received. Alternative measures have been suggested which aim to incorporate both quantity and quality of publications to better estimate research output.

2.1 Studies on Academic Research

The majority of the literature on research productivity and compensation relates to professors in the field of economics, perhaps due to the econometric nature of conducting analysis on the inputs to professors' salaries and the trend to study one's own field. The other papers written on the subject have a certain degree of comparability in data sources, methodology, or results and provide a valuable basis on which to compare and contrast with this paper. This section lays out the similarities and differences between this study and others, and how this study benefits from previous literature on the subject of research and salaries.

2.1.1 Methodology

The literature which relates professors' research to salary spans several decades. Siegfried and White (1973) presented one of the first models relating research and teaching performance of economics professors to salaries. Up until that point, much of the literature around teaching looked at ways in which teaching could be improved. Siegfried and White (1973) postulated that professors act based on incentives, are rewarded for various works such as teaching and research, and apply themselves based on how they are rewarded.

The frame used for each study is heavily dependent on the ability to obtain data. Broadly, past research can be categorized into two groups: those which are cross-sectional and look at a single year, and those which are a time series. Sen et al. (2010 and 2014) and Hamermesh and Pfann (2012) conducted time series studies, while Siegfried and White (1973), Moore et al. (1998), and Moore et al. (2007) conducted studies using cross-sectional data. This paper is similar to the latter half, conducting a cross-sectional study for the 2015 calendar year.

Due to confidentiality restrictions, salary data for much of the United States and United Kingdom is unavailable. Many studies were unable to acquire salary information for the full population, often relying on sample data sets whose origins consist of colleagues who provided the information, and survey respondents. Siegfried and White (1973) and Moore et al. (1998) received salary information through university contacts

who disclosed data to the researchers for entire faculties. Siegfried and White (1973) obtained data for the 45 economics professors at the University of Wisconsin-Madison. Moore et al. (1998) studied nine academic faculties for the 1993/1994 academic year, with a sample of 142 economics professors. In these cases, the universities chosen were not a random sample, and were based on connections the authors had.

Moore et al. (2007) conducted a survey to get individual salaries for professors in the United Kingdom. Since academic pay is confidential in the United Kingdom, data was received by emailing 1,000 economics professors whose email addresses were publicly available. With a 13% response rate, they received 126 completed surveys. When comparing the sample demographics to other surveys done on a similar scale, they found varying degrees of similarity depending on the study. Due to the methods of collecting salary information, this study will have a larger sample size than many previous cross-sectional studies. Additionally, this study will benefit from a frame sample which is very close to the population of interest.

Literature studying European universities may not have the same level of comparability as those done on the United States or Canada. De Fraja, Facchini, and Gethergood (2016) observed that centralized pay structures dominate salary effects in the United Kingdom. In countries such as Spain, academic promotion is done centrally and one of the greatest factors leading to promotion is connection to a committee member (Zinovyeva and Bagues, 2012).

A number of studies were possible in the United States because of individual connections and public universities' salary disclosure rules. Hamermesh and Pfann (2012) were only able to get salary information for a subset of their sample through public disclosure. Hamermesh and Pfann (2012) looked at full professors from 88 top economics departments in the United States. Salary information was obtained for a non-random subset of their sample, from contacts and websites of 43 institutions reporting data for 564 faculty. Bratsberg, Ragan, and Warren (2003) used university records to collect salary panel data on tenured faculty of 5 mid-ranking American institutions.

The two studies conducted on Ontario economics professors, by Sen, Voia, and Woolley (2010) and Sen, Ariizumi, and Desousa (2014), obtained salary information

through the Ontario Government's mandated salary disclosure. This allowed for the study of the entire population of economics professors earning over $100,000. Sen et al. (2010) report that in 1996, only 13.2% of economics professors in Ontario earned over $100,000, while in 2006, 58.2% of economics professors in Ontario met this salary threshold. Similarly, this paper will use the salary disclosure and, with the exception of those earning less than $100,000, obtain a sample very close to the population. The growth in the number of professors covered by the disclosure suggests that for the reference year studied in this paper, 2015, a significant portion of the tenured economics professors will earn over $100,000, providing this study with a large sample.

All papers drew their citation data from two database sources. Moore et al. (1998) and Moore et al. (2007) used the *Social Science Citation Index*, while Bratsberg et al. (2003), Sen et al. (2010) and (2014) used *EconLit*. No studies were found that used the *CitEc* data, presenting an opportunity to test the new database and compare the results to previous studies.

2.1.2 Results

The statistical and practical significance found in the literature for various independent variables in relation to salary is presented below. Most studies done on academic research and salary, such as Moore et al. (1998), build their models with the assumption that salary is based on three productivity inputs: research, teaching, and administrative work. Individual characteristics such as gender, length of career, and professorial rank are often included. Finally, some models include contractual conditions such as unionization or individual university effects.

2.1.2.1 Administrative Duties

A significant portion of a professor's time is devoted to administrative duties. Naturally, this is a difficult variable to measure; it is challenging to tell if a professor shirks or exceeds in these duties. All models which include a measure for administrative duties, such as Sen et al. (2014) and Hamermesh and Pfann (2012), used a similar proxy measurement. Additional responsibilities such as chair or above are flagged, with the logic being that these are an indicator of additional duties which are likely to be rewarded. Sen et al. (2014) only flagged administrative chair positions, excluding any more senior position, while other studies such as Hamermesh and Pfann (2012) flagged all positions at the chair level and above. Across models, the variable had significance at the 1% level. Bratsberg et al. (2003) found such administrative duties had a flat 7.4% salary increase, with an additional 1.3% for each year of the position. Moore et al. (1998) had a reward of 1.7% for each year the position was held. Similar to existing methodology, this paper will measure administrative duties as holding additional responsibility in the position of chair or above.

2.1.2.2 Teaching

Past studies on professorial responsibilities display an issue relating to capturing the effects of teaching. Most universities have a standard professor devote approximately 30% to 40% of their time towards teaching (Jonker and Hicks, 2014). Similarly to administrative duties, this is a difficult variable to measure. Unlike administrative duties, there is no flag which indicates extraordinary teaching. While teacher evaluations are conducted, it is difficult to know if the response indicates effective teaching or ease of course. Additionally, it is hard to tell if the response sample is representative of the population as a whole. Studies often have difficulty finding a proxy for teaching ability and do not include the parameter (Moore et al., 2007). Others use proxies such as receiving a teaching award (Moore et al., 1998) or a survey site such as *ratemyprofessor.com* (Sen et al., 2014), which have potentially large uncertainties relating to whether they are an appropriate proxy. Of those proxies which are used, they are frequently insignificant (Sen et al., 2014) and if not, the coefficient value is often small. Siegfried and White (1973) found the top 15% of teachers earned a 2.5% premium over an average ranked teacher. This small coefficient value suggests that either the measures are not accurate or that teaching is not a variable which is heavily rewarded even though it makes up a significant portion of a professor's job. For those reasons, a proxy for teaching is not included in the approximation for human capital that this paper uses.

2.1.2.3 Years of Experience and Professorial Rank

Years of experience was frequently found to be statistically significant. Siegfried and White (1973) and Bratsberg et al. (2003) found the variable to be significant at the 1% level. For Siegfried and White (1973), each year of experience was associated with a 2.1% salary increase, while Smith and Choundhry (1978) found each year of experience caused a 2.5% salary increase. Moore, Newman, and Turnbull (1998) explored the relationship between seniority and salary and observed the effect publications have on salary. The work re-examines previous work (Ransom, 1976) which finds negative returns to seniority, with seniority defined as the number of years worked at the same institution. Moore et al. (1998) postulate that previous work did not capture research productivity and when included, the negative returns to seniority are mitigated. Typical economic

theory would suggest gains from seniority as human capital is acquired (Ragam and Lipsey, p. 326). Bratsberg et al. (2003) found that two effects exist which relate to years of experience. The first, total experience, had a positive effect of approximately 2.3%. The second, each year at the same institution, had a negative effect of between 0.8 and 1.6%. Overall, Bratsberg et al. (2003) found that each year working at the same institution increased salary by approximately 0.7-1.5%.

Years of experience was not significant when measures of research productivity were included (Moore et al. 1998), while Moore et al. (2007) found strong multicollinearity between professorial rank and years of experience. When professorial rank was included in the model, it was significant at the 5% level and years of experience was not; when rank was removed, years of experience gained statistical significance. Moore et al. (2007) found the number of years since a PhD was obtained to be approximately 16 years, and length of career at current university was approximately 12 years, indicating that there is limited shifting between institutions for professors. Sen et al. (2014) found being an associate professor provided a 5% increase in salary, while being a full professor increased salary by 10%.

2.1.2.4 Gender

Warman, Wooley, and Worswick, (2006) found significant pay discrepancies between male-female cohorts in academia. The literature relating salary to research output had different results; gender was frequently found to be insignificant. Bratsberg et al. (2003), Moore et al. (1998), and Hamermesh and Pfann (2012) included a gender variable but found it to be statistically insignificant. Moore et al. (2007) found gender insignificant until professorial rank was removed. When rank was removed, gender gained significance at the 10% level. Being male was associated with an approximate 10% boost in salary, though this may be biased as no female professors at the highest professorial rank responded to the survey.

Sen et al. (2010) found an indirect relationship between gender and salary; there are differences between male and female professors not just in salary, but significant differences relating to areas such as publications and receiving citations. This paper plans

to test models which look at the interaction between variables in determining salary and so explore the relationship gender has with other independent variables.

2.1.2.5 Unionization

Moore et al. (2007) found significant differences between schools in the United States, which did not have salary regulations, and the United Kingdom, which has strict pay scales. This may mirror conditions between unionized and non-unionized schools in terms of rewards to productivity and salary structures. Sen et al. (2014) found unionization to have little statistical significance when it was included as a dummy variable. This paper will include a unionization dummy variable, but will also conduct analysis where unionization status is used as an interactive term. Unionization may not simply provide a flat increase or reduction in salary, but may affect how other variables, such as years of experience or quantity of research, determine salary.

2.1.2.6 Research

All studies done found some measure of research to be statistically significant in determining salary. Most significance came from number of journal articles published, though a smaller number of studies found citations to be significant measures of research. Frequently, studies broke down articles published by quality of publishing journal. Acknowledging that there were different methods of ranking journals, each publication in the highest ranked journal was found to increase salary by 3.2% (Siegfried and White, 1973), 2.3% (Moore et al., 1998), between 1-3% (Sen et al., 2014), and 1.7% per 10 pages (Bratsberg et al., 2003). Siegfried and White (1997) found a mid-tier publication to be worth 2.8%, while Moore et al. (1998) found the boost to salary to be 1.3% per publication. Research in lower-ranked journals was found to be statistically significant and worth 0.6% (Siegfried and White, 1973), 0.3% (Moore et al., 1998), and 1.1% (Bratsberg et al., 2003). Sen et al. (2014) found publications in lower-ranked journals were usually not significant or if significant then at the 5% level with minor (<1%) impacts on salary. Moore et al. (2007) found all publications to be statistically significant in determining salary for the United States (2.5%), but only publications in high-ranking journals to be significant in the United Kingdom (1.1%). In terms of individual reputation, Hamermesh and Pfann (2012) found that number of publications was insignificant or of very little

value, depending on the model. Hamermesh and Pfann (2012) found that in terms of determining salary, number of publications was significant and had a notable coefficient. While number of publications was usually statistically significant, the results on salary tended to be moderate. Smith and Choundhry (1978) found that articles published had a declining rate of return, suggesting a non-linearity in the variables interaction with salary.

The significance of citations and books published depended on the model being run. Moore et al. (1998) and Bratsberg et al. (2003) both found the variable to be statistically significant and for citations to increase salary by 0.05% and 0.13% respectively. Citations received was removed from some models because of incoherent results, being significant but negative in value (Moore et al., 2007). Sen et al. (2014) found citations to always be insignificant. Hamermesh and Pfann (2012) found citations to be highly significant in determining both reputation and salary, though if the citations received were concentrated or spread across publications did not matter. Bratsberg et al. (2003) found a book publication increased salary by 4.6%, while Sen et al. (2014) found the variable was insignificant.

2.2 Conditions in Ontario

The condition of universities in Ontario, contractual obligations of professors, and universities' reward structures will contextualize this paper, as well as demonstrate the incentive structures faced by economics professors in the province. Martinello (2006) found that economic conditions and university funding level at the time a professor was hired had a significant effect on salary, which lasted their entire career. There is a high correlation between an individual's starting salary and that of their cohort hired at the same time.

A professor's initial salary is based on negotiations they conduct with the university (University of Ottawa, 2016), with acceptance of a job offer being based on the perceived value the professor places on the pecuniary and non-pecuniary benefits in comparison to outside offers. Once a starting salary is accepted, there are five ways a professor can increase compensation from a university. First, they can be promoted to a higher tenure rank. Usually professors become eligible for associate professor after four years of service and full professor after nine years (University of Ottawa, 2016). Promotion is based on contributions to research, teaching and administrative duties, with noticeable contributions required for promotion to associate professors, and significant contributions required for full promotion (University of Ottawa, 2016). Each rank of promotion has a salary floor, so that if a professor's pre-promotion salary is below the salary floor, the promotion increases the professor's salary by the difference (University of Guelph Faculty Association, 2015). Second, the University of Toronto, University of Waterloo, McMaster University, and Queen's University, the former three being non-unionized, offer some form of merit pay (University of Western Ontario Faculty Association, 1998). Third, if a professor believes their pay is out of line with their colleagues, they are not as well compensated for research, or they receive an outside offer and the university is interested in retention of the professor, the professor can ask for a salary anomaly or retention review (University of Waterloo, 2015). Fourth, a professor can leave for a higher paying position at another institution. Finally, the most consistent pay increases come from an annual career increment, a yearly increase up the step of the universities' salary ladder. This incremental increases adjust for inflation, on

top of which they tend to increase salary by a couple thousand dollars (University of Guelph Faculty Association, 2015).

Only a few administrative positions have explicit salary bonuses. For example, holding a chair or directorial position has direct compensation of between $12,000 and $14,000 at the University of Guelph (University of Guelph Faculty Association, 2015). Positions with supplementary remunerations are chair, vice-dean, associate dean, assistant dean, and faculty secretary (University of Ottawa, 2016). Other positions, such as undergraduate supervisor, are not explicitly rewarded. These administrative positions are still included under the administrative duties flag used in this study because administrative work may contribute to one of the indirect methods by which salary can be increased.

There are a number of situations where a professor may be earning a reduced salary. A professor may take unpaid leave or leave which reduces their salary for a period of time. Oftentimes, this leave is only a fraction of a year or is spread over multiple calendar years. These pay reductions vary between universities and because of this, it can be difficult to know the exact amount pay is being reduced. For example, at the University of Ottawa a professor on sabbatical will earn between 50% and 100% of their salary depending on length of career and length of sabbatical (University of Ottawa 2016), whereas at Carleton sabbatical compensation is between 80% and 100% of nominal salary (Carleton University, 2014). For parental leave, the University of Ottawa (2016) and Carleton University (2014) pay 95% of salary less any benefits obtained through the Federal Government's *Employment Insurance Act.* Employment insurance benefits are based on a number of factors, including length of employment and salary, but benefits are capped at $543 a week (Government of Canada, 2016). This paper will correct for reduced salary by using professors' salaries from previous years.

Jonker and Hicks (2014) study different faculties at Ontario universities, including economics, to see where gains in productivity can be had. They look at the expectations and productivity of professors with respect to both teaching and research. Based on faculty contracts tenured professors tend to have equal expectation of time devoted to teaching and research. The standard time breakdown is 40-40-20 in terms of percent of

time devoted to teaching, research, and administrative duties respectively. Jonker and Hicks (2014) found that the average economics professor in Ontario teaches 3.0 courses in the academic year. 27% of faculty are non-publishing, and those non-publishing faculty only teach, on average, 0.9 more courses per academic year than professors who publish.

There are currently institutional changes occurring at universities which are shifting professors away from the previous dynamic of research and teaching (Vajoczki, Fenton, Menard, and Pollen, 2011). There is a rise in sessional lecturers. These are people, usually with a PhD, who are hired to teach a single course (Findlay, 2011). These lecturers have no benefits, are on short term contracts, and receive approximately $5,000-$7,000 for teaching a course (Findlay, 2011). Since lecturers work for a university in a different capacity than tenured or tenure-track professors and are not paid for or expected to participate in research, lecturers are not included in this study.

In addition to the rise in sessional lecturers, there has also been a rise in teaching professors (Chiose, 2015). These are tenure or tenure-track professors hired with the intent that they devote a significant portion of their time to teaching, with no responsibilities relating to research (Vajoczki et al., 2011). Vajoczki et al. (2011) reported that 12 of the 20 universities which were included in this study have teaching stream faculty. The model of human capital used in this study is based on the theory that professors spend a significant amount of their time conducting research. Because of this, any professors who are indicated as teaching stream are removed from the study.

Weingarten, Hicks, Jonker, and Liu (2013) and Maclean's (2016) provide a ranking of universities. Universities are determined to be either undergraduate-focused, comprehensive, or research-intensive institutions. Three of the universities in this study have faculty who are non-unionized (Sen et al., 2014). This paper will determine if there are differences in pay based on either research intensity of university or unionization status, and whether or not this affects returns from variables such as research.

2.3 Bibliometric Measures

The literature which attempts to quantify research overwhelmingly uses quantity of journal articles published, and to a lesser extent citations received, as a proxy for research. Typically, quantity of publications is broken down by journal importance or quality. There is a growing skepticism related to the current peer reviewed journal system (The Economist, 2017), part of which questions how research output is measured.

Hirsch (2005) proposed a bibliometric method of measuring research impact by combining quantity and quality of publications. Hirsch proposed the h-index which gives a score *h*, which is the largest integer where the author has *h* papers which have at least *h* citations. Regardless of total number of publications or citations, the proposal is that any two academics with a similar h-index have made a similar level of contribution to their field. This measure is meant to avoid situations where a professor has published many articles which were not widely regarded or a professor who rarely publishes but has one highly cited paper. Since Hirsch's proposal, other bibliometric measures such as the i10-index have been suggested. The i10-index is based on the assumption that there are a minimum number of citations a publication has to receive to be considered a quality paper. The index counts the number of publications an author has which have been cited 10 times (Google Scholar, 2011).

Other studies, such as Yong (2014), have questioned the degree to which the h-index quantifies value better than more basic measures. Looking at mathematicians, Yong (2014) found that the h-index is not a particularly strong indicator of ability or prestige in the field. Yong (2014) found that the ordinal relation between professors based on number of citations is often as accurate as the h-index, and also found that when comparing two academics with different *h* values, number of citations can often provide the differentiating factor. The issue with comparing such studies is there is no objective measure of quality, and while Hirsch presents his argument about the validity of the h-index, there is no direct comparison to validate that the quality is better than any other measure. The Yong (2014) study, which focuses on publications and academics in the field of physics, presents a number of distinguished physics researchers and their corresponding h-index value to indicate validity.

One advantage this paper has in testing various measures of research is that the dependant variable used is salary. Other indicators of research quality, such as awards received (Yong, 2014), or reputation (Hirsch, 2005), are either rarely occurring events or subjective. Salary allows for a high degree of differentiation between individuals. The disadvantage is that there are other factors which have to be accounted for as influential on salary. If salary is an accurate reflection of research ability, this paper will be able to see which research indicators best capture ability. If salary does not reflect research achievements, this paper should highlight that discrepancy. This paper tests both the calculated bibliometric measures as well as quantity of publications, and citations received. Additionally, because these measures have the possibility of being highly correlated with years of activity, variables which look at productivity and citations received on a yearly basis will also be used.

Weingarten et al. (2013) and Maclean's (2016) both provide rankings of university quality, with one of the main indicators being research intensity of the institution. Weingarten et al. (2013) use the h-index as a measure of academic research, whereas Maclean's uses weighted citations received and total publications produced. These differences in methodology help demonstrate that there is no standard or objective way to measure research output.

3 Methodology

3.1 Data Sources

Professor salary information was obtained through the Ontario Provincial Government's *Public Sector Salary Disclosure Act*, colloquially referred to as a Sunshine List (Government of Ontario, 2017). Released annually for public sector employees earning $100,000 or more, the disclosure provides data on name, sector, employer, job title, and salary. The Act includes information for faculty employed at Ontario universities who meet the annual income threshold. The salary disclosure used primarily in this study was for the 2015 calendar year, released on March 31, 2016 and downloaded for use in April 2016 (Government of Ontario, 2016a). The list contains 115,533 entries for reference year 2015, of which 17,066 are for the university sector. This includes tenured and tenure-track professors for all department types, including economics, as well as other university positions such as non-tenured faculty, directors, and librarians (Government of Ontario, 2016b). At any given time, a number of professors are on various types of leave that reduce their income. To capture these professors' non-reduced salaries, it is necessary to supplement 2015 data with the 2014 (Government of Ontario, 2015) and 2013 (Government of Ontario, 2014) salary disclosure for some professors.

For each faculty member, it is the responsibility of the employing institution to fill out a *Record of Employees' Salaries and Benefits*. There are limited guidelines provided on how specific a job title should be and the conventions that should be followed. Thus, obtaining faculty and professorial rank directly through the job title parameter was challenging due to inconsistency of reporting among universities. The required information was available for some institutions but not for others. For example, professors employed at the University of Toronto had job titles indicating department such as *Professor of Economics*, or *Assistant Professor of Economics* while other institutions, such as Algoma University, did not distinguish faculty by department and had more generic job titles such as *Associate Professor*. Further complicating the matter, some universities, such as Wilfrid Laurier University, only listed job title as *Faculty*, with no distinguishing characteristics.

Faculty information for tenured and tenure-track professors was collected from departmental websites[1]. The information was collected primarily between January and February 2016, with spot verification conducted afterwards. There were no discrepancies between the Ontario Salary Disclosure and the faculty website regarding the university a professor was associated with, indicating that switching institutions in that two month period was not a serious concern to data quality. To qualify as an economics professor, the professor had to be listed under the university's faculty of economics webpage. The only exceptions were smaller universities which did not have depth of faculty to have such distinct departments, in which case if they were listed as an economics professor they were included.

Only information on tenured or tenure-track professors was collected, allowing for a base of comparison as previous literature uses the same categorization. Professorial ranks are standard across Ontario. There are three ranks: the lowest rank being assistant professor, mid-ranked associate professors, and the highest ranked full professors. There are less rigorous definitions of what being a lecturer or non-tenured faculty member entails. The purpose of this paper is to study research. A significant portion of non-tenured faculty are hired to lecture and teach courses, whereas for tenured faculty completing research is considered part of their mandate. Tenured and tenure-track faculty are actively engaging in research and have a base of past contributions. Finally, part of the reason to hire non-tenured faculty is to lower costs. Non-tenured faculty have fewer responsibilities and lack seniority; they have lower salaries (Chiose, 2015). It is not likely that a significant portion of contract professors or non-tenured faculty earn over $100,000 or conduct research, and thus they are not included in the frame of study.

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[1] Western University had two colleges which report as separate institutions to the Ontario Salary Disclosure and that had their own website. The two colleges, Kings College (King's University College & CUPE, 2015) and Huron College (Huron University College Executive Board and HUCFA, 2015), award Western University degrees to graduates, but have independent faculty organizations and bargaining agreements. As such they were kept as two distinct entities in the dataset.

In addition to professorial rank, demographic information was collected for each faculty member, including whether or not they had additional responsibilities, such as holding a chair position or being a unit head. Gender of each faculty member was verified using the picture from the department website. If a picture was not readily available and the name was unisex, an internet search was conducted. Information on university of attendance was taken from the professors' Curriculum Vitae (CV). Most faculty members had a link to their CV on the department website homepage; if this was not available, an internet search was conducted. Through this process, degree information was found for all but 24 professors.

Publication information was sourced from the *CitEc* website. *CitEc* is a newly developed database providing citation information for authors and publications using information from the *RePEc* (2017) digital library, which is associated with the *IDEAS* (2017) website. Hosted by the research division of the Federal Reserve Bank of St. Louis, the *IDEAS* database is the largest bibliographic database dedicated to the field of Economics. The database is available free of charge and maintained on a volunteer basis. The *CitEc* website, founded in 2001, contains information for over 950,000 economic papers, with more than 10 million citations registered in their database (*CitEc*, 2017). The scope of this paper is ideal for testing a new database. *CitEc* is more than a catalogue; it is a database of economic publication information with the distinction being that the website does not simply categorize the items, but draws relationships between them. It links citations to their referencing articles, as well as to the author. A system is created which contains a large amount of para and metadata. *CitEc* data is produced by taking metadata from the *RePEc* site, downloading publicly available documents, and receiving reference data from publishers (Zimmermann, 2013). All data and articles are converted to text, parsed, and a fuzzy matching algorithm links articles' and papers' references, creating a network of interactions (Zimmermann, 2013). While there are a large number of other databases for academic work, including *Web of Science* and *Econlit*, *CitEc* offers its services free of charge. Using the *CitEc* database is an experiment in data mining and touches on the idea of big data and data integration.

3.2 Data Linkage

The first portion of linkage was automated and completed between the Ontario Salary Disclosure and data from departmental websites. Automated linkage was done using direct match on last name, first name, and university. There were no duplicate values, and with the stringent requirements of all three criteria matching, the links made were of high quality. As a result of the automated linkage process, 274 of the 427 faculty in the data set, or 64%, were matched.

For the remaining 36% of faculty, linkage was conducted manually. It would have been possible to achieve a higher linkage rate by relaxing linkage restrictions at the expense of a lower quality of links. For example, only linking by last name would have resulted in duplicate links, one name linking to multiple data points, creating inaccuracies in the data, or data incorrectly linking between points. The small number of remaining links made it feasible to create the matches manually and ensure quality links were made. If the dataset had been larger, either more resources would have been required or the loosening of restrictions would have been tested.

During the manual linkage process, the last name was used as the primary key for linkage between the two files. If matched, first name and university were confirmed and a link was made. Most cases of linkage were fairly routine. The reason cases were not picked up by automatic linkage included minor variations in first name spelling, use of a second name as first name, grammatical formatting such as dashes, or inclusion/exclusion of a second name or initial.

In cases where a match was still not made, missing individuals were compared to their university on the Ontario Salary Disclosure. The Ontario Salary Disclosure was sorted alphabetically and filtered by university, and then the faculty members were searched for. This captured cases where the last name had been slightly misspelled.

After both the automated and manual linkage, approximately 89% of professors, 380 of 427, from university faculty lists were linked to the Ontario Salary Disclosure, while 47 remained unlinked.

There were no discrepancies between university of employment on the 2015 Ontario Salary Disclosure and university of employment based on university faculty lists. This means there were no cases of switching employment during the time lag between the Ontario Salary Disclosure release and the recording of faculty information from departmental websites. This helps validate the claim that the slight difference in reference period of each data source did not lead to an informational mismatch.

The next step corrected the salary of professors who were on leave for at least part of the 2015 reference period. The faculty list was joined to previous years' salary disclosures. Leave did not necessarily occur during a single calendar year, so that salary was compared to both the 2014 and 2013 calendar years. If salary was higher in 2014 or 2013 than in 2015, that higher salary became the compensation which was used in this study. In most cases, when the leave occurred in 2015, the highest salary was from 2014; in cases where leave was split between the 2014 and 2015 calendar years, the 2013 salary was used. The only exception was for professors from the University of Guelph, of which a disproportional number of professors had a reduction in salary for 2015. The University of Guelph had 28 economics professors, of which 26 have salary information and 23 professors were present in the 2014 salary disclosure. Of those 23 professors, 21 had a salary decrease between 2014 and 2015. Only two professors had a decrease of over 3.5%. There was no apparent collective agreement or contractual reason for this almost universal decrease, and so is more likely due to how the administrative offices reported salary then actual change in earnings. Only two professors from the University of Guelph, who had additional decreases due to sabbatical, had their salary corrected for in this study's frame. Overall, the processes led to the modification of 56 salary entries, as well as the addition of 8 professors who did not earn over $100,000 in 2015 but did in 2014 or 2013.

Reduction in salary may be due to loss of an administrative position, such as director, which has a direct salary benefit. The *Internet Archive* (2017) was used to see if this was the case. The *Internet Archive* takes a snapshot of internet webpages at certain points in time, allowing them to be viewed as they were in the past. The 2014 and 2013 versions of faculty webpages were used to ensure the professor did not lose a paid administrative position. The specific archived dates used are presented in Appendix Table

13. Four professors were found to have their salary reduced due to losing a paid administrative position and so their reduced salaries were not modified. Two had previously been directors, while two had been administrative chairs.

31 salaries were modified based on the 2014 salary disclose, while 21 were modified based on the 2013 disclose. Four professors gained a salary value based on 2014 data, and four had salary added to the frame based on 2013 data. For simplicity, the modified or assigned salary was equal to salary from either 2014 or 2013. The professor's full salary for 2015 would likely be higher, as there are yearly increments as well as adjustments for inflation, but calculating these for individuals in a variety of situations and universities was not feasible. With these changes, 388 of the 427 economics professors had an assigned salary of $100,000 or over.

The *CitEc* website has an application program interface (API) which allows for a limited amount of data querying (RePEc Blog, 2016), but not to the extent that it could be used to attempt an automated linkage with salary and faculty data. The API allows users to query publication information, including citation data for an individual paper, but not author information. For a larger scale project, it may be possible to automate linkage. Issues related to data formatting would require the first linkage to be done manually. As such, automation would only be appropriate for larger projects such as time series analysis. For this paper, attempts at automation would have limited benefit and as a result, linkage was done manually.

While time intensive, the quality of the linkage was high. The professor's last name was looked up under the author search function. The author of interest was then selected from a list of authors with the same last name, on the basis of first name. Once selected, the website linked to the author citation information. Additionally, this page also contained university of association which was used in tandem with first name and last name to confirm a correct link was made. Since the previous linkage between the Ontario Salary Disclosure and faculty websites had been completed, information was already available on university of employment, legal name, as well as any other name the professor may be associated with, such as middle names, providing significant detail for linkage. Due to this, it is unlikely that any authors were linked incorrectly; it is not likely

that an author in the dataset was incorrectly given another's citation information. Various spot-checks and routinely working with the data confirmed this. This methodology linked 314 professors to citation data.

A number of authors did not appear when searched by name in the *CitEc* database, but searching for an article by title provided a link to their author profile. The remaining 113 authors were then searched for based on articles written. The article titles were obtained through professors' CVs. This method produced an additional 20 links. Of the 427 professors who constitute the frame for this study, 334 were linked to *CitEc* bibliometric information, leaving 93 (22%) that remained unlinked.

It is difficult to determine, to an exact degree, whether unlinked values are accurate and represent an unpublished professor, or if they reveal a weakness in the data source. Jonker and Hicks (2014) found that approximately 27% of economics professors were considered non-publishing. Their definition of non-publishing, not receiving a tri-council grant and having no publications in the last 3 years, is a more restrictive definition than the one used for this study, which considers any publications listed on the *CitEc* database and so provides a larger timeframe to be considered publishing. Due to the one year data gap between the reference period used in this paper and the Jonker and Hicks paper, the fact that approximately 22% are reported as non-publishing in the dataset used for this paper suggests either differences in methodology concerning what is considered a publication, or bibliometric source data set differences.

There are two likely scenarios in which a professor may be unlinked to citation data, meaning they are not truly conducting academic research. The first is that the professors are new hires who are just beginning their tenure and have not yet made serious academic contributions. These professors would likely have the rank of assistant and be in the lower tail of salary distribution. The second explanation could be an increase in the number of professors who are solely focused on teaching and who are not mandated to complete research. There has been a rise in the number of contract professors hired, and professors hired solely to teach (Chiose, 2015). Though this level of detail is not provided by all institutions included in the dataset, the University of Toronto includes significant information for job titles in the Ontario Salary Disclosure. In their

submission, four of their professors are listed as teaching professors. These professors are well paid, with an average salary of $154,458 even though they are not expected to produce research. This may be distinguished from contract professors who are not tenured and are hired on a per course basis, earning a compensation of approximately $7,000 a course (Chiose, 2015).

Conversely, there are professors who produce research and are not picked up by the *CitEc* system. *CitEc* has data loaded which has not yet been processed by their system. This means that for some professors, their articles and research are on the *CitEc* website when searched for but they do not have an author profile to collect bibliographic information. The article exists in a dumb state, where no citation or bibliographic information is linked, so the author and work are not active on the database. In these cases, it is clear that the values are being missed. Whether this is significant and how it should be dealt with is explored in the data analysis and modeling sections of this paper.

4 Data Description and Modeling

4.1 Variable Description

A full list of variables used in this study and their descriptions can be found in Appendix Table 1. In this study, 23 variables were used across various models. Three of these variables measured institutional characteristics: unionization status, university type based on the Weingarten et al. (2013) paper produced for the Higher Education Quality Council of Ontario (HEQCO), and Maclean's university type. Both measures of university type relate to the research intensity of the institution. The university types are documented in Table 1, which includes all professors identified by department websites. The salary is the average salary for those professors who earned $100,000 or more. For reasons discussed below, not all professors were part of the final frame.

In Ontario, there are three non-unionized universities which have economics departments: the University of Toronto, McMaster University, and the University of Waterloo (Sen et al., 2014). Tenured faculty at the other 17 institutions are represented by a union. The HEQCO categorize four types of universities. Relating to the category coding presented in Table 1, 3 corresponds to universities which are undergraduate-focused, 2 corresponds to comprehensive or mixed schools, while 1 corresponds to a doctoral or research-intensive university. There is a special category, 0, for the University of Toronto as it is regarded as extraordinarily research-intensive. Maclean's distinguishes universities into three types. The University of Toronto is not given its own category and is included in the doctoral or research-intensive category. While Maclean's university types are tested in this paper, the HEQCO results are used as a base when categorizing universities. Unless otherwise specified, any reference by this paper to a university as undergraduate, comprehensive, research-intensive, or to the University of Toronto, is based on the HEQCO university categorization.

The dependent variable used is this study is *Salary*. Salary in this case refers purely to wages paid. It does not include any additional benefits such as value of vacation or sick leave, or any pension or health insurance contributions the university makes of behalf on faculty members. Taxable benefits are not considered salary, and are not included in this

study. Overall, taxable benefits were received by 343 professors, averaging a minor amount of less than $530 per professor. An independent dummy variable, *Salary Adjustment*, is included in all models. This variable flags professors whose salaries were adjusted to their 2014 or 2013 unreduced salary. These salaries are lower than what the professor's true non-reduced 2015 salary would be, and this variable is included to capture that discrepancy.

Professorial rank is included as an independent categorical variable in select models. The variable groups professors by tenure or tenure-track positions: assistant, associate, or full professor (Pettigrew, 2011). Due to potential overlap with *Salary,* it is not clear whether it is appropriate to include *Professorial rank* in the regression analysis. As a precautionary measure, models are tested both with and without this variable, to study what its impact is and whether or not it is an appropriate inclusion.

Additional administrative duties are represented by an *Administrative* dummy variable. Years of experience are measured through a variable, *Years*, whose specifications are defined in the next section. The final individual characteristic in the model is a *Female* dummy variable. There are two types of bibliometric regressors, those relating to publication quantity and those relating to measures of quality. The *h-index* and *i10-index* are mixed measures, relating to both publication count and quality.

Table 1. Economics universities with summary details

University	HEQCO	Maclean's	Union	Number of Professors	Average Salary ($)
University of Toronto	0	1	No	67	172,918
U. of Western Ontario	1	1	Yes	30	167,491
McMaster University	1	1	No	29	170,551
Queen's University	1	1	Yes	29	180,717
University of Ottawa	1	1	Yes	26	150,890
King's College - Western	1	1	Yes	7	140,810
Huron College - Western	1	1	Yes	4	134,591
University of Waterloo	1	2	No	29	145,824
University of Guelph	1	2	Yes	28	159,308
Ryerson University	2	2	Yes	20	148,859
University of Windsor	2	2	Yes	13	134,672
York University	2	2	Yes	47	157,884
Carleton University	2	2	Yes	30	144,367
Wilfrid Laurier University	3	2	Yes	28	153,155
Brock University	3	2	Yes	17	156,046
Laurentian University	3	3	Yes	8	155,164
Lakehead University	3	3	Yes	5	145,161
Trent University	3	3	Yes	5	161,043
Nipissing University	3	3	Yes	2	129,593
Algoma University	3	3	Yes	3	116,701

4.2 Data Description

For 2015, the population of economics professors in Ontario consists of 427 tenured or tenure-track professors. 91% of the population have salaries of $100,000 or more, while 78% link to the *CitEc* bibliometric database. 308 of the 380 professors with financial information available also linked to bibliometric data. Only 49% of the 39 professors earning less than $100,000 linked to the *CitEc* database.

Three groups of professors were dropped from the dataset. The first is professors from Queen's University and the University of Toronto who were cross appointed to their respective business or law schools. Seven professors were dropped, of whom five had bibliometric data and five had salary information. The behaviour and salaries of these professors were different enough to warrant removal. The average salary of a professor in the dataset was $158,953, while the average salary of these professors was $276,858. Different faculties have significantly different rates for publishing and citing work, and so comparisons cannot be made with professors who spend a significant amount of time in non-economics departments (Mryglod, Kenna, Holovatch, and Berche, 2013). Only business schools were explicitly checked for cross appointments. This is due to the high salaries business schools pay (Millar, 2008). In other cases, the professor was only dropped if it was explicitly stated on their university's economics department website that they were a cross appointment. There exists the possibility that some economics professors were cross appointed to non-business schools, without it being recorded on the departmental website. In these cases, the professors remained in sample. Some of the smaller universities combine their financial and economic departments, or do not have a dedicated economics department in their arts faculty. These cases are seen as fundamentally different than the above situations, and as long as these professors were indicated to be economics professors, they remained in the frame.

The next group dropped consisted of any professor with an administrative rank of dean, provost, or vice president. Similar to professors cross appointed to business schools, the rates of compensation when compared to career length and publication for these professors was different enough so as to exclude them from the final dataset. The compensation for a senior position, such as provost, is significantly higher, and the duties

are dissimilar to other tenured faculty (The Board of Governors of McMaster University, 2012). For example, a provost spends a significant portion of their time overseeing the institution, contributes to the universities public profile, and makes key academic decisions (The Board of Governors of McMaster University, 2012). The productivity expectations of the professor no longer heavily relate to teaching and research, so these individuals are removed. In total, five professors were removed for occupying these senior administrative positions.

The final group dropped were professors focused solely on teaching. The focus of this paper is measuring the effect of research on salary. While most professors split their time among administrative duties, research, and teaching, there is a segment who do not contribute research, instead teaching full time. This subset of the population does not fit the human capital model derived for this study, outlined in Section 4.3, and including them in the model would impact the returns to research for the entire sample. Twelve professors were dropped from four universities. Of those dropped, seven were from the University of Toronto. Vajoczki et al., (2011) found twelve universities in this paper's sample have teaching professors, but only four universities were identified in this study as having lecturing professors. All lecturers were identified based on their job title description on the Ontario Salary Disclosure form. This distinction was not always apparent on the faculty website. As previously discussed, there is a large variation in job title reporting across universities. There are potentially other professors who are teaching professors, but there is no way to confirm this. After removal of the three groups mentioned, the sample consisted of 403 professors, 366 had salary information while 324 had bibliometric data. 305 professors had both salary and bibliometric information, forming the frame which was used in this study. Similarly to Table 1, Appendix Table 2 provides distribution and average salary for professors by university.

For analysis to be conducted, it is important that the bibliometric dataset used accurately reflects true publications. Practically, this means the bibliometric data provided by the *CitEc* database needs to be unbiased. Linking the frame of this study to *CitEc* data found 22% of the population to be non-publishing. Previous work by Jonker and Hicks (2014) similarly found 27% of Ontario professors were non-publishing. No database is complete, and all have different methodology and classification. Of those who

did not link to bibliometric data, a segment will be legitimately non-publishing and may be teaching focused. However, there are professors who have publications which are missing from the database. It is important for the quality of the data that those excluded are missing on a random basis.

There are 93 professors who do not have bibliometric data in the *CitEc* database. 38 of those professors did not have publications associated with them on their faculty profile, on their university's department website, or their CV. These professors tend to fit the profile of what constitutes professors without a publication history; many appear to be either teaching professors or in the earlier stages of their careers. Of the 39 professors making less than $100,000, approximately 51% had no bibliometric data. Twelve professors were removed from the frame for being teaching focused, nine of those professors had no *CitEc* bibliometric data, of which five had no publication association on the faculty website or CV. Of the 93 professors without bibliometric data, 60 would be in the frame if they had linked to bibliometric data, meaning they have salary information and would not be excluded for any of the above reasons. 17 of those professors appear to not have a history of publishing work, leaving 43 professors potentially missing from the frame due to *CitEc* incompleteness. Some of these professors had completed a significant body of economic research. These omissions are due to the fact that the *CitEc* website has not linked to all economics publications. Often this is caused by database restrictions or restrictions in accessing the full publication to conduct bibliometric linkage between files.

The salary variable is available for 305 professors in this study's frame with bibliometric indicators, as well as the 43 professors who appear to be publishing but are without bibliometric data. Comparing these two sets of professors indicates a high degree of similarity. 25% of those with *CitEc* data have the administrative flag, compared to 21% of those without *CitEc* data. Of those with bibliometric data, 40% were full professors, 44% associate professors, and 16% assistant professors, compared to 26%, 56%, and 19% respectively for those with no bibliometric indicators. 80% of those with bibliometric data were male, while 91% of those without bibliometric data were male. The mean salary for those with bibliometric data is $161,838, compared to $152,940 for those without. T-tests indicate none of the differences between those with bibliometric data and those missing

bibliometric data were statistically significant, except for gender which was significant at the 10% level.

University contracts indicate that a significant determinant of salary is research output (Carleton University, 2017). For professors in the sample, salary and the h-index have a correlation of 0.6327. While not definitive, if the distribution of salary for professors with and without bibliometric information is similar, it helps indicate a randomness to those whose bibliometric information is missing from the database. The Kolmogorov-Smirnov (KS) test studies the empirical distribution function of two samples. This goodness of fit test uses the distribution of two data sets and determines with what level of statistical significance the cumulative distribution of both sets can be seen as the same. The null hypothesis is that the two distributions are the same; the alternative is that they are not. Using *Salary,* the KS test was used to determine if professors with missing publication information are significantly different from those who have bibliometric data. If there is a significant difference, there may be a bias in how data is loaded into the *CitEc* database, which would have to be controlled for.

The results of the KS test presented in Table 2 suggest the null hypothesis that the two populations do not have a significantly different distribution cannot be rejected at any statistically significant level. These tests are all constrained due to the sample of those missing *CitEc* data being relatively small. The results do not prove that there is no bias to those missing *CitEc* data, nor do they reject the idea that the two subsets of data are the same. This allows for the continued use of the *CitEc* database for analysis.

Table 2. Kolmogorov- Smirnov test for missing CitEc data

Standard		0. 306
Corrected	**P value**	0. 244
Exact		0. 273
***CitEc* Data**	**N**	305
Missing *CitEc*		43

Figure 1 presents the distribution of professors salaries before any dropping of entries occurs. There are four distinct outliers with salaries over $300,000. These three professors are dropped due to cross appointments with business schools or due to holding senior administrative positions. Before any filtering or removal is done, the data set has an extreme rightward skewness of 1.73 and kurtosis with excess of 7.13, indicating a heavy effect on the dataset from these outliers. Once the various groups are dropped, including professors with no bibliometric data and who cannot be included in the regression analysis, there is still a moderate skewness of 0.62 and excess kurtosis of 0.60. The mean salary is $159,357, while the median salary is $157,940. The skewness occurs in the extreme tail end of the data. The 25th and 75th percentile are both approximately $20,000 from the median, while the 5th percentile is $43,000 from the median compared to the 95th percentile which is $54,000 from the median.

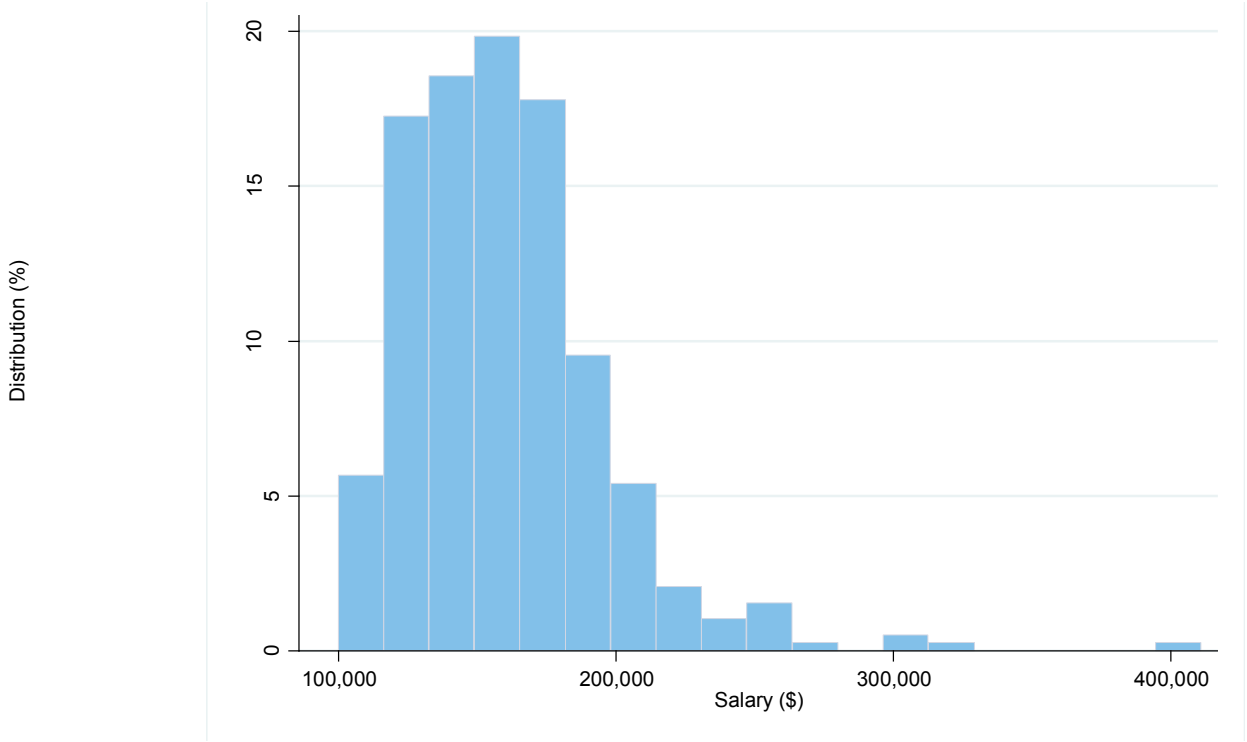

Figure 1. Distribution of Salaries

Table 3 presents descriptive statistics for various dependent and independent variables. The bibliometric indicators all have high positive skewness and large kurtosis, indicating a subset of professors who have an extremely high productivity in terms of both publications and how often their work is cited. Before removal of professors from the three dropped groups, some of whom were outliers, *Salary* also had a high skewness and was affected by outliers. There was a strong justification for removing those professors; they were not dropped simply for being outliers. The same justification is not apparent for other professors in the tail of the distribution. Removing them risks over massaging the data, and so they remain in the final dataset.

Table 3. Regression variables, descriptive statistics

Variable	1%	5%	25%	Median	75%	95%	99%	Mean	Std.	Skewness	Kurtosis
Papers	0	1	5	11	22	50	110	17	23	3.8	23
Articles	0	2	5	10	18	42	94	15	19	4.8	39.6
Publications	2	4	12	21	40	90	205	32	39	4.5	32.9
Publications per year	0.3	0.6	1.0	1.6	2.4	4.0	7.3	1.9	1.3	2.1	9.5
Citations	0	3	40	112	268	1200	2508	272	523	5.2	40.8
Citations per year	0.0	0.5	3.7	8.4	16.5	50.5	89.5	13.8	18	3.5	18.3
Recent citations	0	0	7	17	36	135	337	36	63	4.3	25.5
h-index	0	1	3	5	8	15	22	6	5	1.5	6.0
i10-index	0	0	1	3	6	19	33	5	7	3.1	16.0
Years	1	4	9	16	26	37	45	18	11	0.6	2.4
Salary (Thousands)	**103**	**115**	**136**	**158**	**177**	**212**	**254**	**159**	**31**	**0.6**	**3.6**

Table 4 presents correlation and R-squared values between years of experience and the bibliometric indicators, where correlation is the root of the R-squared value. Variables such as articles, publications, and citations received all have a relatively high correlation with the years of experience variable. The h-index, which was designed to better indicate research output, has a very high correlation with years of experience. Variables which look at productivity per year such as citation productivity, publication productivity, and recent citations have very little correlation with *Years*. These variables better isolate value of research from length of career. *Other writing*, which includes books and chapters published, is likely insignificant. Only 52 professors have any value for *Other writing*, with an average of 3.9 works produced. Likewise, on average when compared to total citations received, number of self-citations is very small.

Table 4. Correlation between years of experience and bibliometric variables

	Articles	Papers	All Pubs.	Citations	Recent Citations	i10-index	h-index	Citation Prod.	Pub. Prod.	All Other Writing
Correlation years	0.55	0.35	0.46	0.39	0.23	0.45	0.51	0.18	-0.07	0.27
R-squared years	0.30	0.12	0.21	0.15	0.05	0.20	0.26	0.03	0.00	0.07

The 427 professors included in the dataset were distributed across 20 universities. While the average number of faculty is approximately 21, there is a large standard deviation in the size of economics departments. More research-intensive universities tend to be associated with more tenured or tenure-track professors, which is logical considering these schools will be contributing more aggregate research.

Of the 427 professors in scope for this study, 144 have the rank of full professor, 186 are associate professors, and 97 are assistant professors. Approximately 22% of all faculty are female. At the full professor rank, 18 professors are female, while 49 are female at the associate level, and 28 are female at the assistant level. Female professors account for 44% of faculty earning less than $100,000 and who are not on the Ontario Salary Disclosure.

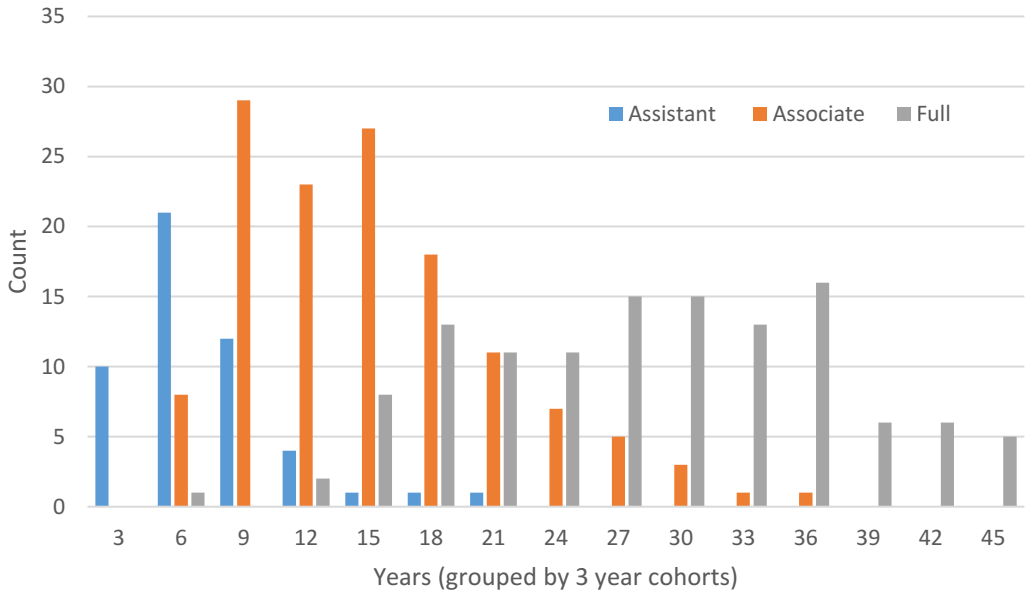

Figure 2. Distribution of professors by years of activity

Based on faculty compensation agreements, it is clear both promotion and salary increases are heavily based on years of experience and research contribution (Carleton University, 2017). Instead of being an input into compensation, professorial rank may behave like salary received and be an output determined by research and years of experience. There is an argument to be made that professorial rank should not be included in any regression analysis where the dependent variable is salary, due to high multicollinearity with years and research. If included, it will be measuring the same underlying factors. Figure 2 shows counts of professors' by professorial rank, across years of experience. Over time all professors tend to transition from assistant to associate and then to full professorship. There is significant overlap in the timeframe of when professors are promoted. The risk of not including rank is that by excluding the variable endogeneity is brought into the model; that promotion also takes into account factors which are excluded from the model and by not including professorial rank the significance of the regression is biased. It is not clear whether the variable should be included, so models will be tested both with and without the variable to observe what the effects are. For this study, years of experience is measured as the time from first publication to 2015. As a result, there is the possibility that time as a professor is cut off, with a professor's first publication happening after obtaining the position of assistant professor. Conversely, it is possible that a professor's first publication occurred before they had received tenure or were tenure-track, adding time to their years of experience. The years of experience variable is not the same as length of career in a tenure or tenure-track position.

Also collected was the length of research career. This is the time from first to last publication. The average years of experience was 18 years, while the average number of research years was 16. This means that the average length of time to a professor's last publication is two years. While the average is quite low, the distribution is heavily skewed. The median professor has published in the past year, while the professor at the 75th percentile has not published in 3 years, and the professor at the 95th percentile has not published in 6 years.

All summary statistics below are for the 305 professors who make up the sample used for regression analysis. Male professors had an average salary of approximately $162,000 while the average salary for a female professor was approximately $150,000.

Female professors averaged 14.5 active years, while male professors averaged 19.1 active years. The average female professor had an h-index of 4.7, a citation productivity of 10 citations per year, recent productivity of 20 citations, and a career average 133 citations. The average male professor had an h-index of 6.3, a citation productivity of 15 citations per year, recent productivity of 39 citations, and a career average 294 citations. The differences for salary and years active were significant at the 1% level, while the differences for all citation related metrics were significant at the 5% or 10% level.

76 professors were flagged as occupying an administrative position, indicating additional administrative responsibility. The flag is used for those professors who have chair positions, but also for directors, co-directors, associate deans, and departmental heads. Those with the position of provost, vice president, or dean were excluded from the study. Of those with the administrative position flag, 41 were full professors, 34 associate professors, and 1 was an assistant professor.

Descriptive statistics for unionized universities are presented in Table 5, and for non-unionized universities in Table 6. There are large differences in salaries between the two school types, significant for two professorial ranks. Non-unionized schools have a significantly higher salary at the assistant and full professor rank. The difference for associate professors is not significant at the 5% level. The average salary for a non-unionized full professor is $196,097, while for a unionized full professor it is $178,847. There is no significant difference between average years of experience for unionized and non-unionized universities, either overall or comparing professorial ranks. Differences in citations received were significant at the 5% level for full professors, with non-unionized professors having on average 692 citations compared to 478 from their unionized counterparts. Non-unionized associate professors had significantly more citations than their unionized counterparts. There was no significant difference in citations between assistant professors. Similar to citations, there is a significant difference in h-index score between university types at the two highest professorial ranks, but no significant difference at the assistant rank. Across all professorial ranks, there was no difference between unionized and non-unionized universities in terms of articles published. This suggests that professors at both university types publish at a similar rate, but more senior

professors at non-unionized schools tend to receive more citations than their unionized counterparts.

Table 5. Unionized universities, descriptive statistics

Professorial Rank	N	Salary ($)	Articles	h-index	i10-index	Citations	Recent Citations	Years	Citation Prod.	Pub. Prod.
Full Prof.	88	178,847	27.3	8.7	8.8	478	51	27	17.9	2.0
Associate Prof.	100	147,738	8.9	4.4	2.5	101	18	14	8.6	1.8
Assistant Prof.	28	118,581	2.8	2.6	1.1	40	12	7	6.5	1.8

Table 6. Non-unionized universities, descriptive statistics

Professorial Rank	N	Salary ($)	Articles	h-index	i10-index	Citations	Recent Citations	Years	Citation Prod.	Pub. Prod.
Full Prof.	34	196,097	24.0	10.7	11.2	692	90	28	28.6	2.2
Associate Prof.	33	157,594	8.9	5.6	4.2	169	29	13	13.9	2.0
Assistant Prof.	22	131,970	2.6	2.5	1.0	32	13	5	6.6	2.0

All non-unionized universities are either the University of Toronto or a HEQCO research-intensive university. This leads to the possibility that non-union schools are not significantly different than unionized universities except for being higher ranked in terms of research intensity. To test this, average variables for the six universities which are unionized and research-intensive are presented in Table 7. The spread in values became smaller in comparison to those of non-unionized universities, though the ordinal size tends to remain the same. Differences in salary maintain significance for full and assistant professors. The difference for associate professors remains statistically insignificant. This indicates potential differences between unionized and non-unionized universities which are not due to research intensity type.

Table 7. Research-intensive unionized universities, descriptive statistics

Professorial Rank	N	Salary ($)	Articles	h-index	i10-index	Citations	Recent Citations	Years	Citation Prod.	Pub. Prod.
Full Prof.	48	181,440	31.2	10.4	11.2	659	73	28	24.3	2.4
Associate Prof.	40	151,391	8.9	4.9	3.2	127	23	14	10.0	1.8
Assistant Prof.	8	120,982	3.1	2.5	0.8	38	10	9	4.8	1.7

Of the three non-unionized universities, HEQCO considers the University of Toronto to be in its own research category. To ensure the differences between unionized and non-unionized schools are not simply the result of the University of Toronto behaving differently from the University of Waterloo and McMaster University, the distribution of the University of Toronto is compared to the other two non-unionized universities. The results in Table 8 suggest that for most variables, the null hypothesis that the distributions come from the same population cannot be rejected. There are two exceptions, the citations variable which finds the null hypothesis can be rejected at the 5% level, and the salary variable where the null hypothesis can be rejected at the 10% level. When running regression models, specifically those which look at unionization and citations, the possibility the University of Toronto is driving any impacts observed needs to be considered. There are two sets of limitations to these results. The first is that the sample size is small. The second is that the possibility exists that the two groups have the same distribution for a single variable, but the interactions between multiple variables are different. As such, nothing is proven conclusively, though it does aid regression model preparation.

Table 8. KS test, distribution comparison between the University of Toronto and other non-unionized schools

	P-value	Corrected p-value	Exact p-value
Salary	0.126	0.086	0.101
Years	0.808	0.743	0.743
Publications	0.1.97	0.143	0.163
h-index	0.148	0.104	0.121
Citations	0.047	0.029	0.036
***N* University of Toronto**			42
***N* other non-unionized schools**			47

4.3 Modeling

This paper uses a model which assumes that wages derive from both specialized and general human capital (Willis, 1986). The model is then tailored to the specifications of a university professor. The specialized portion of human capital assumes fixed educational requirements. In this model, compensation is provided based on worker productivity; the units of labour provided (Willis, 1986, p. 556-559). Under a specialized human capital model, a PhD is considered a fixed requirement to becoming a tenured professor, so for this study a schooling variable is not included. Measures of productivity are then based on the three functions a professor is expected to have; teaching, research, and administrative duties (Jonker and Hicks, 2014).

Human capital models with generalized returns have the input of salary being experience. This is meant to represent the skills one has acquired through working; that an individual's level of human capital indicates their productivity (Willis, 1986, p. 541-548). Models take experience to be a positive coefficient and the quadratic of experience to be negative, indicating the marginal rate of return for experience is decreasing (Becker, 1975, p. 23). Using these assumptions relating to human capital, the models used in this study to conduct analysis are based on equation (1).

$$Salary_i = \beta_0 + \beta_a IndChar_{ai} + \beta_b BiblioMeasures_{bi} + \beta_c InteractiveTerms_{ci} + \epsilon_i \quad (1)$$

Salary is determined by a number of individual characteristics, measures of research, and interactive terms. Individual characteristics include gender, administrative duties, and experience. Gender is included based on the possibility that gender discrimination may impact professor compensation (Altonji and Blank, 1999, p. 3146-3153). Individual characteristics includes a measure for productivity based on administrative duties as measured through the administrative flag variable. An indicator dummy variable is included for professors who had a salary adjustment based on their 2014 or 2013 salary. Individual characteristics also includes experience as measured by years since first publication. The years of experience variable is measured as time from first publication to 2015. A quadratic of years is included to capture the possible diminishing returns from experience. Select models will include a variable measuring

years since last publication, to see if unproductive years are rewarded differently than productive years.

The second independent term, *BiblioMeasures*, relates to research productivity. For professors, research output has traditionally been one of the most significant measures of productivity (OCUFA, 2013). Various proxies for research are tested to determine if quantity, a measure of quality, or a calculated variable based on both best capture how research is measured in terms of compensation. Focus is placed on bibliometric indicators that have a lower multicollinearity with the years of experience variable.

A university fixed effect is included in most models. The exception is when an institutional condition such as unionization or research intensity is included in the model. In some models, interactive terms are included to test whether all universities use the same returns function or if institutional situations impact how other independent variables are rewarded. Additionally, gender may change professors' reward structure and so is tested as an interactive variable.

Academic promotion is due in large part to years of experience, research, teaching, and administrative contributions (Carleton University, 2017). As such, the rewards to promotion should be covered by other variables in the model. The possibility exists that the model is missing variables such as teaching, which have multicollinearity with academic promotion. Inclusion of the variable *Professorial rank* risks multicollinearity with variables already in the model, but its inclusion also may cover effects not measured elsewhere. Whether to include professorial rank or not is tested further in the analysis section.

The distributions of both the dependant and independent variables drive model selection for this paper. Similar to most salary distributions, this dataset has a positive skewness (Mincer, 1974). Two types of models will be used to deal with the skewness and kurtosis of the dataset. The heavy kurtosis and large skewedness of the data requires a model with nonparametric specification (Greene, 2012, p. 247). Quantile regressions allow for analysis to be conducted measuring the conditional median or percentile of the regressand instead of the mean. Because the model relies on median values, and due to

the distribution of the indirect variables for professors missing salary information, a placeholder salary can be assigned to professors earning less than $100,000 without significant concerns about bias.

Logarithmic regressions are used to normalize the distribution of data (Mincer, 1974), allowing for models with parametric specifications. Additionally, the logarithmic model controls for heteroscedasticity, and allows for a direct comparison between independent variables. This normalization of *Salary* also means that by using a tobit regression model, salary can be estimated for the 18 professors who are missing salary data but have bibliometric data.

5 Results

5.1 Quantile Regressions

Table 9 provides results for the preliminary quantile models, which test the inclusion of *Professorial rank* as a regressor. By removing the variable in model 2, it becomes clear how related years of experience, and to a lesser extent, research output are to professorial rank. For all quantile regressions run, unless stated otherwise, the quantile regression is conducted on the 50th percentile. In model 1, the increase to salary from being an associate professor is $14,988. When professorial rank is removed in model 2, the h-index's coefficient increases by $557, years of experience increases by $985, while the years quadratic decreases by $11.42. The median associate professor has 16 years of experience and an h-index of 5. This means for the median associate professor, removing their rank variable increases the salary compensation from the h-index by $2,785, and from years and its quadratic by $12,836, for a total of $15,621. There is high multicollinearity between professorial rank, and the bibliometric and years variables. Removing the variable probably causes slight endogeneity, but it is much preferable to the overinclusion of research and years of experience by keeping the variable. On this basis, it is appropriate to remove the variable from further regression models. The only exception will be models which test the interaction of professorial rank with other independent variables. Model 3 tests the removal of the administrative variable, to demonstrate how the position is highly associated with research and years of experience. Because the position comes with additional responsibilities which are rewarded, is held by a minority of the sample, and to maintain the human capital model being tested, the administrative variable will remain in future models tested.

Table 9. Quantile regression, testing inclusion of professorial rank variable

VARIABLES	(1) Salary	(2) Salary	(3) Salary
Full Prof.	30,519***		
	(4,927)		
Associate Prof.	14,988***		
	(3,638)		
Admin.	10,212***	11,828***	
	(2,582)	(3,218)	
Female	-2,341	-1,022	2,338
	(2,548)	(3,169)	(3,186)
Salary Adj.	-1,821	3,327	-2,227
	(3,092)	(3,821)	(3,844)
Years	2,037***	3,022***	3,435***
	(476.8)	(501.4)	(497.3)
$Years^2$	-30.43***	-41.85***	-47.78***
	(9.744)	(10.95)	(10.84)
h-index	1,041***	1,598***	1,756***
	(306.8)	(416.7)	(453.9)
Constant	95,081***	94,258***	90,583***
	(5,117)	(6,189)	(6,216)
Fixed Effect	University	University	University
Observations	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10 presents quantile regressions with bibliometric variables related to quantity of publications. With the exception of *Other writing*, which includes writing and editing books, all publication-related bibliometric indicators are significant at the 1% level.

The median number of articles written is 10, papers 11, and publication productivity is 1.6. Based on that, the median professor gains approximately $2,200 to $5,300 from publication. Interestingly, for the average professor, publication productivity is most highly rewarded. That variable has one of the lowest correlations with years of experience, so is capturing very little of the year variable. Overall, the salary impact from publications is minor compared to that of holding an administrative position, and dwarfed by that of years of experience.

With a median 16 years of experience, the average professor gains approximately $40,000 when factoring in years and its quadratic. There is a high reward for holding an administrative position. Holding an administrative position is worth between $10,000 and $12,000. This is larger than the prescribed amount for administrative positions which have direct remuneration. This means that administrative positions must contribute to salary in an indirect manner, such as early promotion. The variable *Female* has no statistical significance in any of the models studied. Likewise, the flag variable for adjusted salary has no statistical significance.

Table 10. Quantile regression, quantity related bibliometric measures

VARIABLES	(1) Salary	(2) Salary	(3) Salary	(4) Salary	(5) Salary
Admin.	11,530***	10,949***	11,514***	11,727***	10,310***
	(2,996)	(2,937)	(2,967)	(2,720)	(3,173)
Female	257.4	-118.0	-724.1	-167.1	637.9
	(3,006)	(2,942)	(2,971)	(2,729)	(3,162)
Salary Adj.	16.29	1,530	1,029	1,550	1,124
	(3,621)	(3,545)	(3,579)	(3,281)	(3,816)
Years	3,082***	3,466***	3,166***	3,827***	3,504***
	(453.6)	(444.4)	(448.6)	(413.6)	(479.6)
Years^2	-41.22***	-45.14***	-41.56***	-49.20***	-42.27***
	(10.32)	(10.06)	(10.19)	(9.311)	(10.92)
Articles	372.9***				
	(77.46)				
Papers		199.0***			
		(56.95)			
Pubs.			156.5***		
			(34.72)		
Pub. Productivity				3,285***	
				(775.6)	
Other Writing					619.5
					(467.8)
Constant	96,648***	94,101***	97,170***	86,111***	94,221***
	(5,860)	(5,766)	(5,808)	(5,648)	(6,174)
Fixed Effect	University	University	University	University	University
Observations	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11 shows the results of quantile regression models run for bibliometric variables related to quality of research measurements and calculated variables that combine quality and quantity of research. All bibliometric variables are significant at the 1% level. Self-citations were not included due to lack of significance. Each citation is worth approximately $11, with an average of 112 citations per professor, for a salary boost of close to $1,300. This is slightly less than the average boost to salary caused by recent citations, which is approximately $1,800.

Model 3 runs the regression using citation productivity. With a coefficient of 415 and using the median of citation productivity, the salary reward would be slightly less than $3,000 for the average professor. The average professor is rewarded approximately $4,300 for research using the i-10 index score and $8,000 using the h-index score. Whether or not this value is the highest of all bibliometric indicators because quantity and quality of publications is what is rewarded or because of the high correlation the variable has with years of experience is difficult to determine.

Similar to the models presented in Table 10, the majority of the average professor's gains in salary come from years of experience. *Female* and *Salary Adjustment* were not significant across any of the models. *Years* was significant at the 1% level across all models. The quadratic of years was slightly negative and significant in all models at the 1% level.

All models from Table 11 were re-run with the variable length of time since last publication included. This variable is the difference between length of career, from first publication to 2015, and time since first publication to last publication. The output is not included because the variable had no significance across all models tested. Whether the professor has published recently had no bearing on returns for years of experience.

In Appendix Table 3, the models are re-run with professorial rank included. The biggest change that occurs is a decrease in value to the coefficient of years, with modest decreases for bibliometric measures. All variables maintain the same statistical significance as in Table 11. Based on these results, only models which have include an interaction term with professorial rank will include the variable.

Table 11. Quantile regression, quality and mixed bibliometric measures

VARIABLES	(1) Salary	(2) Salary	(3) Salary	(4) Salary	(5) Salary
Admin.	11,468***	8,893***	10,229***	11,828***	11,282***
	(2,787)	(2,901)	(2,806)	(3,218)	(3,030)
Female	-458.4	-239.1	-282.0	-1,022	229.7
	(2,768)	(2,887)	(2,791)	(3,169)	(2,993)
Salary Adj.	1,464	-893.1	1,530	3,327	1,478
	(3,336)	(3,478)	(3,363)	(3,821)	(3,609)
Years	3,566***	3,327***	3,304***	3,022***	3,168***
	(418.5)	(439.2)	(425.2)	(501.4)	(456.1)
$Years^2$	-48.90***	-41.53***	-39.69***	-41.85***	-43.97***
	(9.466)	(9.866)	(9.559)	(10.95)	(10.21)
Citations	11.32***				
	(2.431)				
Recent Citations		108.5***			
		(20.33)			
Cit. Productivity			414.6***		
			(66.47)		
h-index				1,598***	
				(366.1)	
i10-index					1,449***
					(199.8)
Constant	93,965***	95,588***	90,271***	94,258***	93,425***
	(5,408)	(5,649)	(5,448)	(6,189)	(5,853)
Fixed Effect	University	University	University	University	University
Observations	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The skewness and kurtosis in many of the independent variables is due to outliers at the very edges of the distribution. Table 12 presents quantile regressions run at different percentiles, using the bibliometric variable *Citation productivity*. Those in the mid-quartiles behave similarly to each other, with the largest salary impact coming from years of experience and a small effect coming from the research metric, which tends to have a similar coefficient value at the 25th to 75th percentile.

Only at the tail ends of the distribution do coefficient values and statistical significance change. At the 95th percentile, *Years* statistical significance drops to the 10% level. The decreasing returns from experience, represented by the *Years* quadratic, has a relatively normal distribution centered close to the median. The moderately negative effect from the quadratic of years of experience disappears for those with the highest and lowest salaries. *Citation productivity* has a negative coefficient value at the 5th percentile. At the 95th percentile, *Citation productivity* maintains its 1% statistical significance with its coefficient value more than doubling that of its value in the median model. *Female* was not significant in models run at any percentile. *Salary Adjustment* was significant in two models, the 25th and 95th percentile, though it is clear from the results the variable is capture and effect other than the salary adjustment.

Appendix Table 4 presents the same models but with a different bibliometric indicator, *Citations received*. Models in Appendix Table 5 use the i10-index, in Appendix Table 6 the bibliometric indicator is the h-index, while Appendix Table 7 uses *Articles* as its respective bibliometric indicator. All quality related bibliometric indicators, as well as the i-10 index, are significant at the 1% level for the 95th percentile. For the quantity indicator *Articles* as well as the h-index, which is a mixed indicator, there was reduced statistical significance at the 5th and 95th percentile. The bibliometric indicators for professors in the 5th percentile have coefficients with a slightly negative value, suggesting too few professors have bibliometric contributions at this level to capture a meaningful effect.

Professors in the 95th percentile had a decreased statistical significance from both the administrative variable as well as years of experience. These professors are significantly different than the rest of the population. It may be that these are the most

sought after professors, who have conducted the most research, and who transfer universities. If this is true, it is interesting to see which measure of research is most rewarded. For all models with quality related indicators, the coefficient of the bibliometric indicator was larger at the 95th percentile than the 50th percentile. The largest discrepancy in value between the percentiles was for citations received, which at the tail was worth approximately 4 times the median amount. If the hypothesis about these professors transferring universities is true, it indicates how research is valued. It is not quantity of publications which is valued, as *Articles* had no significance, nor is it yearly productivity, but the quality of work over a career as estimated by citations received. For most of the population, salary increases seem strongly structured around years of experience, but the very top earners seem to have captured a premium for their research contribution.

Table 12. Quantile regression, various percentiles with the bibliometric variable being citation productivity

	Percentile				
	5	25	50	75	95
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Salary	Salary	Salary	Salary	Salary
Admin.	17,120***	10,768***	10,229***	10,663***	17,103**
	(4,796)	(1,911)	(2,806)	(3,611)	(7,920)
Female	-1,676	-1,830	-282.0	330.9	-2,801
	(4,771)	(1,901)	(2,791)	(3,592)	(7,877)
Salary Adj.	-1,424	-4,835**	1,530	373.5	16,197*
	(5,749)	(2,291)	(3,363)	(4,328)	(9,493)
Years	2,265***	3,093***	3,304***	3,471***	2,259*
	(726.8)	(289.6)	(425.2)	(547.2)	(1,200)
$Years^2$	-20.56	-38.09***	-39.69***	-41.19***	0.829
	(16.34)	(6.512)	(9.559)	(12.30)	(26.98)
Cit. Productivity	-332.2***	448.0***	414.6***	461.3***	841.4***
	(113.6)	(45.28)	(66.47)	(85.54)	(187.6)
Constant	89,608***	89,186***	90,271***	98,247***	105,906***
	(9,313)	(3,711)	(5,448)	(7,012)	(15,378)
Fixed Effect	University	University	University	University	University
Observations	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Interactive terms were added into the quantile regressions to test whether individual and university characteristics impact the relationship other variables have with salary. The first variable tested was gender. In previous models, when *Female* was included as a dummy variable it had no statistical significance. In separate models, *Female* was crossed with years, quantitative metrics, qualitative metrics, and mixed bibliometric metrics to determine whether years of activity and research were rewarded differently for male and female professors. Similarly to when the variable was included as a dummy variable, the results indicated no statistical significance for any of the interactive terms.

The first institutional characteristic tested was the effect of working for a unionized university. Appendix Table 8 is the first model run without a university fixed effect, replacing it with a dummy union variable. The variable is significant in all models except for the model which tests the h-index bibliometric indicator. Professors working at a unionized university make approximately $9,500-$14,000 less than their non-unionized counterparts. When removing the university fixed effect and adding unionization, the coefficient value of *Years* dropped, while the returns from the bibliometric indicators rose. Meanwhile, including the union variable increased the coefficient of the constant. Since none of the other indirect variables had large changes to their coefficient value when the union variable was added, this amount is probably related to lower starting salaries. As shown in the data description section, for assistant professors there is no statistical difference between unionized and non-unionized professors in terms of any measure of research or years of experience, but there is a difference between their salaries which is significant at the 1% level. A unionized assistant professor has an average salary of $118,581, while their non-unionized counterpart has an average salary of $131,970.

Interacting the union variable with years, the administrative dummy, and the gender indicator had no statistical significance. Two bibliometric indicators had minor significance when crossed with the union variable, as shown in Table 13. Publication productivity was significant at the 10% level and being a member of a union decreases returns by approximately 57%. When the publication productivity interaction is included, the union variable loses all statistical significance. The citations variable is worth approximately 40 percent less to unionized professors, though for the interaction the

union dummy variable maintains statistical significance at the 5% level. Because so many bibliometric indicators had no interaction effect with the union variable, it is difficult to draw any definitive conclusion from the interactions.

Table 13. Quantile regression, union interaction terms

VARIABLES	(1) Salary	(2) Salary
Admin.	13,343***	9,832***
	(2,960)	(2,959)
Female	-1,110	-275.8
	(3,075)	(3,039)
Salary Adj.	7,172**	1,791
	(3,553)	(3,511)
Years	3,662***	3,286***
	(467.3)	(468.1)
$Years^2$	-47.28***	-43.47***
	(10.57)	(10.64)
Union	-6,392	-7,660**
	(4,796)	(3,226)
Pubs. Productivity	6,639***	
	(1,743)	
Citations		24.18***
		(4.560)
Union*Bibliometric Measure[†]	-3,638*	-10.02*
	(2,006)	(5.244)
Constant	105,556***	114,368***
	(5,454)	(4,321)
Observations	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[†] When crossed with *Union,* the bibliometric measure used is the same variable as the bibliometric variable used as a categorical variable. For model 1, the measure represents publication productivity. For model 2, the measure represents citations received.

The possibility exists that reward structures at the University of Toronto are different than those at the other non-unionized universities, driving the union effects seen in Table 13. HEQCO categorizes the University of Toronto into its own group based on research output. While the distribution between the university and the other two non-unionized universities was similar for most variables, there was a discrepancy for the distribution of citations received, as shown in Table 8. Table 14 separates the University of Toronto from the other non-unionized universities.

In models 1 and 2, the University of Toronto is dropped from the regressions so that the variable *Union* only represents McMaster University and the University of Waterloo. The dummy variable, *Union*, loses all significance, and so do both interaction terms. Models 3 and 4 compare the University of Toronto to all unionized schools, dropping McMaster University and the University of Waterloo from the models. The *Union* variable demonstrates there is a significant salary premium of over $18,500 from working at the University of Toronto, likely coming from a higher starting salary. Models 3 and 4 show a salary adjustment that is significant at the 10% level, and represents the earning increases a professor would gain from between one and two years of service. Similar to when McMaster and Waterloo were isolated, there is no significant difference between the University of Toronto and unionized universities in terms of salary increases for qualitative measures of research crossed with unionization status; the interaction terms lose all significance. The large salary increase from being at a non-unionized university seems to be driven by the University of Toronto. The origins of the moderately significant interactions observed in Table 13 cannot be found. This may be due to the smaller sample size the variable has when divided, and so it cannot be conclusively said where McMaster University and the University of Waterloo are different than unionized universities.

Table 14. Quantile regression, separate non-unionized universities

	McMaster and Waterloo		University of Toronto	
	(1)	(2)	(3)	(4)
VARIABLES	Salary	Salary	Salary	Salary
Admin.	12,060***	11,379***	14,124***	15,753***
	(2,758)	(3,067)	(3,086)	(3,121)
Female	809.8	2,194	-0.805	1,767
	(2,794)	(3,017)	(3,205)	(3,212)
Salary Adj.	56.40	-3,585	6,377*	7,136*
	(3,402)	(3,668)	(3,753)	(3,764)
Years	3,557***	3,469***	3,756***	3,794***
	(441.5)	(476.4)	(496.7)	(504.7)
$Years^2$	-42.79***	-44.72***	-46.87***	-55.02***
	(9.846)	(10.78)	(10.38)	(11.14)
Union	997.9	-3,802	-18,516***	-19,018***
	(6,009)	(3,849)	(6,072)	(4,430)
Pubs. Productivity	6,875**		4,043**	
	(2,959)		(1,998)	
Citations		24.32**		10.64**
		(10.60)		(5.067)
Union*Bibliometric Measure	-3,806	-12.07	-1,007	3.998
	(3,070)	(10.75)	(2,221)	(5.662)
Constant	98,227***	108,674***	115,643***	120,131***
	(6,847)	(5,077)	(6,497)	(5,143)
Observations	263	263	258	258

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 9 presents quantile models with the inclusion of the HEQCO categorical variable of research intensity. The results indicate that there is no significant difference between universities based on research intensity, with the exception of the University of Toronto. Regardless of whether the institution is undergraduate-focused, comprehensive, or a research-intensive institution, salary is not affected. The models shown in Table 13 suggest that, using certain measures of research, professors at the University of Waterloo and McMaster University may have had additional salary gains from research that could not solely be attributed to the University of Toronto. When these schools are categorized with other research-intensive universities, this effect disappears. Similar to models 3 and 4 in Table 14, being a professor at the University of Toronto is associated with a salary boost of between $16,000 and $21,000.

The university research type was never significant when interacted with other dependant variables. Research type crossed with bibliometric indicators, administrative status, and the gender indicator were not rewarded differently based on the research intensity of the intuition.

Similarly to the results found when using the HEQCO categorization of universities, no statistical significance was found related to research intensity of universities when using the Maclean's university categorization. There was no significance when the research level of the school was included as either a categorical variable or an interactive term. Additionally, any significant differences related to the University of Toronto were unobservable since the university was grouped in with other high intensity research institutions. Both HEQCO's and Maclean's categorizations of universities by research intensity failed to provide evidence that research is rewarded fundamentally differently based on level of research conducted by the university. With the exception of the University of Toronto, determination of a university professor's salary was similar regardless of whether the university was undergraduate, comprehensive, or research focused.

In Table 15 professorial rank is interacted with years of experience and citation productivity. No other independent variables interacted with professor rank had any statistical significance. Model 1 interacts professorial rank with years of experience. The base professor, being an assistant professor, receives no significant salary increase from years of experience. Associate and full professors receive approximately $1,600 for each year of experience. Model 2 interacts professorial rank with citation productivity. Only associate professors have any additional gains from citation productivity, where each unit increase in productivity raises salary by $820.

Table 15. Quantile regression, professorial rank interaction terms

VARIABLES	(1) Salary	(2) Salary
Full Prof.	18,473	28,641***
	(11,867)	(4,539)
Associate Prof.	6,303	11,324***
	(6,669)	(3,908)
Admin.	8,881***	11,042***
	(2,480)	(2,052)
Female	-2,540	-2,245
	(2,465)	(2,034)
Salary Adj.	-1,333	-1,650
	(2,989)	(2,466)
Years	979.2	1,982***
	(694.4)	(377.5)
$Years^2$	-38.59**	-25.24***
	(15.27)	(7.753)
Cit. Productivity	318.2***	-228.2
	(60.88)	(376.6)
Full*variable[†]	1,648*	505.4
	(887.9)	(376.8)
Assoc.*variable	1,566**	820.4**
	(734.8)	(397.7)
Constant	82,438***	79,578***
	(8,392)	(6,729)
Fixed Effect	University	University
Observations	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[†] For model 1, the interactive variable represents *Years*. For model 2, the measure represents *Citation productivity*.

The final quantile regressions, shown in Table 16, substitute a salary of $99,000 for those professors without salary data. This allows 18 professors who had bibliometric information but a salary of less than $100,000 to be added to the frame. Except for the addition of 18 professors, the models run are the same as those presented in Table 10 and Table 11, so they can be directly compared. The effects from adding the professors are limited. No changes to statistical significance occur. The value from administrative duties increases marginally. Returns to each year of experience remains relatively constant. While in most models, returns to research decrease slightly.

The truncated data is from those professors with the lowest salaries; most of their independent variables are in the bottom half of their distributions. Because of this, and the fact that the model is based on median values, the estimate which is used for the missing salary data is inconsequential. The regressions were re-run using a replacement salary of $80,000 and the results were almost identical. Most coefficients had the exact same values; those which changed were usually impacted by approximately 1%.

Table 16. Quantile regression, replace missing salary with $99,000

VARIABLES	(1) Salary	(2) Salary	(3) Salary	(4) Salary	(5) Salary	(6) Salary	(7) Salary
Admin.	12,709***	11,100***	12,904***	11,075***	11,324***	11,366***	11,335***
	(2,991)	(2,954)	(2,879)	(2,591)	(2,672)	(3,117)	(2,944)
Female	-2,302	-2,085	-2,618	-2,307	-2,051	-1,763	-2,579
	(2,895)	(2,873)	(2,758)	(2,489)	(2,567)	(2,962)	(2,805)
	2,745	-14.71	3,003	1,965	2,098	1,774	481.7
	(3,663)	(3,615)	(3,493)	(3,148)	(3,246)	(3,749)	(3,553)
Years	3,044***	4,089***	3,358***	3,328***	3,454***	3,040***	3,146***
	(428.3)	(431.2)	(408.6)	(370.4)	(381.4)	(458.7)	(418.5)
$Years^2$	-39.40***	-53.24***	-44.26***	-40.54***	-43.00***	-40.16***	-41.59***
	(9.903)	(9.828)	(9.412)	(8.467)	(8.732)	(10.17)	(9.536)
Articles	356.1***						
	(78.50)						
Pubs. Productivity		2,951***					
		(763.3)					
Citations			11.02***				
			(2.544)				
Recent Citations				114.7***			
				(18.32)			
Cit. Productivity					452.8***		
					(63.07)		
h-index						1,715***	
						(355.6)	
i10-index							1,479***
							(196.2)
Constant	95,810***	78,222***	94,956***	92,272***	87,516***	92,321***	92,937***
	(5,289)	(5,908)	(5,051)	(4,557)	(4,692)	(5,418)	(5,137)
Fixed Effect	University	University	University	University	University	University	University
Observations	323	323	323	323	323	323	323

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.2 Logarithmic Regressions

A number of professors have a value of zero for certain bibliometric indicators. This presents a challenge when taking the logarithm of these continuous regressors. The issue varies in importance depending on the bibliometric indicator; only 7 professors have a value of 0 for the variable citations received, whereas there are 52 instances where professors have an i10-index value of zero.

Whether it is more appropriate to drop the instances or linearly shift all values of the variable so that there are no longer zero values depends on the meaning of the zero value and the specifications of the models being run (Hosmer and Lemeshow, 2000). In this case, zero values indicate true scores of zero and not missing data.

Three logarithmic regressions are presented in Appendix Table 10. These represent various linear transformations to the i10-index to try and accommodate zero values. In model 1, no transformations occur. In model 2, all value of the i10-index are increased by 0.5 before the logarithm is taken, while in model 3 all occurrences of the variable are increased by one, the smallest non-zero value for the variable, before the logarithm is taken (Hosmer and Lemeshow, 2000). Model 1 drops 54 professors who are removed because their i10-index score is zero. Models 2 and 3 do not drop any professors as the i10 score is now a transformed value. Models 2 and 3 indicate the issue with using the linear transformation of a variable to get around zero values. Model 2 decreases the coefficient value by 21% when compared to model 1, while model 3 increases the coefficient value by 5%. These are large value changes in opposite directions, and there is no objective measure to tell which transformation is more appropriate. For that reason, bibliometric indicators with a value of zero are dropped from models where the logarithm of the bibliometric indicator occurs.

The frame is changed due to the censoring of the lowest tail values. This is more significant for bibliometric indicators such as the i10-index, where a large number of indicators are dropped. Running a transformation similar to Appendix Table 10, but with citations received as the bibliometric variable, leads to variation in the coefficient from the various log transformations of less than 5%. It is still not clear what the appropriate

linear transformation would be, so going forward transformations are not used. More caution should be placed in models that, due to their bibliometric variables, have smaller sample sizes.

Table 17 presents the results of logarithmic regressions for all significant bibliometric indicators. Due to the nature of a logarithmic equation, it is not appropriate to include variables which are transformations of other variables in the equation. As shown in equation (2), if such a variable were included, it would be identical in value to other bibliometric indicators and would also impact the value of the *Years* variable.

$$\ln(citation\ productivity) = \ln\left(\frac{citations}{years}\right) = \ln(citations) - \ln(years) \qquad (2)$$

Working at a unionized school decreases salary by approximately 7%, with slight variation depending on the model. Having an administrative position causes approximately a 10% increase in salary, while being female has no significance across models. Each 1% increase to years of experience increases salary by approximately 0.1%.

All other bibliometric indicators were significant at the 1% level as well. The h-index is the largest bibliometric indicator; each 1% change in a professor's h-index increases salary by 0.07%. The next largest bibliometric indicator is the i10-index, suggesting that universities reward a mixture of quality and quantity of research. All other indicators increase salary by approximately 0.03% to 0.05% for each 1% increase.

Table 17. Logarithmic regression, with Union variable

VARIABLES	(1) ln(Salary)	(2) ln(Salary)	(3) ln(Salary)	(4) ln(Salary)	(5) ln(Salary)
Union	-0.0821***	-0.0664***	-0.0579***	-0.0665***	-0.0613***
	(0.0174)	(0.0164)	(0.0178)	(0.0164)	(0.0163)
Admin.	0.101***	0.0885***	0.0843***	0.0922***	0.0922***
	(0.0183)	(0.0174)	(0.0195)	(0.0172)	(0.0175)
Female	-0.00184	-0.0102	-0.00587	-0.0103	-0.00462
	(0.0196)	(0.0182)	(0.0202)	(0.0182)	(0.0181)
Salary Adj.	0.00938	0.0159	0.0207	0.0134	0.000319
	(0.0222)	(0.0211)	(0.0232)	(0.0210)	(0.0212)
ln(Years)	0.135***	0.131***	0.135***	0.132***	0.151***
	(0.0159)	(0.0131)	(0.0157)	(0.0129)	(0.0114)
ln(Articles)	0.0389***				
	(0.0111)				
ln(h-index)		0.0738***			
		(0.0127)			
ln(i10-index)			0.0496***		
			(0.0103)		
ln(Citations)				0.0340***	
				(0.00578)	
ln(Recent Cit.)					0.0417***
					(0.00650)
Constant	11.54***	11.52***	11.56***	11.47***	11.46***
	(0.0352)	(0.0313)	(0.0406)	(0.0326)	(0.0332)
Observations	294	298	251	298	288
R-squared	0.525	0.584	0.533	0.585	0.593

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The union indicator is replaced by the HEQCO research intensity categories in Appendix Table 11. With the exception of the University of Toronto, research intensity of the university had no significance relating to salary. That a university was undergraduate-focused, comprehensive, or research-intensive did not impact compensation. Being a professor at the University of Toronto did have a significant impact on salary, increasing it by between 10% and 17%. This is much larger than the union effect observed in the models displayed in Table 17. This infers that the University of Toronto is significantly different than all other schools and is leading the effect seen in non-unionized schools.

The models in Appendix Table 12 include the individual universities in the regressions. The base institution used is Wilfrid Laurier University, with 20 professors and a mean salary of $153,291; it represents the average Ontario University. Professors at the University of Toronto earn approximately 13% more than those at Wilfrid Laurier University. There is salary increase with a weak level of significance for being a professor from McMaster University, with a coefficient value of 7%. The University of Waterloo does not have the same salary premium. It appears that the difference is not between unionized and non-unionized schools, but between the University of Toronto and to a lesser extent McMaster University, and other universities in Ontario. Across all models York University had a salary premium of approximately 8%. In one model, the University of Western had a 6% premium, with a 10% level of significance. The other universities which have significantly different salaries are Carleton University and the University of Windsor. There is a salary penalty associated with being a professor at both schools. Professors at the University of Windsor earn approximately 13% less, while those at Carleton University earn approximately 8% less than professors at other Ontario Universities.

Table 18 estimates the salary for the subset of the sample which has bibliometric data but a salary of less than $100,000. Because a high percentage of tenure and tenure-track professors were on the *Ontario Salary Disclosure* and most of those missing lacked bibliometric data, there were a limited number of professors whose salary could be estimated. Overall, 18 salaries were estimated but because the models were logarithmic and there were zero values, fewer than 18 professors were added in each models. Depending on the model, between 11 and 17 professors were added. There were

moderate increases to the returns for both *Years* and bibliometric indicators; professors with salaries of less than $100,000 had lower research output. The most noteworthy result was that a professor's gender became significant in two models at the 10% level and one model at the 5% level. Being a female professor was associated with approximately a 4% reduction in wages when compared to a male professor's pay. These are the only models which found any significance related to the gender variable. This is probably due to the fact that a disproportionate portion of the professors added using the tobit regression were female. Of the 305 professors in the frame of this study, 20% were female, while of the 18 professors added through the tobit regression, 44% were female.

Table 18. Tobit regression, with Union variable

VARIABLES	(1) ln(Salary)	(3) ln(Salary)	(5) ln(Salary)	(7) ln(Salary)	(9) ln(Salary)
Union	-0.0819***	-0.0634***	-0.0539***	-0.0629***	-0.0600***
	(0.0189)	(0.0180)	(0.0193)	(0.0181)	(0.0183)
Admin.	0.105***	0.0923***	0.0914***	0.0975***	0.100***
	(0.0200)	(0.0194)	(0.0215)	(0.0193)	(0.0200)
Female	-0.0307	-0.0399**	-0.0206	-0.0394**	-0.0338*
	(0.0209)	(0.0196)	(0.0216)	(0.0197)	(0.0200)
Salary Adj.	0.0264	0.0348	0.0357	0.0321	0.0198
	(0.0246)	(0.0238)	(0.0256)	(0.0238)	(0.0244)
ln(Years)	0.140***	0.142***	0.149***	0.144***	0.169***
	(0.0172)	(0.0139)	(0.0164)	(0.0138)	(0.0123)
ln(Articles)	0.0480***				
	(0.0120)				
ln(h-index)		0.0846***			
		(0.0140)			
ln(i10-index)			0.0566***		
			(0.0112)		
ln(Citations)				0.0381***	
				(0.00642)	
ln(Recent Cit.)					0.0396***
					(0.00742)
Constant	11.50***	11.45***	11.49***	11.41***	11.40***
	(0.0377)	(0.0333)	(0.0420)	(0.0351)	(0.0365)
sigma	0.146***	0.140***	0.139***	0.140***	0.141***
	(0.00610)	(0.00581)	(0.00626)	(0.00582)	(0.00596)
Observations	307	315	262	315	304

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6 Conclusion

A number of conclusions were drawn related to measures of research, the impact of research, as well as the impact of individual and institutional effects on a professor's salary. This paper used a previously untested year of data and a previously untested database to draw inferences related to the determinants of a professor's salary. Research was shown to have a moderate impact on salary, while other determinates of salary were more highly rewarded. Primarily due to the University of Toronto, being a professor at a non-unionized university had a positive effect on salary, while research intensity of the university was not significant in determining salary.

With the exception of a small number of professors earning less than $100,000, the salary and faculty data were census in nature. As such, there were no concerns about the quality of their data. The *CitEc* database and the 2015 reference year were both previously unstudied. While there was missing data, the rate at which bibliometric data was missing was not higher than in studies by Jonker and Hicks (2014) which used other databases. Tests conducted on the missing data did not indicate any bias, and individual variables tended to have the same distribution for professors with bibliometric data as those without. While this does not prove a lack of bias, the fact that no bias was indicated allowed for the dataset to be used in this paper. None of the results indicated any suspicions about the quality of the bibliometric data. As such it would be beneficial to use the *CitEc* databases in further studies.

The main objective of this paper was to better understand how human capital is rewarded in terms of salary for professors at economics departments in Ontario. For the majority of professors in Ontario, the largest increase to salary came from years of experience. Holding an administrative position resulted in a salary increase of approximately $12,000. The administrative flag had high collinearity with years of experience and bibliometric measures; more senior professors tend to acquire the positions. Almost all research measures, whether quality, quantity, or mixed measures, were highly significant. In terms of research measures, the h-index was the bibliometric indicator which caused the highest percentage salary increase. A mixture of quantity and quality of publications was rewarded the most by universities. However, the rewards for

research were small, with a 10% increase in h-index score increasing salary by approximately 0.7%. Much of this increase in value is due to the high correlation the variable has with years of experience. Each citation was worth approximately $11. Citation productivity was the variable least correlated with years of experience. Each unit increase in citation productivity is worth approximately $400 and generated the average professor close to $3,000. In the same model, years of experience would generate the average professor a $40,000 salary increase. Whether a professor was active in publishing during their latest years of employment had no impact on the salary return from years of experience. Books and papers published were never significant. *Female* was significant in 3 models that estimated the salaries of professors who earned less than $100,000. In these models, female professors earned about 4% less than their male counterparts. In theory, the salary adjustment variable should have captured the effect from using the real 2013 or 2014 salary, instead of the unreduced 2015 salary, but in practice no effect was observed.

Professors in the 95th percentile had their salaries behave significantly different than those of the rest of the population. For these professors, years of experience and extra administrative duties had no significance, while bibliometric measures had much larger values than for professors in the median percentile. Along with the fact that those with the highest earnings tended to have the highest levels of research output, this was the one situation where professors earned large amounts of money based on research. This may be because these professors are able to transfer to a university which pays them more. The bibliometric variable which had the largest difference from its median value was citations. This suggests that a very high quality of work over an entire career was what facilitates such job switching.

Being a member of a union depressed salary by approximately 7%. These results indicate that a fair portion of this salary discrepancy may be due to higher starting salaries at non-unionized universities. This result is largely due to the University of Toronto, and to a lesser extent McMaster University. A larger dataset would allow for a more thorough study to determine if the University of Toronto dominates the salary increases from non-unionized universities. Research intensity of the university had no impact on professors' salary structure or rewards. Interactive terms tended to be insignificant for the variables

tested: unionization status, research intensity, and gender. In a couple of instances, if the professors were unionized the value of bibliometric indicators decreased. While this change was a large percentage of the variable's coefficient value, the value of bibliometric research was small enough that the impact on overall salary would be negligible. Finally, years of experience was rewarded for associate and full professors, but not for assistant professors.

This paper has some interesting findings which would benefit from further research. The models used in this paper present a set of scenarios, but due to limitations of the dataset they cannot be conclusively proven. These include: the interaction between unionization and bibliometric indicators, if gender is significant, and if the premium to research from the top earners is due to university switching. The cross section data set used in this study suggests these findings may be occurring, but these questions could be more definitively answered if the models used in this paper were applied to a panel data set.

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8 Appendices

8.1 Appendix A: Data Tables

Appendix Table 1. Variable description

Variable	Variable Type	Description
Salary	Value	Salary received by professor for reference year 2015
Salary Adjustment	Indicator	Dummy variable, indicating if salary was modified based on 2014 and 2013 data.
University	Category	University of employment
Professorial Rank	Category	Status as an assistant, associate, or full professor
Administrative	Indicator	Dummy variable for additional administrative responsibilities. 1 indicates additional responsibilities. Represented by *Admin.* in output tables
Female	Indicator	Gender variable used in this study. It is a dummy variable where 1 indicates a female professor
Years	Value	Also known as years active. The amount of time from first publication to 2015
$Years^2$	Value	Quadratic of years
Articles	Value	Number of published articles
Papers	Value	Number of papers produced
Publications	Value	Calculated variable, which is the sum of articles and papers. Represented by *Pubs*. in output tables
Books	Value	Number of books written
Chapters	Value	Number of chapters written
Other Writing	Value	Calculated variable, the sum of books and chapters written
Publication Productivity	Value	Calculated variable, the total number of publications/years active. Represented by *Pub. productivity* in output tables.
h-index	Value	Largest value *h,* for *h* number of publications with at least *h* citations
i10-index	Value	Number of publications with at least 10 citations
Citations	Value	Total number of citations received
Recent Citations	Value	Total number of citations received in the last 2 years
Self-Citations	Value	Total number of citations received from self
Citation Productivity	Value	Calculated variable, total number of citations/years active. Represented by *Cit. productivity* in output tables
Maclean's Categories	Category	Maclean's categories of Ontario universities based on research intensity, for reference year 2015
HEQCO Categories	Category	Higher Education Quality Council of Ontario's ranking of universities based on research intensity
Union	Indicator	Dummy variable for university unionization. 1 indicates university is unionized

Appendix Table 2. Economics university with summary details for professors in frame

University	HEQCO	Maclean's	Union	Number of Professors	Average Salary ($)
University of Toronto	0	1	No	42	175,312
U. of Western Ontario	1	1	Yes	28	168,242
McMaster University	1	1	No	21	169,712
Queen's University	1	1	Yes	22	176,992
University of Ottawa	1	1	Yes	20	147,827
King's College - Western	1	1	Yes	1	117,215
Huron College - Western	1	1	Yes	-	-
University of Waterloo	1	2	No	26	147,854
University of Guelph	1	2	Yes	25	162,171
Ryerson University	2	2	Yes	18	148,193
University of Windsor	2	2	Yes	6	125,133
York University	2	2	Yes	28	161,602
Carleton University	2	2	Yes	25	142,798
Wilfrid Laurier University	3	2	Yes	20	153,291
Brock University	3	2	Yes	14	156,349
Laurentian University	3	3	Yes	3	160,862
Lakehead University	3	3	Yes	3	138,286
Trent University	3	3	Yes	1	180,121
Nipissing University	3	3	Yes	1	151,747
Algoma University	3	3	Yes	1	102,887

Appendix Table 3. Quantile regression, with professorial rank variable

VARIABLES	(1) Salary	(2) Salary	(3) Salary	(4) Salary	(5) Salary
Full Prof.	31,507***	30,942***	28,612***	30,519***	31,830***
	(4,510)	(4,757)	(4,710)	(4,927)	(5,437)
Associate Prof.	15,799***	15,887***	14,541***	14,988***	16,081***
	(3,414)	(3,582)	(3,514)	(3,638)	(4,080)
Admin.	9,544***	8,649***	9,279***	10,212***	9,302***
	(2,418)	(2,533)	(2,476)	(2,582)	(2,900)
Female	-52.01	-3,047	-2,396	-2,341	-1,598
	(2,401)	(2,522)	(2,466)	(2,548)	(2,867)
Salary Adj.	-4,679	-1,395	-1,421	-1,821	-3,622
	(2,915)	(3,058)	(2,991)	(3,092)	(3,483)
Years	2,333***	1,931***	2,233***	2,037***	2,055***
	(446.7)	(468.1)	(457.9)	(476.8)	(532.8)
$Years^2$	-35.39***	-24.89**	-30.17***	-30.43***	-30.93***
	(9.203)	(9.608)	(9.399)	(9.744)	(10.94)
Citations	10.74***				
	(2.138)				
Recent Citations		86.18***			
		(18.16)			
Cit. Productivity			320.1***		
			(60.90)		
h-index				1,041***	
				(310.4)	
i10-index					752.1***
					(197.0)
Constant	93,272***	96,798***	94,227***	95,081***	95,769***
	(4,815)	(5,052)	(4,944)	(5,117)	(5,749)
Fixed Effect	University	University	University	University	University
Observations	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 4. Quantile regression, various percentiles with the bibliometric variable being citations received

	Percentile				
	5%	25%	50%	75%	95%
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Salary	Salary	Salary	Salary	Salary
Admin.	15,561***	10,646***	11,468***	10,202***	15,331*
	(4,631)	(2,111)	(2,787)	(3,554)	(8,660)
Female	-1,798	-1,644	-458.4	802.4	-3,398
	(4,599)	(2,097)	(2,768)	(3,530)	(8,600)
Salary Adj.	-5,048	-5,251**	1,464	2,595	18,351*
	(5,544)	(2,528)	(3,336)	(4,255)	(10,368)
Years	2,733***	3,364***	3,566***	3,579***	2,569**
	(695.4)	(317.1)	(418.5)	(533.8)	(1,300)
$Years^2$	-28.75*	-46.29***	-48.90***	-47.26***	-12.74
	(15.73)	(7.172)	(9.466)	(12.07)	(29.42)
Citations	-10.56***	13.77***	11.32***	17.76***	33.90***
	(4.040)	(1.842)	(2.431)	(3.101)	(7.556)
Constant	84,867***	88,504***	93,965***	99,431***	107,520***
	(8,986)	(4,097)	(5,408)	(6,897)	(16,805)
Fixed Effect	Universities	Universities	Universities	Universities	Universities
Observations	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 5. Quantile regression, various percentiles with the bibliometric variable being the i10-index

	Percentile				
	5%	25%	50%	75%	95%
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Salary	Salary	Salary	Salary	Salary
Admin.	15,842***	12,293***	11,282***	11,544***	14,998*
	(4,474)	(2,183)	(3,030)	(3,396)	(8,804)
Female	-2,566	-104.1	229.7	245.1	-3,903
	(4,419)	(2,156)	(2,993)	(3,355)	(8,696)
Salary Adj.	-26.11	-5,630**	1,478	143.4	13,411
	(5,329)	(2,600)	(3,609)	(4,045)	(10,486)
Years	2,578***	3,028***	3,168***	3,518***	2,410*
	(673.4)	(328.6)	(456.1)	(511.2)	(1,325)
$Years^2$	-26.50*	-39.80***	-43.97***	-47.51***	-10.70
	(15.08)	(7.355)	(10.21)	(11.44)	(29.67)
i10-index	-599.1**	806.4***	1,449***	1,223***	1,999***
	(295.0)	(143.9)	(199.8)	(224.0)	(580.5)
Constant	86,916***	91,004***	93,425***	98,611***	109,998***
	(8,642)	(4,216)	(5,853)	(6,560)	(17,006)
Fixed Effect	Universities	Universities	Universities	Universities	Universities
Observations	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6. Quantile regression, various percentiles with the bibliometric variable being the h-index

	Percentile				
	5%	25%	50%	75%	95%
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Salary	Salary	Salary	Salary	Salary
Admin.	18,658***	11,398***	11,828***	11,795***	12,136
	(5,522)	(2,122)	(3,218)	(3,266)	(8,778)
Female	-846.1	-415.5	-1,022	69.27	-5,392
	(5,438)	(2,090)	(3,169)	(3,216)	(8,645)
Salary Adj.	-149.8	-4,725*	3,327	2,246	13,805
	(6,557)	(2,520)	(3,821)	(3,878)	(10,424)
Years	2,103**	3,023***	3,022***	2,992***	1,798
	(860.2)	(330.7)	(501.4)	(508.8)	(1,368)
$Years^2$	-14.86	-40.42***	-41.85***	-36.68***	1.027
	(18.79)	(7.221)	(10.95)	(11.11)	(29.87)
h-index	-825.9	1,405***	1,598***	2,000***	2,508**
	(628.2)	(241.5)	(366.1)	(371.6)	(998.7)
Constant	89,770***	87,052***	94,258***	98,138***	107,717***
	(10,619)	(4,082)	(6,189)	(6,281)	(16,882)
Fixed Effect	Universities	Universities	Universities	Universities	Universities
Observations	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 7. Quantile regression, various percentiles with the bibliometric variable being articles

	Percentile				
	5%	25%	50%	75%	95%
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Salary	Salary	Salary	Salary	Salary
Admin.	17,378***	11,767***	11,530***	10,972***	17,549*
	(5,066)	(2,242)	(2,996)	(3,740)	(9,578)
Female	-150.0	-587.8	257.4	281.0	1,975
	(5,082)	(2,250)	(3,006)	(3,752)	(9,609)
Salary Adj.	-2,583	-4,447	16.29	-748.6	8,065
	(6,121)	(2,709)	(3,621)	(4,519)	(11,573)
Years	1,659**	3,259***	3,082***	3,872***	3,552**
	(766.9)	(339.5)	(453.6)	(566.2)	(1,450)
$Years^2$	-4.540	-44.35***	-41.22***	-57.34***	-34.52
	(17.46)	(7.726)	(10.32)	(12.89)	(33.00)
Articles	-275.4**	282.5***	372.9***	368.5***	355.2
	(131.0)	(57.97)	(77.46)	(96.69)	(247.6)
Constant	93,685***	87,379***	96,648***	95,189***	99,023***
	(9,907)	(4,385)	(5,860)	(7,314)	(18,731)
Fixed Effect	Universities	Universities	Universities	Universities	Universities
Observations	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 8. Quantile regression, with union dummy variable

VARIABLES	(1) Salary	(2) Salary	(3) Salary	(4) Salary	(5) Salary	(6) Salary	(7) Salary	(8) Salary
Admin.	14,664***	16,177***	13,573***	11,468***	8,893***	10,229***	11,828***	11,282***
	(2,871)	(2,966)	(3,082)	(2,787)	(2,901)	(2,806)	(3,218)	(3,030)
Female	176.6	-621.8	-351.4	-458.4	-239.1	-282.0	-1,022	229.7
	(3,006)	(3,089)	(3,215)	(2,768)	(2,887)	(2,791)	(3,169)	(2,993)
Salary Adj	3,093	5,450	5,971	1,464	-893.1	1,530	3,327	1,478
	(3,465)	(3,561)	(3,702)	(3,336)	(3,478)	(3,363)	(3,821)	(3,609)
Years	2,976***	3,376***	3,620***	3,566***	3,327***	3,304***	3,022***	3,168***
	(450.5)	(462.9)	(483.6)	(418.5)	(439.2)	(425.2)	(501.4)	(456.1)
$Years^2$	-38.60***	-46.87***	-44.08***	-48.90***	-41.53***	-39.69***	-41.85***	-43.97***
	(10.27)	(10.55)	(10.93)	(9.466)	(9.866)	(9.559)	(10.95)	(10.21)
Union	-12,938***	-10,846***	-12,534***	-9,518*	-10,199*	-13,947***	-6,164	-12,142**
	(2,672)	(2,744)	(2,853)	(5,324)	(5,550)	(5,367)	(6,098)	(5,759)
Articles	420.0***							
	(77.22)							
Publications		189.9***						
		(35.70)						
Pub. Productivity			3,970***					
			(891.4)					
Citations				11.32***				
				(2.431)				
Recent Citations					108.5***			
					(20.33)			
Cit. Productivity						414.6***		
						(66.47)		
h-index							1,598***	
							(366.1)	
i10-index								1,449***
								(199.8)
Constant	119,275***	114,567***	109,412***	103,483***	105,786***	104,218***	100,421***	105,567***
	(4,235)	(4,375)	(5,002)	(5,002)	(5,216)	(5,039)	(5,722)	(5,421)
Observations	305	305	305	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 9. Quantile regression, with HEQCO research intensity categorical variable

VARIABLES	(1) Salary	(2) Salary	(3) Salary	(4) Salary	(5) Salary	(6) Salary	(7) Salary
U of T	20,637***	19,734***	19,408***	19,073***	16,053***	16,220***	19,567***
	(4,731)	(4,702)	(4,685)	(4,417)	(4,458)	(4,980)	(5,170)
Intensive	1,029	1,356	1,046	1,275	279.4	-971.8	817.8
	(3,783)	(3,744)	(3,672)	(3,415)	(3,449)	(3,872)	(4,043)
Comprehensive	-1,445	-3,254	-3,722	-2,409	-4,282	-2,793	-3,789
	(4,150)	(4,082)	(4,010)	(3,728)	(3,753)	(4,188)	(4,408)
Admin.	15,142***	13,907***	13,172***	12,693***	12,916***	15,801***	13,381***
	(3,029)	(2,979)	(2,973)	(2,759)	(2,779)	(3,132)	(3,287)
Female	826.9	586.5	2,343	2,639	2,783	924.4	2,273
	(3,173)	(3,108)	(3,054)	(2,845)	(2,858)	(3,184)	(3,358)
Salary Adj.	1,868	4,287	1,903	332.6	3,332	4,485	3,300
	(3,631)	(3,554)	(3,501)	(3,259)	(3,275)	(3,653)	(3,849)
Years	3,063***	3,519***	3,529***	3,453***	3,283***	2,602***	3,196***
	(470.1)	(461.6)	(452.9)	(424.1)	(425.9)	(491.2)	(501.2)
$Years^2$	-37.90***	-42.63***	-48.55***	-45.22***	-40.18***	-33.50***	-41.34***
	(10.73)	(10.47)	(10.33)	(9.596)	(9.649)	(10.83)	(11.32)
Articles	332.4***						
	(81.14)						
Pubs. Productivity		4,313***					
		(872.2)					
Citations			14.67***				
			(2.647)				
Recent Citations				105.8***			
				(19.80)			
Cit. Productivity					426.2***		
					(66.02)		
h-index						2,262***	
						(356.9)	
i10-index							1,262***
							(220.6)
Constant	106,318***	98,242***	104,887***	104,434***	104,738***	106,094***	105,766***
	(5,336)	(5,440)	(5,161)	(4,805)	(4,821)	(5,380)	(5,688)
Observations	305	305	305	305	305	305	305

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 10. Logistic regression, with various linear transformations of the bibliometric indicator

VARIABLES	(1) ln(Salary)	(2) ln(Salary)	(3) ln(Salary)
Admin.	0.0902***	0.0939***	0.0917***
	(0.0192)	(0.0174)	(0.0174)
Female	0.00431	-0.0102	-0.00986
	(0.0192)	(0.0177)	(0.0176)
Salary Adj.	0.00677	0.00193	0.00212
	(0.0227)	(0.0214)	(0.0213)
ln(Years)	0.147***	0.143***	0.141***
	(0.0159)	(0.0123)	(0.0122)
Ln(i10)	0.0368***		
	(0.0108)		
Ln(i10+0.5)		0.0292***	
		(0.00806)	
Ln(i10+1)			0.0385***
			(0.00987)
Constant	11.39***	11.41***	11.40***
	(0.0487)	(0.0393)	(0.0382)
Fixed Effect	University	University	University
Observations	251	305	305
R-squared	0.614	0.650	0.653

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 11. Logistic regression, with HEQCO research intensity categorical variable

VARIABLES	(1) ln(Salary)	(2) ln(Salary)	(3) ln(Salary)	(4) ln(Salary)	(5) ln(Salary)
University of Toronto	0.165***	0.119***	0.103***	0.113***	0.108***
	(0.0284)	(0.0281)	(0.0323)	(0.0286)	(0.0293)
Intensive	0.0210	9.57e-05	-0.00211	-0.00306	0.00808
	(0.0227)	(0.0221)	(0.0257)	(0.0223)	(0.0226)
Comprehensive	0.00255	-0.0178	-0.0141	-0.0242	-0.0104
	(0.0247)	(0.0239)	(0.0278)	(0.0241)	(0.0249)
Admin.	0.104***	0.0935***	0.0922***	0.0965***	0.0974***
	(0.0176)	(0.0170)	(0.0194)	(0.0169)	(0.0175)
Female	0.00526	-0.00190	0.00128	-0.00200	0.000784
	(0.0190)	(0.0178)	(0.0200)	(0.0179)	(0.0180)
Salary Adj.	0.00947	0.0152	0.0218	0.0128	0.00300
	(0.0214)	(0.0205)	(0.0227)	(0.0205)	(0.0209)
ln(Years)	0.137***	0.138***	0.143***	0.139***	0.155***
	(0.0153)	(0.0129)	(0.0158)	(0.0128)	(0.0114)
ln(Articles)	0.0379***				
	(0.0108)				
ln(h-index)		0.0643***			
		(0.0129)			
ln(i10-index)			0.0405***		
			(0.0106)		
ln(Citations)				0.0293***	
				(0.00593)	
ln(Recent Cit.)					0.0346***
					(0.00678)
Constant	11.45***	11.45***	11.50***	11.42***	11.40***
	(0.0381)	(0.0354)	(0.0470)	(0.0353)	(0.0362)
Observations	294	298	251	298	288
R-squared	0.564	0.609	0.553	0.608	0.607

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 12. Logistic regression, with university fixed effects

VARIABLES*	(1) ln(Salary)	(2) ln(Salary)	(3) ln(Salary)	(4) ln(Salary)	(5) ln(Salary)
Algoma	-0.185	-0.134		-0.151	-0.135
	(0.124)	(0.120)		(0.120)	(0.120)
Brock	0.00789	0.0440	0.0814	0.0435	0.0210
	(0.0424)	(0.0421)	(0.0511)	(0.0422)	(0.0446)
Carleton	-0.0833**	-0.0746**	-0.0700*	-0.0789**	-0.0759**
	(0.0357)	(0.0343)	(0.0395)	(0.0344)	(0.0356)
King's	-0.164	-0.167		-0.165	-0.138
	(0.123)	(0.118)		(0.118)	(0.119)
Lakehead	-0.0343	-0.00868	-0.0213	-0.0178	-0.0200
	(0.0737)	(0.0711)	(0.0881)	(0.0712)	(0.0714)
Laurentian	0.0171	0.0555	0.0875	0.0543	0.0603
	(0.0750)	(0.0729)	(0.0897)	(0.0732)	(0.0862)
McMaster	0.0692*	0.0662*	0.0714*	0.0627*	0.0660*
	(0.0372)	(0.0359)	(0.0391)	(0.0361)	(0.0361)
Nipissing	-0.0239				
	(0.127)				
Queens	0.0352	0.0323	0.0348	0.0262	0.0277
	(0.0372)	(0.0358)	(0.0392)	(0.0361)	(0.0362)
Ryerson	0.0559	0.0239	0.0487	0.0170	0.0177
	(0.0399)	(0.0379)	(0.0438)	(0.0380)	(0.0389)
Trent	0.0710	0.0949	0.143	0.112	0.108
	(0.124)	(0.119)	(0.123)	(0.119)	(0.120)
Guelph	0.00765	0.0164	0.0225	0.0154	0.0143
	(0.0358)	(0.0344)	(0.0389)	(0.0345)	(0.0346)
Ottawa	-0.0391	-0.0292	-0.0150	-0.0295	-0.0341
	(0.0382)	(0.0365)	(0.0407)	(0.0366)	(0.0373)
Toronto	0.164***	0.144***	0.140***	0.139***	0.124***
	(0.0329)	(0.0318)	(0.0358)	(0.0323)	(0.0330)
Waterloo	-0.00930	-0.00454	0.00776	-0.00467	-0.00226
	(0.0363)	(0.0349)	(0.0394)	(0.0350)	(0.0352)
Western	0.0629*	0.0489	0.0539	0.0433	0.0400
	(0.0356)	(0.0340)	(0.0376)	(0.0345)	(0.0347)
Windsor	-0.155***	-0.129**	-0.115*	-0.135**	-0.136**
	(0.0556)	(0.0536)	(0.0659)	(0.0536)	(0.0538)
York	0.0779**	0.0815**	0.0871**	0.0761**	0.0777**
	(0.0356)	(0.0342)	(0.0374)	(0.0344)	(0.0349)
Admin.	0.0934***	0.0917***	0.0902***	0.0951***	0.0945***
	(0.0174)	(0.0168)	(0.0192)	(0.0167)	(0.0175)
Female	0.00204	-0.00415	0.00431	-0.00452	-0.00293
	(0.0180)	(0.0171)	(0.0192)	(0.0172)	(0.0174)
Salary Adj.	0.00187	0.00580	0.00677	0.00403	-0.00444
	(0.0214)	(0.0205)	(0.0227)	(0.0206)	(0.0209)
ln(Years)	0.140***	0.145***	0.147***	0.146***	0.158***
	(0.0150)	(0.0129)	(0.0159)	(0.0130)	(0.0113)
ln(Articles)	0.0348***				
	(0.0107)				
ln(h-index)		0.0500***			
		(0.0129)			
ln(i10-index)			0.0368***		
			(0.0108)		
ln(Citations)				0.0222***	
				(0.00609)	
ln(Recent Cit.)					0.0278***
					(0.00691)
Constant	11.45***	11.44***	11.46***	11.41***	11.41***
	(0.0407)	(0.0380)	(0.0482)	(0.0384)	(0.0391)
Observations	294	298	251	298	288
R-squared	0.640	0.667	0.614	0.665	0.662

*Wilfrid Laurier is the base level for the university fixed effects; Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

8.2 Appendix B: Data Sources

Appendix Table 13. Data Sources

Variables	Organization	Source	Data Accessed
Frame: individuals to include in sample, including individual characteristics	Universities respective economics department websites	Algoma University: algomau.ca/economics/faculty/ Brock University: brocku.ca/social-sciences/departments-and-centres/economics/faculty/faculty-directory Carleton University: carleton.ca/economics/faculty-and-staff/regular-faculty/ Huron University College: huronuc.on.ca/Academics/FacultyofArtsandSocialScience/Economics/Faculty King's University College: kings.uwo.ca/academics/economics-and-finance/people/ Lakehead University: lakeheadu.ca/academics/departments/economics/people Laurentian University: laurentian.ca/program/economics McMaster University: economics.mcmaster.ca/people Nipissing University: nipissingu.ca/academics/faculties/arts-science/Pages/Chairs-and-Faculty.aspx Queen's University:econ.queensu.ca/people/faculty Ryerson University: economics.ryerson.ca/index.php/people/faculty Trent University: trentu.ca/economics/staff.php University of Guelph: uoguelph.ca/economics/people?role=Faculty&=Apply University of Ottawa: socialsciences.uottawa.ca/economics/about-department/professors University of Toronto: economics.utoronto.ca/index.php/index/person/faculty University of Waterloo: uwaterloo.ca/economics/about/people/faculty-0 University of Western Ontario: economics.uwo.ca/people/faculty/faculty.html University of Windsor: uwindsor.ca/economics/our-faculty-and-staff Wilfrid Laurier University: legacy.wlu.ca/fac_listing.php?grp_id=491 York University: people.laps.yorku.ca/people.nsf/facultydirectory?readForm&unit=econ	January and February 2016
Salary	Ontario public sector salary disclosure	2015 Salary: https://www.ontario.ca/page/public-sector-salary-disclosure-2015-all-sectors-and-seconded-employees 2014 Salary: https://www.ontario.ca/page/public-sector-salary-disclosure-act-disclosures-2014 2013 Salary: https://www.ontario.ca/page/public-sector-salary-disclosure-act-disclosures-2013	March 2016
Bibliometric Data	*CitEc*	http://citec.repec.org/p/index.html	Initial variables April 2016 Expanded variables (articles and publications) Fall 2016

University Research Type	Maclean's Magazine Higher Education Quality Council of Ontario	Maclean's: http://www.macleans.ca/education/unirankings/university-rankings-2015-methodology/ Weingarten, H. P., Hicks, M., Jonker, L., & Liu, S. (2013, July 23). The Diversity of Ontario's Universities: A Data set to Inform the Differentiation Discussion.	April 2016
Union Status	Journal publication	Sen, A., Ariizumi, H., & Desousa, N. (2014, March). Evaluating the Relationship between Pay and Research Productivity: Panel Data Evidence from Ontario Universities. Canadian Public Policy / Analyse de Politiques, pp. 1-14.	2016
Historical Faculty Lists	Internet Archive	Storage of historical websites: https://archive.org/web/ Websites looked up using archive feature and historical date viewed: Algoma University: Not Available Brock University: brocku.ca/social-sciences/departments-and-centres/economics/faculty/faculty-directory June 9, 2014 Carleton University: carleton.ca/economics/faculty-and-staff/regular-faculty/ December 3, 2014 King's University College: Not Available Laurentian University: Not Available McMaster University: economics.mcmaster.ca/people November 24, 2014 Nipissing University: nipissingu.ca/academics/faculties/arts-science/Pages/Chairs-and-Faculty.aspx July 10, 2013 Queen's University:econ.queensu.ca/people/faculty September 8, 2013 August 11, 2014 Ryerson University: economics.ryerson.ca/index.php/people/faculty September 8, 2013 Trent University: trentu.ca/economics/staff.php July 29, 2014 University of Guelph: uoguelph.ca/economics/people?role=Faculty&=Apply July 10, 2013 University of Ottawa: Not Available University of Toronto: economics.utoronto.ca/index.php/index/person/faculty October 12, 2013 October 24, 2014 University of Waterloo: Not Available University of Western Ontario: economics.uwo.ca/people/faculty/faculty.html August 16, 2013 University of Windsor: uwindsor.ca/economics/our-faculty-and-staff August 29, 2014 Wilfrid Laurier University: legacy.wlu.ca/fac_listing.php?grp_id=491 May 14, 2015 York University: people.laps.yorku.ca/people.nsf/facultydirectory?readForm&unit=econ March 23, 2015	August 2017