THE CHANGING STRUCTURE OF INEQUALITY IN CANADA: A MULTI-LEVEL ANALYSIS OF LICENSING AND EDUCATION EFFECTS ON WAGES WITHIN AND ACROSS OCCUPATIONS

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Abstract

This dissertation investigates the claim that occupational licensing functions as social closure, creating barriers to entry and generating rent for its existing members, and that licensing has thus contributed to increasing wage inequality. Using Statistics Canada's Labour Force Survey and a database of occupational regulations collected from public data sources, I explore the wage effects of licensing and how it interacts with other occupational characteristics. This dissertation includes three primary chapters. Chapter 3 compares a human capital approach with a social closure model using two-level hierarchical models. I find that the entire wage premium associated with licensing can be explained by education and skill differences between occupations, suggesting licensing does not have independent effects on wages. Chapter 4 explores the question of *how* education shapes wages; is it just human capital or can it function as social closure? I use factor analysis to measure the presence of different labour allocation mechanisms, reflecting the influence of human capital, internal labour markets, and social closure. I also explore the extent of over-qualification and returns to over-qualification to indicate how the three mechanisms shape the effect education on wages. I conclude that education does function differently based on the three mechanisms, and that it can function as social closure. Finally, chapter 5 employs growth curve models to investigate the wage effects of new licenses enacted between 1997 and 2019. I am able to show that new licenses do have wage effects, contributing to an acceleration in wage growth after enactment, an effect that is more significant if the occupation achieves high levels of coverage, and that education plays only a small part in this process. Overall, I conclude that occupational licensing can have wage effects independent of education, but this effect is modified by other occupational characteristics like education, the number of years since the license was enacted, and the coverage of licensing achieved in the occupation. While licensing does appear to contribute to wage inequality, it is likely that licensing is only one part of a larger societal process of institutional transformation in the Canadian labour market.

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Chapter 1: Literature Review

Introduction

Over the past several decades a number of nations, including Canada, have experienced a pattern of increasing economic inequality (Brzozowski, Gervais, Klein, & Suzuki, 2010; Fortin, Green, Lemieux, Milligan, & Riddell, 2012; Green & Sand, 2015; Piketty, 2014; Saez & Veall, 2005). Many argue that this development coincided with the rise of neoliberalism and its associated policy prescriptions. They contend that increasing inequality is a consequence of market oriented reforms, trade liberalization, and cuts to social programs (Harvey, 2007; Navarro, 2007). However, it may be argued that both neoliberalism and the associated increase in economic inequality are ultimately the result of more fundamental ongoing structural processes. One such process is the transformation of the structure of labour markets, and associated shifts in labour market regulation and the development of supporting institutions, including for example, the establishment of occupational licensing and the creation of specialized education programs.

Licensing and educational credentialing, have become increasingly common in labour markets, acting as a mechanism through which structural changes occur. Licensing is regarded as a form of social closure that uses the power of the state to create the right to practice, erecting formal barriers to entry and excluding those who do not meet certain requirements (Kleiner & Krueger, 2010; Sørensen, 1996; Weeden, 2002). This creates rent in certain occupations by altering supply and demand in order to decrease competition and increase rewards. In contrast, some disagree and speculate that modern forms of licensure actually facilitate the entry of new workers into an occupation rather than being exclusionary (Redbird, 2017). This could be accomplished for example, through the creation of educational institutions intended to prepare workers to meet licensing requirements. This disagreement suggests a need for further analysis of licensing, education, and their effect on wages.

The effects of education and credentialing are even more complex, as suggested by three prominent theories that attempt to explain how education affects earnings and employment. The most widely recognized is human capital theory, which argues that education entails the acquisition of skills and knowledge that improve productivity, leading to higher wages (Becker,

1964; Mincer, 1970). A second theory sees labour productivity as attached to jobs, not workers, and so workers do not compete for wages but for access to jobs (Thurow, 1975). From this perspective education acts a crude signal of a worker's inherent characteristics such as intelligence or dedication, which affect the cost of training and thus, the likelihood of being hired or promoted into higher paying jobs (Weiss, 1995). A third theory sees education and credentialing as a form of social closure itself because access to and success in education excludes some people from acquiring it, barring them from particular types of employment (D. K. Brown, 1995; Murphy, 1988; Weber, 1978). It is doubtful that any of these theories can provide a singular explanation for the growth of inequality in recent decades. Instead it is likely that the effects of education vary according to the structural context of the labour market, differentiated by occupation, region, and industry (Van de Werfhorst, 2011).

We are therefore left with the question of how licensing relates to education and how it varies across occupational markets, and what their combined effects might be on the distribution of wages and on the widespread trend of increasing inequality. Research by Redbird (2017) and Van de Werfhorst (2011) for example, suggest that these two mechanisms are associated. Their work however, has some important limitations and does not provide a satisfactory explanation of their effects. I believe that licensing and education operate in conjunction, along with other factors like market forces, cultural change, and technological development, to produce change in the structure of labour markets. Analysis of the combined effects of licensing and education will help to explain long term trends in economic inequality.

This dissertation examines the effect of licensing, education, and credentialing on occupational wage rates in Canada, relying centrally on Statistics Canada's monthly Labour Force Survey (LFS) and a database of occupational regulations in Canada of my own creation. My initial argument is that the regulation of entry, as well as the practice of an occupation produces rent but this effect varies between occupations and regional labour markets and also depends on the education, experience and other personal characteristics of workers. My analyses draw upon the theoretical insights from labour economics and stratification sociology which are introduced and discussed in this chapter. From these theories I attempt to elaborate a theoretical framework that combines the traditional economist emphasis on markets and individual behaviour with a sociological focus on structural and institutional effects. This approach will

address many of the limitations in existing research and make a contribution to our understanding of labour markets, the effects of government regulation, and the role of supportive institutions in shaping both their structure and their social and economic consequences.

Literature Review

This dissertation concerns the structures and processes that produce inequality within and between labour markets. To start, we can consider a labour market, in its most basic sense, to simply be an arena in which workers exchange their labour power for wages, status, and other rewards (Kalleberg & Sorensen, 1979). Labour markets possess certain characteristics, such as institutions and commonly accepted practices that govern the purchase, sale, and price of labour. These include those structures that shape the allocation of individuals to different kinds of jobs, the rules and institutions that govern qualifications, mobility, the acquisition of skills, and the distribution of rewards. Specifically, and important for the purpose of this paper, occupations play a central role in defining the structure of labour markets. Occupations arise from the technical division of labour and define the arena in which demand for certain tasks is connected to the supply of workers who possess the skills needed to carry out those tasks.

A number of theories attempt to explain how wages are determined in different labour markets. This dissertation integrates elements of human capital theory, internal labour market (ILM) theory, and stratification sociology into a comprehensive theoretical framework that allows for the analysis of the multiple factors which shape wage distribution across various labour markets. Importantly, this framework is able to account for both the influence of individual characteristics and the characteristics of occupational labour markets in the wage determination process. For example, it is able to account for the effect of individual educational attainment on wages within a given labour market while situating that effect within the context of occupational markets that differ in terms of credential requirements or the prevalence (and form) of various institutions like schools and regulatory bodies. Put simply, this approach aims to explain wage determination as a result of the interaction of individual characteristics with processes that operate within, and differ between, occupational labour markets.

Theoretical Models of the Labour Market

In classical theory the labour market functions much like any commodity market, operating as a large singular competitive system where wages are determined by supply and demand, being affected by such things as the desirability or the cost of training associated with different jobs. For Adam Smith (1999, 1910), wage inequality occurs and persists partly because institutional constraints and regulations impede labour mobility and alter competitive pressures. Smith is criticized for relying on an overly simple conception of wage determination as well as his treatment of the labour market as one large singular system. John Stuart Mill (1890, 1848) proposed the alternative idea of non-competing groups, each subject to different kinds of employment, consisting of different individuals, and operating by different rules and institutional systems. This approach helps to explain why wages do not tend toward equilibrium between different kinds of employment in real labour markets. It also suggests that a more complex conception of the structure and operation of the labour market is needed, one where market forces are not necessarily absent but are constrained, altered, or channeled in a systematic manner that affects the distribution of wages. The idea of non-competing groups is found in a number of modern labour market theories and can appropriately be applied to the role of occupations (Kalleberg & Sorensen, 1979; Leontaridi, 1998; Sweetland, 1996).

Human Capital Theory

Human capital theory is the dominant modern conception of the labour market. Its origin can be traced to the 1960's, centrally to early in the work of Gary Becker, who in 1964 published *Human Capital*. This and other works (Mincer, 1958, 1974; Schultz, 1963, 1971) mark the earliest attempts to employ the logic of investment typically applied to physical capital, to expenditures on health, social services, and education. Human capital theory adheres to the neoclassical assumption of a perfectly competitive market, but sees wage determination as linked to market forces by arguing that worker's pay is determined by productivity. The basis for human capital theory is the simple idea that people spend on themselves and at times this spending takes the form of an investment (Blaug, 1976; S. Brown & Sessions, 2004; Wang & Sun, 2009). From a human capital perspective, expenditures on education and training are literally investments that have a rate of return that is based on the extent to which they provide a person with productivity enhancing skills (Becker, 1964). The rate of return on this investment

is determined by supply and demand for a particular set of skills and is seen as compensation for the cost and forgone earnings involved in acquiring these skills.

It is generally assumed that demand for education or skills is stable over the long term and thus persistent wage differences are explained almost entirely by the supply side effects of education, training, and experience in a given population (Kalleberg & Sorensen, 1979). While this assumption may be flawed, it is seen by some to reconcile the neoclassical idea of compensating wage differentials with the persistence of wage differences observed in actual labour markets (Kalleberg & Sorensen, 1979). When the logic of human capital theory is applied to a conception of the labour market that includes the idea of non-competing groups, it can help to explain persistent wage differences between groups of workers. For example, if we accept that skill requirements within occupations do not change much over the long/medium term, wage differences between occupations might be explained by those differences in skill requirements. From this perspective, persistent wage differences between occupations result from fundamental differences in occupational training and educational requirements which, as mentioned above, are generally assumed stable. Human capital theory explains wage differences within occupations by certain supply side effects including differences in education, experience, and ability or other measures of human capital at the individual level.

While human capital theory can help to explain persistent wage differences, it suffers from some important limitations. There are two main critiques. First, the assumption that education affects ability may be flawed or too simple (Blaug, 1976, 1992; Marginson, 2017; Sweetland, 1996). This assumption results in methodological problems relating to the use of overly simple earnings models. In a standard human capital model there is potential for biased estimation of the effect of education if the model does not include other independent and interaction effects that relate to wages. For example, human capital theory does not account for the role of background characteristics in wage determination. If variables like parents' education or family income affect earnings (either directly or through education) and are not included the model, the estimated effect of education will be biased upward.

Second, the assumption that income differences reflect differences in marginal productivity may also be too simple (Blaug, 1976, 1987; Marginson, 2017; Sweetland, 1996). Firstly, it is difficult to separate the effect of individual characteristics from the effects of other

factors of production on labour productivity, such as investment in technology. There are a number of alternative theories that suggest several possible explanations for a mismatch between productivity and wages. Some of these emphasize the effects of training costs which are considered to be quasi-fixed in that they do not vary in relation to tenure (Kampelmann & Rycx, 2012). These costs may be amortized in profit seeking firms by paying a sub-marginal product wage and this effect is likely to vary between occupations and firms depending on things like skill specificity (Oi, 1962). Another class of theories relies on more sophisticated conceptions of individual utility, recognizing that individuals can be incentivised by things other than one's own wages (Kampelmann & Rycx, 2012). For example, if inequality in pay is seen as unfair this may reduce effort and some firms will combat this by paying high productivity workers (or jobs) below their marginal product and low productivity workers above their marginal product. If either of these effects is common, the relation between productivity and wages will be highly variable across the labour market. Ultimately, a significant problem with any theory of productivity based rewards is that productivity is almost never measured directly, so connecting productivity to wages empirically is difficult. The acquisition of skills and its relation to pay are likely to vary across firms, markets, and occupations. These differences can alter the relevance of education to wages across varying contexts. For example, if an employer requires specific skills or if institutions or regulations dictate certain aspects of employment in some occupations, these differences can shape rewards for skills and education. So, the myriad differences between occupations present a significant analytical challenge in that they make inter-occupation comparisons of productivity and its relation to wages difficult.

Finally, it is worth noting an overarching critique of neoclassical theory not addressed in the human capital approach is the importance of imperfections. Deviations from the perfectly competitive market conception of neoclassical theory are highly debated. The basis of the criticism is that treating these deviations as mere 'imperfections' limits the ability of the theory to provide an understanding of real markets. It also implies a normative standard that may have negative implications if enacted into policy, particularly if it is done so on the basis of an incorrect/incomplete understanding of markets. Some alterative theoretical traditions treat these 'imperfections' as features of actual markets that should be accounted for both in theory and in analytical models.

Internal Labour Markets

One alternative labour market theory relies on the concept of the internal labour market (ILM), which explains the importance of institutions, regulations and social relations in markets, without reducing them to imperfections. The concept came out of institutional economics in the 1950's as part of an attempt to account for variation in the institutional characteristics that shape the structure of different markets (Leontaridi, 1998). The basic definition of an internal labour market is: a set of rules and bureaucratic systems that facilitate the movement of workers between jobs within a given organization (Kalleberg & Sorensen, 1979; Kerr, 1954). These organizations may be large firms, unions, government agencies or other institutional structures that determine or exert influence over the allocation of workers to jobs, as well as access to training and the distribution of rewards. Formal and informal rules and procedures thus structure the labour market, replacing or modifying the influence of market forces (Kerr, 1954). An internal labour market differs from a more typical "external" market where these allocation and distribution functions are more directly determined by market forces (Dunlop, 1957). Internal labour markets emerge in situations where market conditions result in unreliable demand, incentivising firms to minimize labour costs from turnover by maintaining opportunities for advancement within the organization (Blaug, 1976). Generally an internal market is contained within a single organization, but this idea can be expanded upon by considering the ways in which ILM's form part of the structure of larger labour markets (i.e., those defined by an industry, region, or occupation). These organizations effectively subdivide existing markets into a number of smaller internal markets, that is, an occupational market may be subdivided by a group of large firms, each of which creates its own semi-independent internal labour market. Through the creation of job ladders, seniority systems, collective bargaining arrangements, and government regulations, these organizations shape employment and income distribution within individual occupational markets, spanning multiple occupations. These systems impose an order on the labour market that functions semi-independently of market forces.

Employment relations in ILM's are characterized by a relatively long tenure and job opportunities that come with on the job training specific to an organization. Employers in this type of market tend to have specific and enduring technical requirements in terms of education and other background characteristics for new applicants. This differs from what a human capital model would predict, which is that the more highly educated person always has the competitive

advantage if the labour market operates on the basis of wage competition. A human capital model would also predict a decline over time in the wage premium afforded to a particular level or type of education, as the competitive market would incentivise increasing supply to meet demand (assuming demand remains stable). There is no explanation in human capital theory for the long term persistence of educational requirements observed in some labour markets. It is often argued that whatever the effect of education, employers can never accurately assess the true skills and productivity of a given worker at the time of hiring. Employers must therefore rely on a crude signal of these qualities which are associated with certain groups (Blaug, 1976; Spence, 1973).

ILM theorists argue that education does not involve the acquisition of skills, but is an indication of inherent abilities and personality traits such as intelligence, dedication, or the ability to work in a rule based organization (Spence, 1973). Education is the most common "signal" employers use to screen external applicants and make a simple estimation of the cost of training a worker (Arrow, 1973; Blaug, 1976; Thurow, 1975). This differs from the wage competition model of human capital theory, in which workers compete not for wages but for jobs and the characteristics of jobs determine productivity and therefore wages (S. Brown & Sessions, 2004; Thurow, 1975). In this kind of market individual workers are ordered into a labour queue, which is a ranking of individuals based on their estimated training cost, which is in turn based mostly on their education, with those at the top being selected for the most complex and higher paying jobs. Educational attainment determines one's position in the queue rather than affecting one's productivity (Van de Werfhorst, 2011).

This sorting mechanism also effectively subdivides the labour market into non-competing groups or segments by limiting mobility between them. Internal labour markets contribute to segmentation through their reliance on educational credentials, institutional rules, and regulations that insulate certain jobs from competitive pressures with the consequence that some find it difficult to gain entry into these kinds of markets. It is often argued that the concept of segmentation raises doubts regarding a straightforward connection of wages and worker allocation to individual characteristics like human capital or the inherent abilities mentioned above (Leontaridi, 1998). Instead, the labour market consists of many non-competing segments between which rewards to human capital differ, not as a result of individual differences in skills

or abilities, but as a result of other factors, like institutional rules that maintain barriers between segments. Thus, wage inequality persists because certain groups become trapped in lower segments as a result of such things as social class background (Doeringer & Piore, 1971; Leontaridi, 1998). Classically, the segmented labour market has been conceived as a dual market system consisting of a high paid primary sector characterised by high wages, good working conditions, and job security, while jobs in the secondary sector are less stable, less pleasant, and lower paying (Piore, 1969, 1970). A conception of segmentation that can effectively characterize modern labour markets would account for the multiple market-level factors that inhibit labour mobility, including not just ILMs but other institutions and regulatory systems such as educational institutions, credentialing, and licensing requirements. Occupations represent an ideal way to operationalize labour market segments in that they consist of non-competing groups and possess institutional and regulatory characteristics that shape both wage determination and labour allocation (Kreckel, 1980; Leontaridi, 1998). It is also important to account for the role played by individual characteristics in relation to these occupational systems and how they combine to prevent some people from entering certain sectors, resulting in a form of labour market segmentation that can be complex.

The importance of education from the ILM perspective diminishes the role of supply side dynamics and market forces more generally, but is not inconsistent with human capital theory in that education still pays off. Furthermore, a job competition approach is able to link the concept of ILM's to certain neoclassical assumptions in that profit maximization behaviour is consistent with attempts to minimize the costs of on the job training. Where this theory differs is that the incentive for individuals is not to acquire skills to maximize wages but rather to acquire the credential that functions as the appropriate market signal to maximize their chance of getting a high paying (or high status) job. The implication of this is that there is a rate of return tied to education as a selection mechanism rather than to education as the acquisition of productivity enhancing skills. Theorization of supply dynamics in ILMs centres on the fact that institutional rules create boundaries to between-market labour mobility. These boundaries influence the supply of labour to these kinds of markets by excluding or prioritizing certain candidates and by shaping the behaviour (i.e., educational attainment) of those that wish to enter them. Internal labour markets limit between-firm mobility, while occupational regulations limit between-

occupation mobility, and these two can intersect to create complex market systems that shape worker allocation and the distribution of wages within and across labour markets.

One significant limitation of ILM theory is that it does not on its own provide an overarching explanation of larger market systems, such as occupational markets or national economies. It may also be argued that Internal Labour Market theory deemphasises the role of supply side effects in regard to skills and education which limits the ability of this approach to explain certain labour market outcomes. To address these limitations and explore questions about wage distribution in labour markets more generally calls for additional theoretical concepts. Drawing on insights from economic sociology while integrating concepts from ILM and human capital theory will provide a theoretical framework capable of explaining wage variability within and across a large number of differing sub-labour markets.

Stratification Sociology

What is needed is to conceptually link individual labour markets to a wider economic system (as well as to each other) while also identifying the characteristics of labour markets that are relevant to economic inequality, and understand both how these characteristics affect wage distribution and how these effects vary between contexts. This can be done by drawing on stratification sociology, specifically a structural theory of social inequality elaborated by Aage Sørensen (1996). Social structures, like labour markets, are related to income inequality in a number of ways (Sørensen, 1996; Weeden, 2002). First, social structures are hierarchical, with some positions within them being more accessible and more numerous than others. Second, rewards (along with other properties) differ between these positions. Third, the differences between positions in a structure have behavioural consequences in that they incentivise behaviour designed to gain access to positions and alter or maintain their properties. We can add that individual characteristics interact with positions in a structure, and their properties, and this shapes both the allocation of individuals into these positions as well as the outcomes they produce. Additionally, all of these processes interact with each other and with others, such as market forces, to alter their social and economic consequences.

In this conception, any social system, like a labour market, consists of a hierarchically structured arrangement of distinct but interrelated positions occupied by one or more individuals. In a labour market these positions can be defined by occupation, industry, geography or

jurisdiction. Occupations are both salient to this project and an ideal way to define the structure of a labour market. Occupations can therefore, be thought of as an example of hierarchically arranged 'positions' and thus define how we conceptualize the labour market as a social structure. In practically any economic system, the division of labour acts as a social mechanism that is based on the realities of production. Production involves the tasks and technical requirements that can be aggregated into groups to define occupations. It is through the division of labour as well as the decisions of employers that individuals are allocated into groups that share certain characteristics defined by the technical requirements of the occupation and the rewards that are associated with its position in the social structure of the labour market (Bielby & Kalleberg, 1981). With this conception then, occupations are an important social grouping in the labour market and help to define its structure and thus also the structure of inequality.

There are two ways in which social structures like the labour market shape the distribution of wealth in a capitalist society. One is generally recognized in economic theory, and entails the ways in which social structures shape the behaviour of individuals both within a given position as well as among those that seek to enter it (i.e., by acquiring education, seeking out training, increasing individual productivity to gain a promotion and so on). These behaviours then affect outcomes for individuals within these positions due in large part to the ways in which individual characteristics lead to differing abilities to take advantage of opportunities (Sørensen, 1977, 1996). A second (and more commonly overlooked) issue is that positions within a social structure tend to have certain properties that are independent of the characteristics of individuals and that shape outcomes for those that occupy them. The implication is that some (or even most) of the differences in wages or other rewards between positions are derived from the characteristics of the positions themselves, independent of individual action (Sørensen, 1996). The relation between inequality and social structures can be understood with the concept of rent. Rent is essentially a payment for the use of a limited economic resource, such as land, new technologies, or uncommon abilities (Sørensen, 1996, p. 1338). The key characteristic of this payment is that it is obtained from possession of the resource only, and not for any effort on the part of the owner. Sørensen (1996) extends this concept to include a broader meaning of the term 'resources', so that it includes positions in a social structure with properties that shape outcomes, such as wages.

To clarify, given Sorensen's use of the concept of rent, his argument appears to be that within a given structure some portion of the distribution of rewards is still due to individual characteristics, like experience or productivity, and these can be associated with positions in the sense that the position incentivizes their acquisition. However, there is also a portion that is due purely to the characteristics of the positions themselves, independent of the individuals within them. Sørensen (1996) argues that the benefits associated with occupying a position in a given social structure are determined independently of individual effort or ability (p.1338). This suggests that all the individuals in a given position would receive the same (or proportional) benefit from the rent accruing to that position. I would add that the effects of the characteristics of any given position in a social structure (like occupational labour markets) can vary across the individuals in that position as a function of their individual characteristics. In technical terms, this implies one set of separate effects for individual variables, another set for the characteristics of the position, and a third set for the potential interaction between individual and position characteristics. For example, the effects of individual educational attainment on wages may vary across occupations. There is also the possibility of interactions between intersecting positions (i.e., occupation and industry). Sorensen's (1996) concept of a pure structural effect on inequality suggests that there is some universality in the effect of a structure within a given position and thus, in Sorensen's conception, some portion of inequality and its social consequences is endogenous to social structures. If there is however, some interplay of individual and structural effects this would suggest a more complex picture where structural inequality and its consequences are not evenly distributed both between and within positions in a given social structure.

The importance of rent in a structural conception of inequality can be understood from an examination of how rent produces various social consequences. Many of the social consequences of rent come from its tendency to generate zero-sum competition (Sørensen, 1996). This occurs because a rent generating position in a social structure is by definition in limited supply and always incentivizes more individuals to compete for the position than can obtain it. Thus, a consequence of this competition is the oversupply of labour for certain positions which results in social waste, for example in the form of over investment in education (Sørensen, 1996, p. 1346). Another consequence of zero-sum competition is that it produces interdependence in the behaviour of individuals. Sørensen (1996) points out that this is the

impetus for strategic behaviours like collective agreements that lower competitiveness in the pursuit of rents (p. 1347). This interdependence may also affect the generation of structural inequality, in the sense that the actions of those who successfully acquire rent are not independent of those who are excluded from it. The costs and benefits associated with the pursuit of rent are not equally distributed, and those who occupy certain positions may seek to alter the properties of their position, for example by lobbying for licensing, to their benefit, but to the detriment of outsiders. Further, the creation of rent also shapes economic inequality by creating lower level strata within a given position (i.e., an unlicensed sector in an occupational market) or creating a new position that is located below the protected one in the structure, such as a new and distinct occupation that produces less rent.

The potential social consequences of rent raise the question of how it is created in a labour market, particularly in relation to positions in a social structure that can or should be able to function without it. We should distinguish between rents generated from resources that are naturally in limited supply from those whose supply is kept low artificially. Weber (1978) argues that situations where people face competitive pressures in obtaining their livelihood will result in the creation of groups aspiring to protect these opportunities from competition. Groups attempt to do this by erecting formal or informal barriers to entry, reducing competition and maximizing rewards. The general term for this is *social closure*, which describes any situation where incumbents within a position in a social structure attempt to monopolize that position by closing off opportunities for outsiders (Kreckel, 1980; Redbird, 2017; Weber, 1978; Weeden, 2002).

Occupational closure is a specific instance of social closure. Occupations and their members are social groups that possess certain characteristics, which define the social conditions of the occupation and the ability of its members to exert the control necessary to create the boundaries that exclude outsiders and protect their rewards (Weber, 1978; Weeden, 2002). Generally, occupational closure is accomplished by elites (i.e., those in high paying and/or high status occupations) but is carried out through institutions that give closure some measure of legitimacy (Van de Werfhorst, 2011). The exclusionary effect of social closure is what is necessary to generate rent, and does so by limiting the supply of workers in a given occupational market (Redbird, 2017; Sørensen, 1996; Weeden, 2002). An occupation and its social conditions

define the extent of closure, as well as how it functions within the occupation's membership, which is how different individuals in the occupation are affected both positively and negatively. An occupation and its characteristics can shape the effect of social closure on wage distribution, both internally and within the larger social structure.

It has become more generally accepted that changes in economic inequality, like the upward trend seen in Canada over the last several decades, can be explained more by changes in the prevalence and distribution of rent than by changes in market competition (Redbird & Grusky, 2015; Sørensen, 1996). In sociology this is commonly referred to as the rent destruction or redistribution hypothesis. This hypothesis argues that increasing inequality is due in large part to the simultaneous loss of rent among lower class groups (as a result of the decline of unions for example) and the creation of rent among upper class groups (through such things as stock ownership, skill biased technological change, and social closure) which has shifted wealth upwards; increasing inequality (Morgan & Cha, 2007; Redbird & Grusky, 2015; Sørensen, 2000). My dissertation is concerned with occupational closure as a specific form of social closure that accrues rent to occupations. This implies that a significant proportion of rent redistribution occurs between occupations; specifically detailed occupations (discussed more in the next section). This understanding draws on a related concept referred to as *disaggregate structuration* which points to the fact that it is at the level of detailed occupational groupings that social closure occurs which creates barriers, reinforces self-selection, and promotes homogenization, and it is therefore at the level of detailed occupations that economic inequality is structured in modern economies (Grusky & Sorensen, 1998, pp. 1207-1208).

There is little existing research that can adequately test the importance of occupations as a key factor in the changing structure of inequality in modern economies. Kim and Sakamoto (2008) test Grusky and Sorensen's (1998) concept of disaggregate structuration using growth curve models consisting of repeated observations of Gini coefficients to measure within occupation wage inequality, and occupation mean wages to measure between occupation wage inequality. They find that the proportion of overall wage inequality that occurs between occupations has declined over time, suggesting that occupations have become a less significant factor in wage variability in the U.S. over time (Kim & Sakamoto, 2008, p. 152). Therefore, they conclude that there is little support for the concept of disaggregate structuration in the case

of the U.S. labour market. However, Mouw and Kalleberg (2010) convincingly argue that this conclusion is likely erroneous. This is because Kim and Sakamoto (2008) utilize a procedure known as hot deck imputation[1] to generate estimated wage values for those with missing responses, but instead of using detailed occupations they use major occupation groups. This would result in imputed wage values that tend toward the major occupation group mean rather than the detailed occupation mean to which they actually belong. As a result, the detailed occupation mean wage values would be less variable and this would shift some of the between occupation wage variability into the within occupation component, thus introducing a downward bias into the estimated between occupation component. Mouw and Kalleberg (2010), attempt to address this problem using multiple imputation with detailed occupations and their results suggest in Kim and Sakamoto's (2008) estimates are inaccurate, and conclude that there is support for the polarization of wages between occupations. Therefore, it does appear plausible that inequality is structured to some degree by detailed occupations and thus, changes in occupational characteristics may be an important factor in economic inequality and the ways in which it changes over time.

This research contributes to our understanding of the role occupations play in economic inequality; exploring how certain occupational characteristics shape wage inequality within and across occupational labour markets. It seeks to explain, not just if, but how occupations structure inequality in Canada and how this has changed over time. For this research the labour market is understood as a hierarchical arrangement of occupational-regional labour markets. Occupational markets are sub-divided by geographic and jurisdictional boundaries that affect labour mobility and subject workers in different regions to differing regulations. Specifically, licensing and credential requirements are established and enforced by provincial governments. While these occupational markets are part of a larger national social/economic system, they are semi-independent as a result of barriers to mobility between them, and there is variability in the characteristics they possess that determine how they function. This research integrates social closure, human capital and ILM theory into this overarching conception such that each of these occupational-regional markets can be classified as operating on the basis of one or some

[1] Hot deck imputation is one of the simplest methods of imputing missing data. In this case it would replace missing wage data with the value from the most recent processed individual with a valid observation on wages who has the same values on a set of variables and these could include sex, age, race, education, and occupation (Mouw & Kalleberg, 2010, p. 413).

combination of these theories. For example, some markets may operate on the basis of human capital, indicated by individual level returns to educational attainment and work experience, while others may be characterized by the presence of ILMs as indicated by such variables as firm size and job tenure. It is necessary to determine how individual and market level characteristics vary across labour market contexts and operate together in different occupational markets to shape wage determination.

Detailed Occupations and the Structure of Real Labour Markets

In the previous section we have defined occupations as positions within a hierarchical social structure but there are significant conceptual and methodological reasons to focus on the role of *detailed* occupations specifically. While these can be understood in the abstract terms discussed above, it is important to understand occupations as technical classifications and as units of analysis that are fundamental to the study of labor markets. Detailed occupations can be defined as a category, usually created by a government organization (like Statistics Canada for example) for the purpose of grouping functionally similar jobs together. These groups are created in a given cultural, economic, and technical context on the basis of similarity in typical activities, duties, site of employment, tenure, skills and education, as well as product or service produced (Hauser & Warren, 1997). Detailed occupations tend to be created around a set of tasks and these are commonly an occupation's defining characteristic. However, other factors can come into play such that some occupations are broadly defined enough that they include a large number different kinds of jobs while others are much more specialized, some are partly defined by industry, and some exist across multiple industries.

Some argue that it is detailed occupations specifically that represent the most realistic and empirical account of both the economic and social structure of labour markets because they are actual existing groups and they are the 'location' where rent extraction takes place (Grusky & Sorensen, 1998). As discussed in the previous section, occupations can be thought of as the 'components' in Sorensen's (1996) conception of a social system consisting of groups that form a larger social and economic structure, implying that it is at the level of detailed occupations that real labour markets are fundamentally structured. This also suggests that occupations emerge from existing economic, technological, social, cultural, and political systems and therefore possess or signal properties that are important to the sociological analysis of markets (Grusky &

Sorensen, 1998). Occupations are commonly recognized and embedded within modern societies, business, and governments; they also represent subjective career aspirations for many, and form the basis for educational institutions, promote their own subcultures, values, and even shape individual identity (Grusky & Galescu, 2005; Grusky & Sorensen, 1998; Kim & Sakamoto, 2008; Treiman, 1976). It is also important to note that while occupations have different human capital requirements, they are more than indicators of human capital and represent institutionalized segments in the division of labour (Weeden & Grusky, 2005).

The institutionalization of occupations, that is, the development of occupation specific organizations such as vocational schools and regulatory bodies, is an important factor in the study of labour markets and of economic inequality for two main reasons. One, occupational institutions shape the fundamental labour market characteristics of an occupation. Two, institutionalization varies in form and prevalence between detailed occupations specifically, reflecting differences in how narrowly an occupation is defined, such that more narrowly defined occupations are more likely to experience institutionalization. Institutional practices like professional standards enforcement and training requirements help to maintain differences between occupations in terms of values, customs, manners of dress and so on (Grusky & Sorensen, 1998). These systems also promote self selection inside occupations, producing homogeneity in such individual characteristics like abilities, background, attitudes and behaviour. It is also institutionalization that ensures social closure (and thus rent extraction) operates within detailed occupations, creating and reinforcing the economic and social boundaries between them.

In addition to type of work and extent of institutionalization, a key difference between detailed occupations is in compensation (See Kim and Sakamoto (2008) and Mouw and Kalleberg (2010) discussed above). This is multivariate and can include job security, benefits, and prestige in addition to wages. An important aspect of the differences in compensation between occupations is the degree of within occupation variability such that some occupations may be highly unequal in pay while others are more homogenous. These differences can reflect differences in occupation characteristics such as those that may shape the importance of human capital attainment versus credentials in wage determination. Finally, labour supply (and therefore also the process of self selection) occurs around detailed occupations based on

perceptions of certain occupation characteristics like remuneration, status, and intrinsic value. Some aspects of labour demand is shaped by employers, who define the tasks they need completed, or other gatekeepers who operate formal occupational mechanisms like licensing bodies, or vocational schools (Weeden & Grusky, 2005). It is therefore clear that it is at the level of detailed occupations that a number of key social and economic factors operate to shape economic inequality in modern societies.

Licensing, Credentials, and Education

Licensing is an increasingly common form of labour market regulation, which is thought to affect wages within and between occupational markets. Licensing has become increasingly prevalent in western economies, owing to a shift toward a more service based economy, the decline of unions, a desire to protect consumer safety, popular support for government control, and the professional aspirations of occupational groups. According to the Canadian Information Center for International Credentials (CICIC) approximately 13% of occupations are licensed somewhere in Canada, while about 20% of all jobs are in licensed occupations (CICIC, 2018). Licensing is described as one of the fastest growing institutions in the United States (Kleiner, 2006; Kleiner & Krueger, 2010) It is likely that licensing will continue to expand in Canada and remain a significant feature of modern labour markets well into the future.

Licensing creates the right to practice in a given occupation, mandating who can carry out certain tasks and can identify themselves with certain titles (Kleiner & Krueger, 2010; Redbird, 2017; Weeden, 2002). Licensing involves a set of pre-requisites that an individual must meet before they are granted this right, including educational requirements, apprenticeship, formal examination, citizenship, and even good moral character (i.e. lack of criminal record) (Redbird, 2017). These pre-requisites are administered either by a division of the state or by a regulatory agency specific to the occupation in a given region and commonly staffed and operated by existing license holders. Licensing differs from other forms of certification in that these rules and restrictions are enforced by the state, often with legal consequences for practicing without a license.

In Canada, occupational regulation includes licensing that restricts the right to practice, but also includes restrictions of the use of specific job titles, as well as both voluntary and mandatory certification. Occupational licenses are granted based on the assessment that an

individual can perform the job. Mandatory certification is similar to licensing is focused on the acquisition of necessary skills and training, and restricts the right to work in a job to recognized apprentices and journeymen/women. Both licenses and mandatory certification created by provincial governments through acts of legislation, which authorize a professional association to exert control over their occupation, and can include definition of the scope of practice, and establishing entry standards, in addition to establishing the right to practice. Some exceptions exist, including most occupations associated with air travel such as air plane mechanics, and pilots, which are regulated by Transport Canada rather than a provincial regulatory body, but these regulations function in a very similar manner, effectively restricting who can work in the regulated occupation.

Licensing represents the culmination of a 'project' of professionalization, the basis for which is the assertion of an exclusive jurisdiction over an area of technical expertise (Redbird, 2017; Wilensky, 1964). The process of professionalization generally occurs through a five step process involving, not necessarily in a set order; 1) the definition of an occupation as a set of tasks (this must be broad enough that they cannot be mastered easily by outsiders, but not so broad that the occupation is not distinct from other disciplines); 2) the establishment of training schools; 3) the formation of professional associations; 4) lobbying for laws of protection and enforcement of ethical standards and; 5) the enactment of rules to remove the unqualified and reduce competition (Wilensky, 1964).

It is important to note that licensing can occur independently of professionalization. This raises the question of why some occupations become licensed while others do not. There are two theories that explain why licensing is enacted in certain occupations. The first holds that licensing is pursued by rent seeking incumbents who 'capture' state power using the wealth, status, and cultural capital they have acquired as members of certain high status and/or high paying occupations (Stigler, 1971). An alternative argument is that licensing is intended to protect public welfare and address problems of information asymmetry in certain kinds of occupations (Law & Kim, 2005; Shapiro, 1986). Stemming from this is the possibility that the state is not always "captured" but may instead be an active participant in the creation of regulatory bodies and may even be important in lending legitimacy to certain institutional forms (Zhou, 1993). It is likely that in some occupations licensing is pursued primarily by interest

groups seeking rent while in others the potential for externalities or threats to public welfare (i.e., collapsing buildings or the spread of infectious diseases) may make the need for regulation apparent enough that it is actively pursued by the government (Graddy, 1991).

Licensing is thought to create a barrier to entry and therefore, to function as a social closure mechanism in modern markets. Licensing (and its social closure effects) may have a number of positive and negative effects. Licensing is often justified on the basis that it protects consumers who lack information by removing low quality goods or services from the market. This provides some assurance about quality but also raises prices for those who would prefer or can only afford the low quality option (Shapiro, 1986). Additionally, as mentioned above, licensing may protect social welfare or minimize externalities by preventing the harms that come from errors in quality selection that are more or less costly in certain occupations (i.e., the harm caused by a poorly trained surgeon are more significant that those caused by a poorly trained massage therapist) (Graddy, 1991; Kleiner & Soltas, 2018; Shapiro, 1986). On the other hand, if licensing creates a sufficiently high barrier to entry it will generate rent within an occupation primarily by restricting the supply of labour, creating artificial scarcity and generating a wage premium in a given occupational market. In order to prevent a corresponding decline in demand, licensing is thought to also affect demand directly, by preventing the emergence of a non-licensed and therefore discounted labour market (relying on the power of the state), while also engaging in marketing campaigns and lobbying efforts to increase demand by signaling the quality of their services (Gittleman & Kleiner, 2016; Kleiner & Krueger, 2010; Redbird, 2017; Weeden, 2002). Under these conditions it is possible that licensing will produce a dis-employment effect (meaning less people employed than would be under optimal market conditions) and this may outweigh its benefits (Kleiner & Soltas, 2018). Where licensing is not as strictly enforced or when its regional coverage is low (meaning an occupation is licensed in one province but not others), it may instead create a bifurcation of the market that solidifies differences in wages between the licensed and unlicensed sectors and jurisdictions. Ultimately, if licensing functions as a form of social closure, it could exacerbate economic inequality, inflating the wages of those with a license at the expense of both consumers and those who are excluded from the market.

A number of studies find that licensing has social closure effects, producing a wage premium for those in licensed occupations. Weeden (2002) explores the wage effects of multiple closure strategies in the U.S. including licensing and credentialing, finding that all had significant effects but in particular that the supply restriction effects of licensing are most effective at 9%. Kleiner and Krueger (2010) similarly conclude that licensing in the U.S. has wage effects similar to that of unions increasing wages by as much as 15%. One significant limitation in much of the existing research is that it is cross sectional, making it difficult to empirically establish a causal relationship between licensing and wages. There are only a few who have conducted longitudinal studies of occupational regulation. Damelang, Haupt, and Abraham (2018) examine the effects of deregulation in German craft occupations. They argue that the relaxation of regulatory barriers to self employment altered the bargaining power of those that remained in the market, increasing competition and reducing wages after the reforms were enacted. Zhang (2019) however, examines licensing in Canada from 1999 to 2011 using fixed-effect models and concludes that the licensing wage premium can be attributed to unmeasured variables. On the other hand, Zhang and Gunderson (2020) use unconditional quantile regression and Statistics Canada's Labour Force Survey in 1998, 2008, and 2018, finding that licensing does increase wages and has more pronounced effects at the top of the wage distribution, contributing to wage inequality. Redbird (2017) compares all occupations over 30 years in the U.S, measuring the effect of time since the enactment of a new license. She finds no evidence of a wage premium in licensed occupations on average and concludes that licensing does not act as a mechanism of social closure. These more recent findings appear to contradict much of the older research as well as each other, raising important questions about the true wage effects of licensing. Redbird (2017) speculates that licensing may instead do the opposite, stimulating the creation of institutions that facilitate the entry of workers into an occupation. This suggests that the importance of licensing goes beyond supply and demand effects, and that it shapes the institutional character of the occupation, causing a shift toward more bureaucratic methods of operation. This could have the consequence of making entry into an occupation a more meritocratic process rather than being merely exclusionary.

Redbird however, cannot account for the contextual differences between occupations (for example, differences in market forces between occupations and between regions) and this prevents her analysis from being able to explain variability in the effects of licensing in different

occupations. The implication is that licensing has varied effects on wages, functioning as social closure in some occupations but not others. Redbird does not identify these occupations nor explain why licensing effects vary between them. While Redbird's conclusions regarding the institutional effects of licensing on occupations are only speculative, the notion of a broader licensing effect is useful. This is important given that occupations are clearly a complex component of labour markets and the effects of licensing may reach beyond simply altering market forces to also shape the institutions within an occupation. This suggests that the effects of licensing are likely to be different in different institutional and structural contexts, and any analysis of licensing should account for those relevant contextual factors. One key contextual factor worth considering is the effect of education, which is a common pre-requisite in licensed occupations and is also associated with institutions that can shape an occupation in important ways (i.e., by facilitating the entry of new workers, possibly even reversing the labour supply restrictions often associated with licensing, shaping the kinds of skills workers posses, institutionalising a meritocratic/bureaucratic process, or shaping the choices of individuals).

As suggested above, three theories offer explanations for the effects of education on wages: it may serve as a measure of skill acquisition or human capital, signal future training costs, or generate rent through social closure. The complexity in the effects of education comes from the possibility that some markets function on the basis of human capital, while others are characterised by the presence of many internal labour markets, and some may combine more than one function. Additionally, education effects in some occupations will be more varied across regions, and in some it will change over time. Given this complexity, we are left with the question of how licensing relates to education and its variability between occupational markets, and what their combined effects might be on the distribution of wages.

Redbird (2017) and Van de Werfhorst (2011) suggest that licensing can act as a social closure mechanism, but that the establishment of a license in an occupation also shapes the institutional character of that occupation over time, formalizing the entry of new workers. One indication of this would be the creation of formal educational programs that prepare students for entry into a licensed occupation (as law school is preparation for bar exams). This suggests that we might see social closure effects of licensing independently of education effects in occupations that are characterised by a *less* formalized educational institutional apparatus. Additionally, we

would also expect that with the expansion of licensing into an occupational market the resulting formalization of entry will promote the development of institutions supporting the operation of the market within the occupation. Hypothetically they would do this by facilitating the supply of labour through the establishment of schools and other institutions that prepare new entrants into a licensed occupation. Over time, we would expect licensed occupations to exhibit an increased prevalence of specific forms of education and credential attainment (i.e., vocational), correlated with the increased coverage of licensing in a given occupation. This may entail a shift of the rent generating/social closure effects from licensing to education, for example, by limiting the number of spaces in certain educational programs or erecting barriers to those with credentials from other jurisdictions. Alternatively it may be that this process reduces rent generation and instead promotes entry into an occupation as well as increasing equality in pay and employment.

Gender and Immigrant Status in the Labour Market

The theoretical framework elaborated above indicates the expectation that some individual characteristics can interact with the characteristics of positions in a social system, such as occupation in the labour market. There are two individual characteristics that are commonly examined in studies of the labour market and economic inequality, and which are present in the available data. These are gender and immigrant status, both of which are individual characteristics but may either have or relate to structural effects. The next two sections explore some theoretical arguments about how these characteristics function at the level of individuals and how they relate to the structural characteristics of the labour market system and contribute to economic inequality.

Gendered Labour Allocation and Occupational Inequality

A common conception of gender and its role in wage inequality draws upon segmentation theory to explain wage inequality between men and women as ultimately being a consequence of the gendered allocation of labour into differing occupations, even describing this process as 'gendered occupational segregation' (Dale, 1987; Schirle, 2015; Tam, 1997). While there has been a documented decline in the unexplained component of wage differences between men and women in Canada, occupation and industry continue to have sizable effects (Schirle, 2015). Some argue that while wage discrimination may not occur in western nations, the process through which men and women are allocated into different occupations is, in complex ways, gendered and even discriminatory (Dale, 1987; Tam, 1997). The result of this process is a sex

segregated labour market where wage differences between men and women occur largely as a result of gendered labour allocation into occupations and industries.

As an example, Dale (1987) argues that segmentation occurs in a gendered manner due to two interconnected processes: 1) the household division of labour shapes labour supply dynamics in different ways for men and women, and 2) the tendency for women to take on more domestic labour affects women's bargaining power in the labour market and results in women's labour being defined as unskilled and of lesser value. Dale's (1987) argument suggests that gender differences in wages occur primarily between occupations and reflect differences in the ability to negotiate the position of the occupation relative to other occupations, and this ability differs due to the presence of women in the occupation. While the salience of gender is likely to vary between occupations due, for example, to the presence of ILM's and social closure which alter labour supply dynamics in other ways, this 'devaluation' hypothesis implies that discrimination occurs against certain types of work (occupations) rather than against certain types of individuals. Thus gender is more important as an explanation of between occupation wage differences than it is as a determinant of individual wages.

An alternative explanation for between occupation wage differences contends that they result from differences in specialized human capital rather than the devaluation of certain kinds of work (Tam, 1997). The implication is that women tend to go into certain kinds of occupations which come with a certain type or amount of education and/or human capital requirements, and it is these requirements rather than the presence of women which explains the wage levels of those occupations. Tam (1997) employs a human capital model with measures of training as an indicator for the costs of education at the level of occupations. Once specialized human capital is accounted for the proportion of women in an occupation ceases to be a statistically significant contributor to wages (Tam, 1997, p. 1669). These results do suggest that it is not 'women's work' per se that is devalued but rather certain kinds of work requiring specific forms of education and training. Thus, while the valuation of labour may not be gendered, the process of labour allocation into different occupations may be. It is important to remember however, that while this process may be gendered, it could be discriminatory or it may result from differences in men and women's preferences.

Another possible explanation for wage differences between occupations and the associated difference in the proportion of women focuses on demand side effects, specifically the influence of bureaucratic systems in the labour market. Baron, Hannan, Hsu, and Koçak (2007) find that the adoption of bureaucratic hiring practices is associated with higher representation of women in high-tech start up firms in the United States. This occurs because the adoption of bureaucratic logic installs a set of objective rules that mean employers rely less on subjective judgements, informal social relations, and stereotypes in hiring and promotion decisions (Baron et al., 2007). Baron et al.'s (2007) work focuses on the effect of bureaucratic logic within firms, so it is unclear if this effect also operates at the level of occupations. Hypothetically, the presence of such things as ILM's, licensing, and credential requirements represent bureaucratic systems that shape entry into occupations, though not strictly as demand side effects. If these systems represent the implementation of bureaucratic logic within occupations, their presence could be an important explanation for differences in the salience of gender to wage determination between occupations and across the labour market as a whole.

Immigrant Human Capital, Credentials, and Earnings across Occupations

There is a common finding among literature about immigrants and the extent to which they successfully integrate into the labour market in North America. Generally, immigrants who arrive as adults have lower overall earnings than natives, but have greater returns to credentials than natives (Ferrer & Riddell, 2008; Gomez, Gunderson, Huang, & Zhang, 2015; Warman, Sweetman, & Goldmann, 2015). However, there has also been a downward trend in returns to pre-immigration labour experience as well as the pace of labour market integration (how long it takes an immigrant to achieve earning similar to comparable natives) (Gomez et al., 2015; Warman et al., 2015).

There are several factors that may explain this downward trend. One factor is that the origin of immigrants to Canada has shifted away from Europe to places like South America and Asia (Ferrer & Riddell, 2008). This shift could have come with a decline in the equivalence, and thus transferability of pre-immigration education and labour market experience. Both Ferrer and Riddell (2008) and Warman et al. (2015) find that credentials are beneficial to immigrants with returns to education that are equal or even higher when compared to natives. However, these benefits depend significantly on place of origin, language proficiency, and pre/post immigration

occupation matching (Ferrer & Riddell, 2008; Warman et al., 2015). This suggests that some of the downward trend in immigrant integration is due to a lack of credential recognition and language compatibility which delays job matching and earnings attainment among immigrants coming from certain parts of the world. Unlike credentials however, pre-immigration work experience is rarely rewarded in Canada, suggesting that certain kinds of human capital may not be 'portable' (Warman et al., 2015). While a lack of credential recognition slows immigrant integration the non-portability or work experience is a much longer lasting disadvantage to immigrants from some regions.

Another significant factor that shapes labour market outcomes for immigrants is occupational licensing. Gomez et al. (2015) find that licensing results in gains in earnings that even surpass comparable natives. This suggests that licensing can function as an effective means for assimilating adult immigrants into the labour force in those cases where immigrants manage to enter regulated occupations. On the other hand, Gomez et al. (2015) also find that immigrants have a lower probability of being in a regulated occupation. This may reflect the influence of those factors discussed above like credential recognition or language proficiency, or it may reflect other unmeasured variables that distinguish immigrants from natives. Some argue that occupational regulation itself presents an unfair barrier to entry for immigrants due to such things as testing procedures, and domestic experience requirements (Augustine, 2015; Gomez et al., 2015). Augustine (2015) compares occupation match rates in Ontario before and after Fair Access legislation was enacted in 2006 and contends that the law increased the probability of immigrants holding a license but that actual employment outcomes are moderated by other factors like labour market conditions. If licensing does present a barrier in and of itself to immigrants, this kind of legislation (which exists also in Manitoba, Quebec, British Columbia, and Nova Scotia) will result in different wage effects of licensing among immigrants in different occupations and jurisdictions.

Conclusion

Much of the research on labour markets and inequality employs a singular theoretical perspective. Often these are focused either on the process of individual attainment as in much of economic theory, or on the role of large abstract social groups as in class analyses. This chapter overviews three different theories of the labour market, attempting to draw upon the strengths of

each to generate a theoretical framework that addresses their weaknesses and allows for a comprehensive analytical approach to the study of labour markets. The first is Human Capital theory, which focuses on the individual attainment of skills that affect productivity, primarily through education. These skills allow an individual to earn higher wages in a conception of the labour market where wages are determined by the supply and demand for those skills.

The Second is Internal Labour Market theory which attempts to account for the role played by institutions and bureaucratic system of rules in forming the structure of labour markets and modifying the effects of market forces. In this conception education is not regarded as the acquisition of skills, instead it focuses more on the effect of credentials where a degree serves as a crude signal of training costs. So, rather than affecting wages by increasing productivity, education affects how likely it is that an applicant will be hired and/or promoted by an employer. While this theory accounts for the effects of institutions and bureaucratic systems, it still conceives of a labour market where the focus is on the individual attainment of education and its effect for that individual even though this is situated in an institutional setting. What is missing is an accounting of the role of larger economic and bureaucratic systems, such as those that operate at the level of a national economy, a particular region, or an occupation.

One of the main goals of this dissertation is to conceptualize the labour market in a way that can account for the importance of both the individual, as well as the larger structural context in which that individual behaves. To do this I draw upon a third theoretical tradition, stratification sociology, primarily using Sorensen's (1996) theory of structural social inequality. In this conception a social system such as a labour market, can be thought of as consisting of a number of independent, but interconnected positions that can be occupied by one or more persons. So for this project, a labour market is a social system whose structure is defined by occupations, which are groups of tasks and skill sets that arise from the realities of production. Sorensen (1996) links the individual to these positions by pointing out that they affect individual behaviour (by for example incentivising educational attainment), while also having characteristics of their own that are independent of the individuals within them. In this conception economic inequality arises within this kind of social structure mostly by the generation of rent in certain positions, and this capacity to generate rent is inherently a

characteristic of the position, having nothing to do with the actions or abilities of the individuals within it.

While Sorensen does not ignore the existence of income differences between individuals, the primary contributor to overall economic inequality is due to what he calls a pure structural effect arising from the characteristics of the positions in a social structure. I argue that in addition to this it is possible for the individual and structural characteristics to interact, resulting in further complexity in the structure of econ inequality in modern economies. A key component of this theoretical conception is Weber's (1978) concept of social closure. As a practice that creates barriers to entry into a group or institution, social closure functions as a structural characteristic that is often argued to generate rents for those that occupy that social position. In the context of a labour market, institutions, practices, and systems of rules that create exclusionary boundaries limit the supply of workers to a particular occupation. The extent of this exclusion is what determines the extent of rent generation in different occupations. It is therefore, differences in rent generation that explain a significant portion of overall economic inequality in developed economies.

In modern economic systems, closure often occurs at the level of occupations, through such mechanisms as credential requirements, sometimes unions, and, principally, licensing. The licensing of occupations in Canada is mandated by provincial governments and creates the right to practice in a given occupation. Because it includes a set of pre-requisites to enter an occupation it is argued to create a barrier to new workers and thus function as a social closure mechanism (Damelang et al., 2018; Kleiner & Krueger, 2010; Weeden, 2002). Licensing and its hypothesized social closure effects is a central concern of this dissertation, but my analysis seeks to connect licensing to both other occupation characteristics as well as the characteristics of the individuals within licensed occupations. The goal of this is come to a more nuanced understanding of licensing and its role in modern economic inequality.

This dissertation integrates Human capital, and Internal Labour Market theories along with Stratification Sociology into an overarching conception of the labour market whose structure can be characterised as a hierarchical arrangement of positions consisting of occupations and regions. Each of these positions has characteristics that are independent of the individuals within them, and these characteristics determine the extent to which each position

operates on the basis of one or more of these three theories. So, none of these theories is chosen as the preferred explanation for the labour market as a whole and instead each theory may apply to differing degrees in different occupations. Employing this kind of theoretical model makes it possible to analyse a large and complex economic system, like a national labour market, in a way that can account for the fact that different positions within that system, like occupations, operate according to different rules and through different institutions. This kind of approach can give us a more nuanced and comprehensive understanding of national labour markets and avoid a 'one size fits all' approach to the formulation of labour market policy and the pursuit of solutions to the problems of economic inequality.

Chapter 2: Methods, Data, and Descriptive Statistics

The core aim of this dissertation is to examine the effects of occupational licensing on wage inequality in Canada. It is often claimed that the licensing of occupations produces a wage premium by acting as a social closure mechanism. It is also plausible that the establishment of a license in an occupation results in changes to the institutional character of that occupation, affecting for example, the development of educational systems that are more oriented toward vocational training. I employ two different approaches to analyse the social closure effects of licensing and its relationship to education. The first is by comparison, which would ideally involve comparing licensed occupations to unlicensed occupations that are otherwise identical. Because no such perfect comparison is possible the first alternative is to compare licensed and unlicensed occupations (or occupation-provinces) while attempting to account for the influence of the most commonly recognized occupation and region characteristics that shape wages and that may be correlated with licensing. The second, and perhaps better way to approach this issue, is to measure change over time, by relying on repeated observations on occupations over time and in a period where there are enough newly enacted licenses that they present an opportunity to examine their effects on wages and education.

Licensing is a regulatory body that governs a specific (detailed) occupation, so it and its social closure effects occur at the level of occupation and province. As such, much of the existing literature suffers from an important limitation. They typically employ standard regression models in which occupation or jurisdiction are modelled as individual level control variables. This makes it very difficult to account for the influence of occupation and/or region characteristics, and they ways in which they modify the effect of licensing on wages (examples include: Kleiner and Kreuger (2010); Kleiner and Soltas (2018); Muzondo and Pazderka (1980)). The use of a two-level hierarchical model is a good alternative that allows for the proper identification of individual traits and the effects of occupation and region characteristics on the distribution of wages.

Models

Chapters 3 and 4 investigate the wage effects of licensing in Canada using two-level random effect models consisting of individual workers at level one, nested inside occupations or occupation-provinces at level two. This type of model takes the following form:

$$Y_{ij} = \beta_{0j} + \beta_{kj}X_{ij} + r_{ij} \qquad (1)$$

In this model Y_{ij} represents the hourly earnings (or other dependent variable) of individual i in occupation-province j. So, X_{ij} represents a vector of individual level covariates (i.e., gender, age, education) and in a two level random effects model each individual slope coefficient (β_k) is not modelled directly but is instead represented by the following:

$$\beta_{1j} = \gamma_{10} + U_{1j} \qquad (2)$$

Each gamma term (γ) represents the average effect of that individual level characteristic (X_{ij}) across all occupation-provinces. The U_{1j} represents the variability of the slope between occupation-provinces. For the analysis in Chapter 3 the slopes (β_{kj}) are treated as fixed, so the U_{1j} is assumed to be zero and therefore the gammas simply replace the betas in equation (1). However, the variation of the intercept (β_{0j}) is included and is modelled as follows:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}W_j + U_{0j} \qquad (3)$$

This equation introduces a second level predictor W_j which operates at the level of j, or 2nd level units, which are in this case occupations or occupation-provinces. The γ_{01} is the coefficient for this level two variable and represents the difference in average hourly earnings between occupation-provinces per unit change in W_j (S. W. Raudenbush & A. S. Bryk, 2002). If we substitute equations 2 and 3 into 1, we can see the full random intercept model takes the following form:

$$Y_{ij} = \gamma_{00} + \gamma_{01}W_j + \gamma_{10}X_{ij} + U_{0j} + r_{ij} \qquad (4)$$

From this complete form we can see that Y_{ij} is dependent on both individual and occupation characteristics but we can also see that there is more complex error structure such that $Var[Y_{ij}]=Var(U_{0j} + r_{ij}) = \tau_{00} + \sigma^2$, which represent the variation in Y_{ij} that occurs between occupations (i.e., intercept variance) and individuals respectively (S. W. Raudenbush & A. S. Bryk, 2002). This error structure would make OLS estimation biased because the U_{0j} component varies between occupations rather than individuals. Because licensing is a characteristic of occupations the γ_{01} coefficients are of primary interest in this dissertation. As an example, the gamma coefficient in each of the models in Chapter 3 represents the average dollar per hour

difference between licensed and unlicensed occupation-provinces, that is, this indicates the presence and strength of the wage premium associated with licensing in Canadian occupations.

The use of a random effects approach introduces some risks but also comes with some potential benefits. The main risk of a random effects model is that unmeasured variables at level two of the model (particularly those that characterise provincial jurisdictions) could result in biased estimates of licensing wage effects. Hypothetically any measured licensing effect could be the result of unknown inter-provincial or inter-occupational characteristics that are more or less likely to be present in licensed occupations or jurisdictions. However, this risk is present in any regression model and the use of this kind of model allows for a more nuanced examination of inter and intra-occupational variability in the wage effects of licensing. One important thing I can do with a random effect model is explore the possibility that the wage effects of licensing vary between occupations and provinces by introducing level 2 interactions and, more specifically, variables that may condition the effects of licensing. Licensing coverage and years since enactment are examples of characteristics at level two, upon which the effects of licensing may depend and which may explain more inter-occupation wage variability. Another thing that can be done with random effect models is to explore the possibility that the effects of a level 2 variable could be dependent on a level one variable. Specifically, I can explore the possibility that women and men benefit to differing degrees by being in a licensed occupation through the use of a cross level interaction. This kind of interaction effect requires an additional parameter be added to the above model, such that the slope equation (2) now takes the following more complex form:

$$B_{kj} = \gamma_{10} + \gamma_{11} W_j \qquad (5)$$

If for example this were the slope equation for gender, this equation would be substituted into the equation 4 and we would get the following full model:

$$Y_{ij} = \gamma_{00} + \gamma_{01} W_j + \gamma_{10} X_{ij} + \gamma_{11} W_j X_{ij} + U_{0j} + r_{ij} \qquad (6)$$

The $\gamma_{11} W_j X_{ij}$ clearly suggests an interaction between a level one and level two variables. Thus, if X_{ij} were gender and W_j licensing, the γ_{11} coefficient would indicate the extent to which the slope of gender differed in licensed versus unlicensed occupations, or conversely the extent to which the wage premium from licensing differs for women relative to men. This kind of

model allows us to examine the potential complexity in the wage effects of licensing. Thus, if the effects of licensing do vary between occupations in complex ways as described above, this approach is most suitable to uncovering that complexity. This does present a significant challenge, in that I must determine how to best model that complexity and this is only possible if the data contain the correct variables. Given the limitations of available data the only way to proceed is to test the variables and interaction that have strong effects and that are sensible based on existing theory. Despite the challenges, this approach is a useful way to advance our understanding of the social closure effects of regulations and institutional systems that operate within occupations.

The second method employed in this dissertation is growth curve modelling. Chapter 5 includes data consisting of repeated observations on average wages and other key variables of occupation-provinces over 23 years. This kind of data forms a hierarchical structure, with the repeated observations being nested in occupation-provinces. Growth models entail the application of a multi-level framework to this kind of data, and they take a form that is very similar to that described above. Level one of the model is used to represent an individual growth trajectory; it consists of observations, often called measurement occasions, at two or more points in time and parameters that describe the trajectory (i.e., the pattern and rate of change). Level two of the model contains the characteristics that differ between the units being analyzed (in this case occupation-province) and which relate to the growth trajectory in some way.

The basic structure of a growth curve model is similar to the other hierarchical models discussed above. The outcome can be denoted as Y_{ti}, representing the observed status of occupation i at time t, where i indexes occupations and t is the index of the order and number of measurement occasions (equaling 0 through T). The outcome is modeled as a function of the growth trajectory formed by the measurement occasions which, in this case, refers to years. The parameters of this function describe the initial status of the unit and rate of change in the dependent variable in relation to the passage of time. It is often the case with longitudinal data that all between unit variability cannot be modeled with observed covariates, and any unobserved between unit heterogeneity that is ignored will induce a correlation between the observations in each unit (Skrondal & Rabe-Hesketh, 2008, p. 277). The easiest way to account for between unit heterogeneity when it cannot be modeled is to allow the units to have different intercepts,

accounting for the between unit variability as a second level variance term. One of the simplest forms that a hierarchical growth model can take is analogous to the random intercept linear model described above, which is structured as follows (S. Raudenbush & A. Bryk, 2002, pp. 162-163):

$$Y_{ti} = \pi_{0i} + \pi_{1i}a_{ti} + e_{ti} \qquad (7)$$

In this equation a_{ti} represents an interval measure of progression (usually of time), and may be age, years, days, hours and so on. The π_{0i} term is analogous to the intercept, and here signifies the value of Y_{ti} at t=0, and can be thought of as the initial status of the occupation characteristic being measured (this is discussed on more detail below) [2]. Similarly, π_{1i} is analogous to the slope, and in this model represents the expected rate of change in Y_{ti} over a fixed unit of time. These two parameters may vary between level two units as a function of the characteristics of those units (in this model the slopes are restricted):

$$\pi_{0i} = \beta_{00} + \Sigma\, \beta_{0q}X_{qi} + r_{0i} \qquad (8)$$

$$\pi_{1i} = \beta_{10} \qquad (9)$$

Together these demonstrate that the two parameters describing the growth trajectories (initial status and rate of change) vary between units as a function of their observed characteristics. Just as with the HLM above, the β_{00} and β_{10} terms are analogous to the 'grand intercept' and 'grand slope', while the other terms describe the unit characteristic dependent variability (the explained variability) in initial status and rates of change. Thus, this model would allow us to describe/explain differences in growth trajectories between different subgroups in the sample (i.e., rates of wage growth may differ among licensed and unlicensed occupations). Note that this model contains two error terms e_{ti}, and r_{0i}, with the variances: σ^2, and τ_{00} which represent the residual variance of the measurement occasions and the variability of

[2] In addition to the predictors that describe the growth trajectory, there are times when it is useful to include predictor variables at this level of the model that are measured as more typical covariates but that vary over time (time varying covariates or TVCs) and describe something about the unit that both predicts Y and changes over multiple measurement occasions. As an example, for some occupation-provinces licensing varies over time as new licenses are enacted. This would result in an additional term in the model, $\pi_{ti}a_{pti}$, which could be modeled as fixed $\pi_{pti} = \gamma_{p0}$ or randomly varying, $\pi_{pti} = \gamma_{p0} + r_{pi}$ (S. Raudenbush & A. Bryk, 2002, p. 180). If fixed this would suggest that the effect of licensing on wage is the same for all newly licensed occupations, if random the effect would vary between occupations (while the wage value would also vary across occasions within each occupation-province).

the growth trajectories (in this case just intercepts) between units. Note also that the model is currently restricted to have identical rates of change (or slopes) between all the units.

If a random slope is added to the above model, the second level slope/growth rate model would then appear as:

$$\pi_{1i} = \beta_{10} + \Sigma\, \beta_{1q} X_{qi} + r_{1i} \qquad (10)$$

In addition to the overall average rate of growth (grand slope) represented by β_{10}, the model now contains the $\beta_{1q}X_{qi}$ terms indicating modeled variability in rates of growth as well as an additional second level error term indicating the unexplained variability of units around the overall average rate of growth. If we substitute the two second level equations into the first level, the full model would now appear as:

$$Y_{ti} = \beta_{00} + \beta_{10} + \Sigma\, \beta_{0q} X_{qi} + \Sigma\, \beta_{1q} X_{qi} a_{ti} + e_{ti} + r_{1i} a_{ti} + r_{0i} \qquad (11)$$

Two things are of note in this model. First, the fourth set of terms can be interpreted as an interaction between unit (occupation) level characteristics and the covariate indicating the passage of time. This term would describe the differences in rates of growth/change between subgroups in the sample (i.e., between licensed and unlicensed occupations). Second, this model contains an additional random term, r_{1i}, which also interacts with the passage of time and represents the time dependent variability in rates of change between units.

In order to obtain a good fit it may be necessary to include a polynomial growth parameter to capture the curvature, that is, the acceleration or deceleration in the rate of growth as a function of time (a_{ti}). This can be done straightforwardly with the inclusion of a growth parameter of an appropriate degree polynomial, $\pi_{pi}(a_{ti})^m$, which can have a fixed or random slope at level two of the model (S. Raudenbush & A. Bryk, 2002, p. 169; Snijders & Bosker, 1999, p. 183). Substituting level two (which is unchanged from earlier models), the full model now appears as:

$$Y_{ti} = \beta_{00} + \Sigma\, \beta_{pq} X_{qi} (a_{ti})^m + r_{0i} + \Sigma\, r_{pi} (a_{ti})^m + e_{ti} \qquad (12)$$

Where m can take any set of values from 1 through t-1, that is, the function describing the curve cannot take a polynomial of a degree higher than 1 less than the number of measurements in each unit or the number of unique time points in the entire sample (Snijders & Bosker, 1999, p. 184).

The first two sets of terms make up the expected growth curve across all units. This includes the intercept (or initial status) as well as the linear and curvilinear components of growth. The intercept residual, r_{0i} ,is unchanged from earlier models. The residual slope(s) indicated by the second summation, now varies between units capturing variability in both the instantaneous rate of growth (the linear component) and the rate of acceleration/deceleration in the rate of growth (the curvilinear component) over a given interval of time. The polynomial, m, defines the shape of the curve across all t measurement occasions. Polynomials offer a convenient and adaptable method for approximating curvilinear growth.

One of the simplest and easiest to interpret functions that deals with these issues is the piecewise linear growth model. This is a continuous linear function but with slopes that change at specific values of t, called nodes (Snijders & Bosker, 1999, p. 186). This serves to break up a curvilinear trajectory into separate linear components, which makes the modelling and description of a complex growth pattern much easier when compared to the use of higher order polynomials (S. Raudenbush & A. Bryk, 2002, p. 178). The function is defined by a set of constants (slopes) in each of the intervals that define different phases of the growth trajectory. A simple one interval case appears as (Snijders & Bosker, 1999, p. 187):

$$f(\mathrm{t}) = \begin{cases} a & (t \le t_1) \\ a + (b-a)\frac{t-t_1}{t_2-t_1} & (t_1 < t < t_2) \\ b & (t \ge t_2) \end{cases}$$

Depending on the values of the constants, in this case a and b, this function defines the linear growth as having different rates in each segment of the trajectory. This allows for the approximate representation of a non linear function, but one that would be easy to understand and each section would be insensitive to changes in the other sections. They are also useful if one wishes to compare growth rates in two or more different time periods (like before and after the enactment of a license). They do however, suffer from the disadvantage that it is likely to be only a crude representation of more complex curvilinear functions and the function itself tends to take on a rough appearance.

There are several advantages to the use of growth curve modeling. They are capable of studying wage growth as a dynamic process over an extended period of time. They are parametric models so they tend to be robust and it is easy to compare different model

specifications (i.e., quadratic versus cubic). Additionally, these models decompose the variability in the dependent variable, giving us a measure of both the extent of change within an occupation in a given time period (in the residual variance), as well as differences between occupations in the intercept and slope variance components, which may be explained by the variables included at the occupation-province level. It also allows for time invariant and time varying covariates to be integrated into a single model. This is especially useful in this dissertation because it enables the inclusion of both the time invariant and the time varying effects of occupational licensing. This makes it possible to create a model that can account for the effects of older licenses (which do not vary), and most importantly, the effects of licenses that have been enacted within the period covered by available data, and which therefore represent a time varying effect.

Data and Variables

The primary source of data for this dissertation is Statistics Canada's Labour Force Survey (LFS) (Statistics Canada). The LFS is designed as a rotating panel where each individual remains in their panel for six months. As a result, each individual can appear in the records covering one calendar year between one and six times. In each month the sample size is approximately 55,000 households in which each individual 15 years or older is included, producing a sample of about 100,000 unique individuals in each year. One effect that the panel design of the LFS may have is that it consists of repeated observations nested in individuals. This nesting would not result in biased means or regression coefficients but without correction would result in underestimated standard errors. Because I am working with the micro data file I can identify individuals and therefore measure and control for this effect. I tested two types of models. The first is a 2 level model with only one observation for each individual included in the model. The other was a 3 level model which nested observations in individuals which were themselves nested in occupation-provinces. In both cases there was virtually no effect on standard errors. Therefore, I decided that controlling for repeated observations is not necessary for this analysis.

Individual Level Variables

Other than licensing, the two variables that are at the centre of this dissertation are hourly earnings and education. Hourly earnings is measured in Canadian Dollars, and in the case of

Chapter 5 which includes data from 1997 to 2019, adjusted for inflation with a base year of 2016. Education is coded in the LFS as an 8 category ordered variable used to indicate credential effect, but it is sometimes included as estimated years of education intended as a measure of human capital. Years of education is estimated by relying on assumptions about how long it would typically take to achieve each level of education in the highest level of education variable from the LFS. For example, a bachelor's is assumed to take 4 years. This assumption introduces some error in that people may take different numbers of years to finish various levels of education and there is also no way to account for those who have more than one degree at the same level. The variable (potential years) of work experience is derived from the years of education variable and equates to age - years of education – 6, which is the typical method of generating this variable in labour market research when a direct measure is not available (see Weeden, 2002 and Redbird, 2017). It is worth noting that such a measure tends to over-estimate the work experience of women due to their higher probability of leaving the labour market to care for young children. In combination with level of education these variables measure key aspects of human capital attainment at the individual level.

The union member/covered[3] binary variable accounts for the individual level effect of collective bargaining while the binaries for part-time and non-permanent measure labour force participation and the variables for establishment and firms size>500 account for the effect of working for large firms and in large workplaces (known to have consistent wage effects). Finally, the industry variable captures the individual level effect of inter-industry wage differences.

Occupation Level Variables

The data for the occupation level variables that are central to this dissertation come from a database of my creation that draws on data from publically available online sources. Most of the data on licensing and certification come from cicic.com acquired through the use of a web scraping program I created using Python. This website includes information on over 490 different occupations in all provinces and territories of Canada. It is however, not perfect and I discovered as many as 50 occupations that appear in the LFS that are not found in the cicic data.

[3] Union covered includes those that are covered by a collective agreement but are not members of a union. Often this is the case for those in supervisory positions.

I manually added licensing data for these 50 occupations using the Canada.ca NOC website[4]. There is one other complication in the use of these publically available data with the LFS. Both cicic.com and the NOC website include information on occupations with 5 digit codes (####.#) whereas the LFS includes only 4 digit occupation codes (####). I therefore had to collapse some occupations with more than one 5 digit code into a single 4 digit occupation group (i.e., occupation 2213.1 and 2213.2 both become 2213) so that the occupational regulation data could be linked with the occupation variable in the LFS. In some cases one of the 5 digit occupations will be licensed in a given jurisdiction while the other is not meaning that when they are collapsed I am combining a licensed and non-licensed occupation into one group. In these cases the occupation is treated as licensed, meaning there will be some individuals in the data that may not be licensed but are treated as being in a licensed occupation and the LFS does not distinguish these cases[5].

This problem highlights a limitation in the use of an occupation level measure of licensing and an unfortunate limitation in the detail available for occupation in the LFS micro data file. These limitations mean that there may be unlicensed individuals in some of the occupations that are listed as licensed in the data. This causes a problem referred to by Weeden (2002) and Redbird (2017) as 'slippage', that is, due to the fact that some unknown number of individuals in any occupation listed as licensed may not actually hold a license, and if licensing acts as social closure these individuals will have lower wages than their licensed counterparts and will therefore suppress the estimated occupation level effect of licensing. While this is not the ideal way to measure the effects of licensing, there is no nationally representative dataset with an individual level licensing variable and I am confident that the effects of slippage on the overall estimated effect of licensing will be minor. In general it is likely, given that it is illegal to operate without a license, that the unlicensed sector will always be relatively small. In those cases where I have had to collapse to 5 digit codes and one is unlicensed I am unable to distinguish the unlicensed and therefore have to treat the entire 4 digit occupation as licensed. This was done rather than dropping the entire occupation because it affects very few licensed occupations, and only adds to the existing problem of slippage. I therefore think it reasonable to

[4] https://noc.esdc.gc.ca//Home/Welcome/cef782b51b3f40c79d7c0096949fe3f2?GoCTemplateCulture=en-CA

[5] This affects eight occupations including: Acupuncturists, Chiropodists, EMG Technologists, Lawyers (due to the inclusion of Quebec Notaries), Mortgage Brokers, Notaries Public, Registered Nurses, and Respiratory Therapists.

assume that this will have very little effect on estimates of the wage effect of licensing requirements.

The final variable added to my occupational regulation database includes the date of enactment of licenses for 601 of the 740 licensed occupation-provinces that appear in the LFS 2019. These data were manually collected through an examination of legislative and regulatory documents available online primarily through canlii.org but also using documents that are publically available on provincial government websites. All of this occupation level regulatory information was then linked to individual records in the LFS using their occupation codes combined with the province variable.

An additional variable that is potentially important as an indicator of the social closure effects of occupational licensing is coverage. Licensing coverage refers to the proportion of an occupation nationwide that is licensed. It is proposed by Weeden (2002) and Redbird(2017) that low coverage, such as a single license in one province, would have limited social closure effects and that only license requirements that are widely established are able to effectively close an occupation to outsiders and thus have a social closure effect that is detectible as a difference in wages. It is calculated by producing a weighted estimate of the total population of each occupation, then calculating the population size in each occupation's licensed jurisdictions only, then computing the percentage using these two figures.

Another measure of social closure is derived from the educational attainment variable included in the LFS and measures the within occupation-province variation in educational attainment among the individuals within the occupation. This measure is usually on a scale of 0 to 1 but it has been rescaled to 0 to 100[6]. An average of 73 in 2019 suggests that variation of educational attainment within occupation provinces tends to be quite high.

The three remaining occupation level variables in chapter 3 and 4 (see Table 3-5 and Table 3-1) are all derived from the O*NET 23.2 occupational database (onetcentre.org), which

[6] This measure of variance equates to one minus the square root of the sum of squares of the relative frequencies of each category of the variable. So k is the number of categories in the variable and f_k is the frequency divided by the total of the frequencies, in the kth category:
$V_2 = 1-\sqrt{1-(1-f_0^2-f_1^2-\cdots f_k^2)}$
This is then standardized to a 0 to 1 scale as follows:
$V_{2s} = V_2 / 1-(1/\sqrt{k})$
(see Allaj, 2018)

contains a rich collection of variables describing work and worker characteristics for a wide range of occupations. Each represent an abstract measurement of 'how much' or what 'level' of ability, knowledge, and skill are typically required to do a job, and is based on surveys of people within these occupations in the United States. These measures were first crosswalked from the American SOC classification system into the Canadian NOC occupation codes using a crosswalk file provided to me by CAPS-Canada[7]. Each one of these three measures is based on a large number of subtypes of ability, knowledge, and skill. For example, the original ONET data include abilities like oral comprehension, deductive reasoning, finger dexterity, and so on. Each one of these includes a 5 point scale indicating the importance of each skill to the tasks of the occupation. It also includes a 7 point scale measuring the level of that skill needed to carry out their tasks. The variables included in this dissertation consist of a weighted mean of the 'level' variable using the 'importance' value as a weight attached to each ability, knowledge, or skill. Therefore, these variables are essentially the average level of ability, knowledge, and skill weighted by how important each sub-type of ability, knowledge, or skill is in a given occupation. As such, these variables serve as measures of occupation specific human capital.

Descriptive Statistics

This section presents a descriptive analysis of the extent and variation of licensing and wage differences among Canadian occupations. This includes other key variables (like education) that have been hypothesized to work in combination with occupational regulation to shape wage determination within and between occupations. To determine if licensing, and education are significant factors in wage inequality we first need to examine the presence of both and determine to what extent licensing is an important characteristic of the Canadian labour market. This entails an examination of how common licensing is and how much it varies between occupations. Additionally, it has been hypothesized that education and licensing are related in that they can shape each other, affecting the impact they have on wages over time. This chapter explores how much education varies across regulated and unregulated occupations. Educational differences between occupations will highlight the possibility that licensing shapes

[7] CAPS-Canada is a free online tool developed by The Environmental Epidemiology and Population Health Research Group of the CHUM Research Centre. It was developed to assist researchers and experts in the coding of occupations and economic sectors. (See https://host.credim.u-bordeaux.fr/caps-ca/Rechercher.aspx for more)

the development of an education system within an occupation which in turn moderates the social closure/rent generation effects of licensing over time.

Licensing

One of the most common arguments in existing literature regarding licensing is that it interferes with the operation of the market. According to Sorensen (1996), regulatory forms that act as barriers preventing entry into a particular position in the market alter the structural properties of those positions, exacerbating wage inequality. In order to explore this claim, we first need to consider the prevalence of licensing in the Canadian labour market. The prevalence of licensing will point to the potential this mechanism has to exert significant effects on wages and inequality in Canada. The first way to look at prevalence is to look at the number of occupations that are licensed, which indicates what proportion of the occupational structure in Canada is potentially affected by licensing.

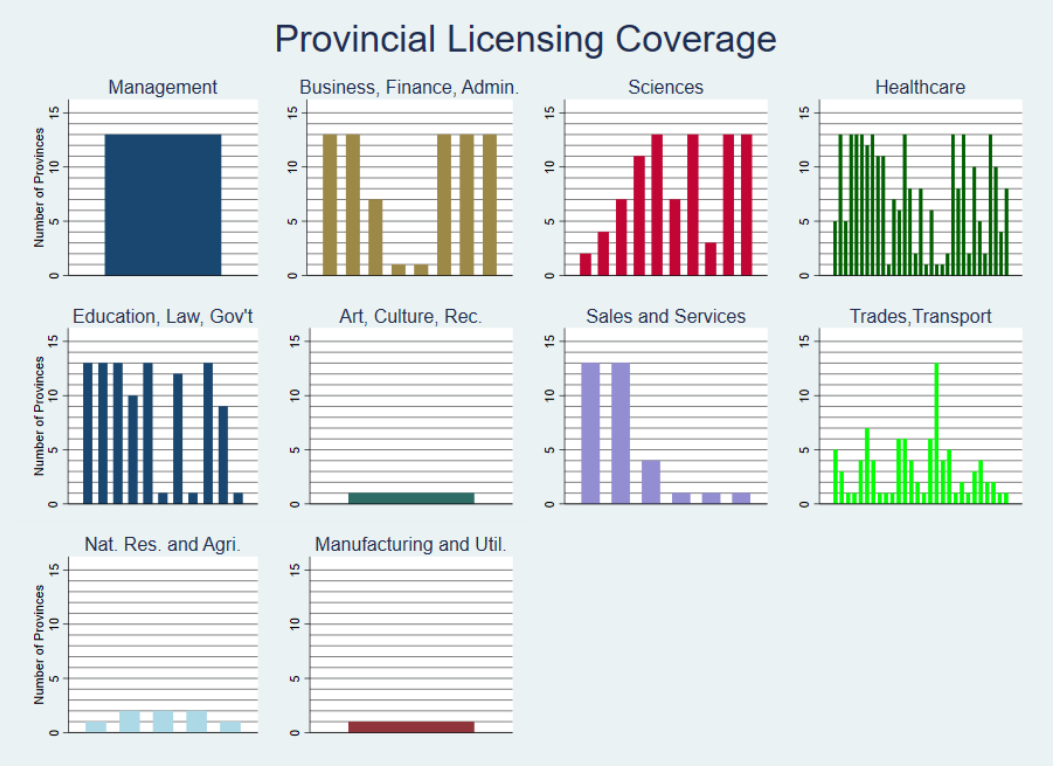
According to the data scraped from the CICIC website and supplemented with some additional data from the Government of Canada website[8], 90 of the 502 occupations that appear in the LFS in 2018 are licensed in at least one province. This means that about 18% of the occupational structure in Canada could be affected by the wage effects of licensing. This suggests that the presence of licensing as a feature of the labour market is prevalent enough that it could make a significant contribution to wage inequality. In contrast, 312 occupations have voluntary certification in at least one province, and this amounts to 62% of occupations. This leaves approximately 32% of occupations unregulated which serve as the group of occupations against which we compare the wages of those that are regulated. Another way to consider the prevalence of occupational regulation is to examine the number of individuals who are in regulated and unregulated occupations. This will give us some idea of how much of Canada's labour force are affected by licensing. According to estimates generated from the Labour Force Survey approximately 2.54 million workers are employed in licensed occupations in 2018, which equates to a little over 12% of all workers.

Perhaps the most important way to measure the prevalence of occupational regulation is to examine its coverage, that is, across how many jurisdictions is a given occupation licensed?

[8] https://noc.esdc.gc.ca/Home/Welcome/5bfe48ef9961405f8882476835e93bbb

Figure 2-1 provides a graphical representation of regional licensing coverage in Canada, subdivided by major occupational groups. Each bar represents a single detailed occupation, and its height indicates how many provincial and territorial jurisdictions in which it is licensed. The subdivision by broad occupational category gives us an impression of variation in licensing prevalence and coverage in relation to differences in skill (i.e., what kinds of occupations tend to be licensed, and tend to have high, low, or variable coverage). We can make some basic judgements about the association between these regulatory differences and types of occupations, which may also be related to wage differences.

Figure 2-1



It is clear for example that there are few licensed occupations in management (insurance, real estate, and financial brokerage managers), art, culture, and recreation (support occupations in motion pictures, broadcasting, photography, and performing arts), as well as manufacturing (petroleum, gas, and chemical process operators) so it is obvious that occupations of some major groups tend not to be licensed, likely due to varying reasons (i.e., the high presence of unions in

manufacturing, or the difficulty of arguing for the public good in relation to art, culture, and recreation, hampering efforts to lobby for licensing). The one licensed occupation in management, that also has full coverage, might be explained by the fact that a university level of education is usually required or possibly by a lower amount of variability in level of education. It may have more specific educational requirements compared to other management occupations. On the other hand, the large number of licensed occupations in healthcare, sciences, and education, law, and government, many of which have high or full provincial coverage, is not surprising as these kinds of occupations tend to come with higher level and specific educational requirements and in many cases it would be easy to lobby for licensing in the name of the public good. In contrast, the occupational groups of sales and services as well as natural resources and agriculture tend to have lower level and highly variable educational requirements. It is therefore, not surprising that only a few are licensed and most have limited coverage.

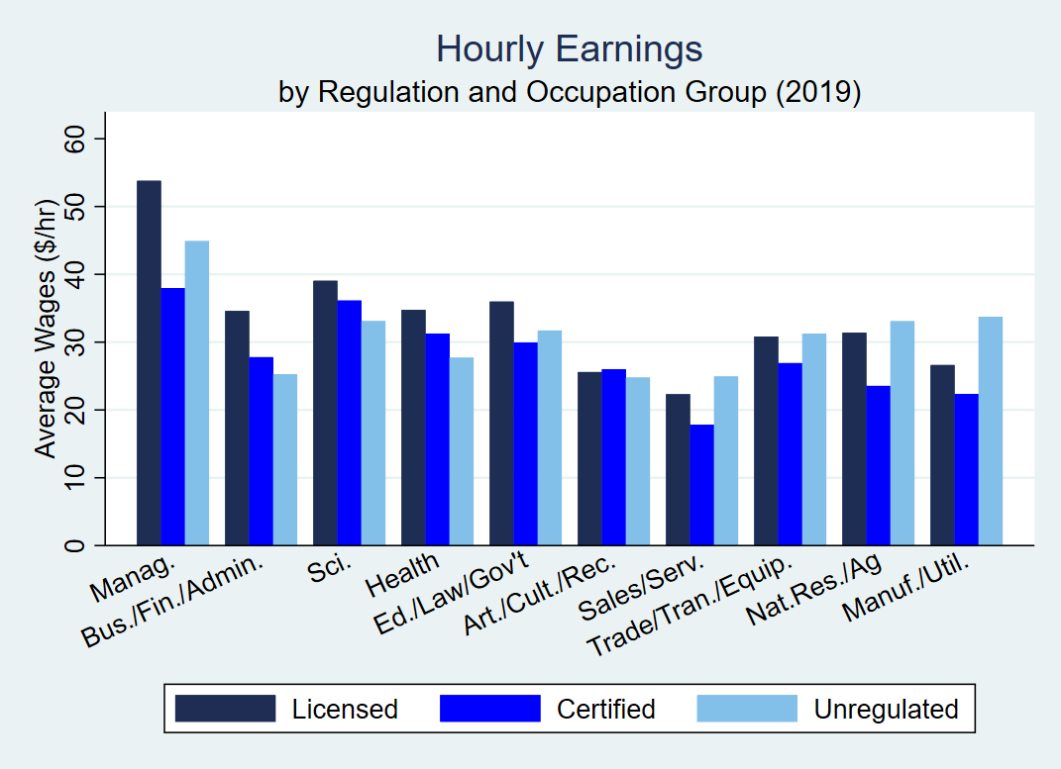
The coverage of licensing requirements in any given occupation is an important factor to consider as it is believed to directly affect the strength of the social closure effect on earnings (Redbird, 2017, p. 609; Weeden, 2002, p. 77). Generally, if our hypothesis about licensing coverage is correct, we should expect occupations with higher coverage to have a higher licensing wage premium than those with lower coverage. We would therefore also expect that licensed occupations in groups that have consistently higher coverage will have higher wages on average due to a stronger presence of social closure among those occupations. Thus, we might expect a high licensing wage premium on average in education law and government whereas we would expect a weak wage effect on average in natural resources and agriculture. However, it is possible that there are confounding variables that affect wages while also being common in licensed occupations, perhaps even correlated with licensing coverage. As mentioned above, one of the most significant of these is differences in education. We would expect that type and level of education will differ between occupational groups while also varying in relation to form of regulation. Both of these will affect wage differences between groups of occupations and specifically shape the effect of licensing on wage inequality. The causes and consequences of differences in licensing coverage may become more apparent in the next section where educational differences between groups of occupations that vary in form of regulation and occupational group are examined.

Wage Differences Within and Between Occupations

Before exploring the effects of occupational licensing and educational requirements on wages it is worth considering the structural character of inequality, meaning in this case, the extent to which wages vary between and within occupations. The concept of disaggregate structuration highlights the importance of smaller and more detailed social groups in defining the structure of society more generally and of economic inequality in particular (Grusky & Sorensen, 1998; Weeden & Grusky, 2005). This is in contrast to the more generally recognized and applied concept of proximate structuration wherein society and economic inequality is structured at the level of larger and more abstract groups, as in Marxist class analysis, studies of socioeconomic status, or even the effects of educational credentials. The concept of disaggregate structuration suggests that we should expect to find meaningful amounts of inter-occupational variation in wages, particularly in comparison to the extent of intra-occupational wage variability.

Figure 2-2 displays the average of mean hourly wages of detailed occupation-provinces within groups defined by occupational group and regulation. These data points indicate that there are significant differences in wages on average between these groups of occupations however; these differences do not conform to a consistent pattern relating to occupational group and regulation. Focusing on the differences in wages across occupational groups specifically, we can see that there is a slight tendency for those occupation groups on the left side of the graph to have higher wages which range from a high of just over $50 per hour to a low of ~$25. As discussed below these tend to have higher human capital/levels of education and also have consistently higher licensing coverage. If we interpret these wage differences from a human capital perspective we might conclude that there is a weak relationship between human capital measures and wages (for example, proportion of university graduates in Figure 2-4). However, while there is a vaguely similar pattern between skill groups in this graph and that of proportion of university graduates, there are also significant differences. Most notable is the lack of stark differences between the occupation groups in this graph. In particular, average wages among the unregulated occupations in trades, natural resources and manufacturing, are similar to the wage levels of certified and unregulated occupations in business, healthcare, and education, law and government.

Figure 2-2

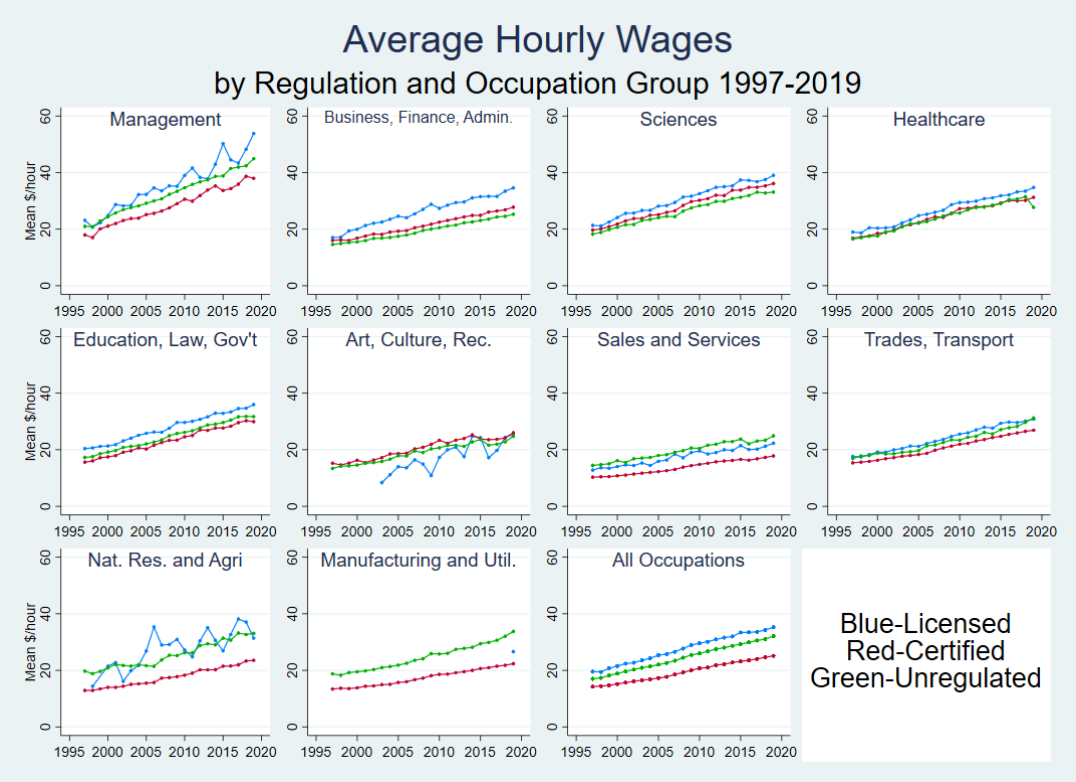


When we shift our focus to wage differences based on regulation (i.e. the potential effects of social closure) it is clear that there is a general lack of a consistent regulation effect across types of occupations. In many cases, those licensed occupations on the left side have consistently higher wages. At the same time however, there are several occupational groups in which licensed individuals on average do not have higher wages and in some cases even have lower wages on average than in non-regulated occupations (i.e. sales, sciences, and manufacturing). Additionally, in a number of cases certification in particular appears associated with the lowest average wages. It is clear from these results that we cannot point to a universal effect of licensing. This is not unexpected given our hypothesis that the wage effects of licensing are likely to vary in relation to other occupational characteristics such as the development of other occupational institutions. Furthermore, we have also theorized that some occupations operate on the basis of different labour allocation and wage determination processes so we would expect that in some cases the wage effects of licensing may be obscured or even counteracted by the wage effects of human capital differences or the predominance of internal labour markets. This theory is explored in Chapter 4 using statistical models that account for

these differing processes at the level of detailed occupations. Despite the limitations of descriptive statistics we can conclude that there are some significant differences between these groups of occupations, suggesting that occupations are an important factor in the structure of inequality, and the extent to which these differences exist/operate between detailed occupations is important.

When we examine how average wages in these groups have changed over time, as seen in Figure 2-3, it is clear that wages have generally trended upwards over the last two decades and at a surprisingly similar rate but there has also been only little change in the differences between regulated and unregulated occupations. There are two small exceptions that might be worth noting. First, average wages in the licensed occupation in management (Insurance, real estate, and financial brokerage managers, NOC: 0121) has increased at a slightly higher pace than other management occupations, resulting in a difference of about $10 in 2019 from what was initially an insignificant difference in 1997. With only one occupation in this group however, it is unclear whether or not this can be attributed to licensing alone. Also, there is a similar pattern in business, finance, and administration but the average for the licensed management group has been much less stable. This may be due simply to the fact that it is a single management occupation and the mean would be more stable over time among a larger group of occupations. However, it is also possible that the fluctuations in mean wages are the result of the enactment of new licensing requirements, or perhaps expanding coverage into new provinces. Alternatively, it could reflect changes in labour supply brought about by the development of associated educational institutions.

Figure 2-3



In most other occupation groups average wages among licensed occupations differ only slightly. Two minor exceptions are art and culture and natural resources. In both of these groups the wage levels of licensed occupations fluctuate widely but end up at a level very similar to the unregulated. This likely reflects small numbers of licensed occupations in these groups, while suggesting that licensing in these occupations produces no clear or consistent wage premium. It is also worth noting the single licensed data point for manufacturing, indicating that there were no licensed occupations in this group until 2018, meaning there has not been enough time for social closure to affect wages in this case. Overall, looking at the average trend over time it is clear that certified occupations have tended to be lower in average wages and have experienced slower wage growth as well, indicating that certification has not produced the expected social closure effects. Additionally, there has been little change in the difference between average wages of licensed and unregulated occupations in this period. This might be consistent with our expectations that licensing acts as social closure but produces a wage premium only in some cases while having no effect or even negative wage effects in others.

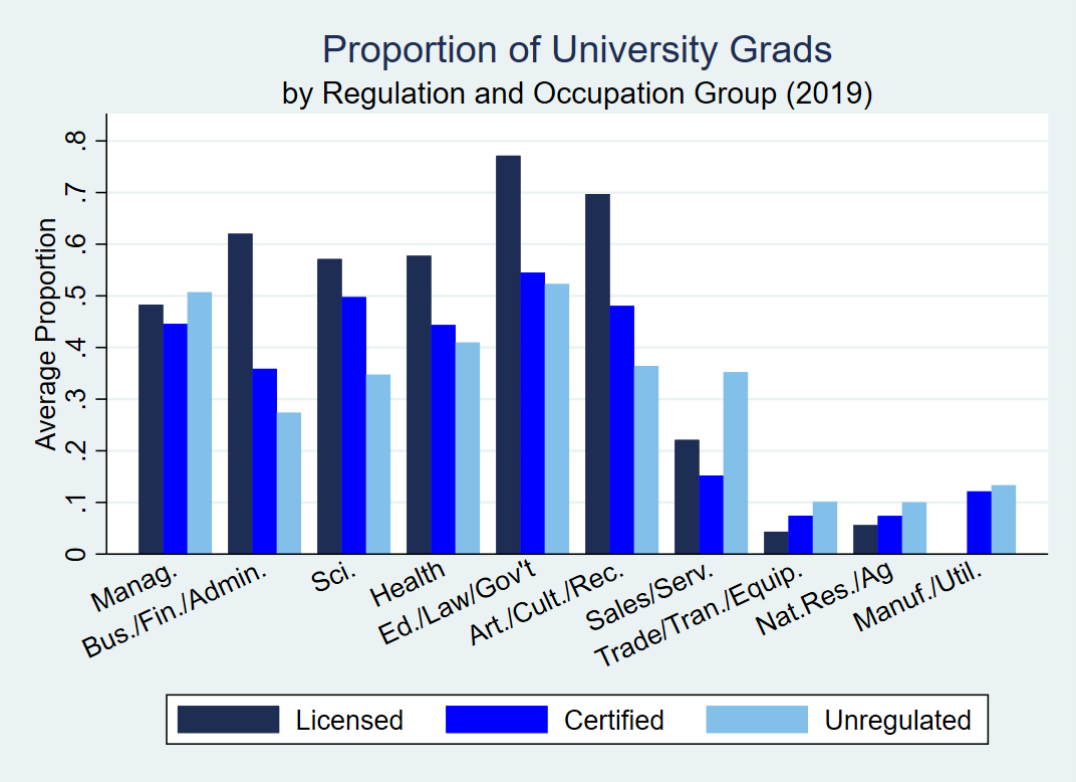
Education

As occupations are essentially a description of a set of tasks, the skills and education generally required to carry out those tasks are defining characteristics of occupations, and highlight important differences between them. Differences in education requirements are also significant contributors to the structure of the labour market and to the structure of wage inequality. Educational requirements frequently operate at the level of occupations and serve as formal mechanisms for labour allocation. Specific training requirements reinforce homogenization within occupations as well as differences (and barriers) between them (Weeden & Grusky, 2005). When educational requirements become formally institutionalized in an occupation (as is common in internal labour markets for example) they can function as a social closure mechanism on their own or in combination with others (i.e., licensing). Alternatively, education and training may also indicate differences in human capital which may be how education relates to or explains between occupation inequalities (Kalleberg & Sorensen, 1979). Human capital theory would predict higher average wages in occupations that have higher average levels of education (Mincer, 1958, 1970, 1974). It does not however, explain any association between wages and variability in education. Human capital theory would only see variability of education *within* an occupation as an explanation of *within* occupation wage variability. However, institutional and structural theories suggest that less variable amounts of education, suggesting more specific credential requirements, would act as a barrier (or social closure mechanism) between occupations, increasing wages in certain occupations and shaping between occupation wage inequalities.

In order to explore the relationship between education, occupational regulation, and wage inequality, we first need to measure the extent of between occupation differences in levels of education. Figure 2-4, shows us the average proportion of university graduates in groups of occupation-provinces subdivided by occupation group and form of regulation. This measure is simply the number of workers in a (detailed) occupation-province with a bachelor's degree or higher as a proportion of all the workers in that occupation-province. These proportions are averaged within each group defined by regulation and occupation group. It is immediately apparent from Figure 2-4 that there is an overall pattern in the different levels of education between these groups. The five groups on the left: management, business, finance and administration, sciences, healthcare, education, law and government, all have generally higher

proportions of university graduates, ranging from a low of just under 30% to a high of almost 80%. This is not unexpected but it is interesting to note that four of these five have the highest proportion of university graduates among licensed occupations. The one exception is management where all three sub-types have similar proportions, likely reflecting the tendency of this occupation type to have high educational requirements regardless of regulation, though it is important to keep in mind that there is only one licensed occupation in this group. You will note that as suggested in the previous section, occupations in groups that tend to have high licensing coverage also appear to have generally high average levels of education (like those on the left side of this graph) particularly among licensed occupations in these groups.

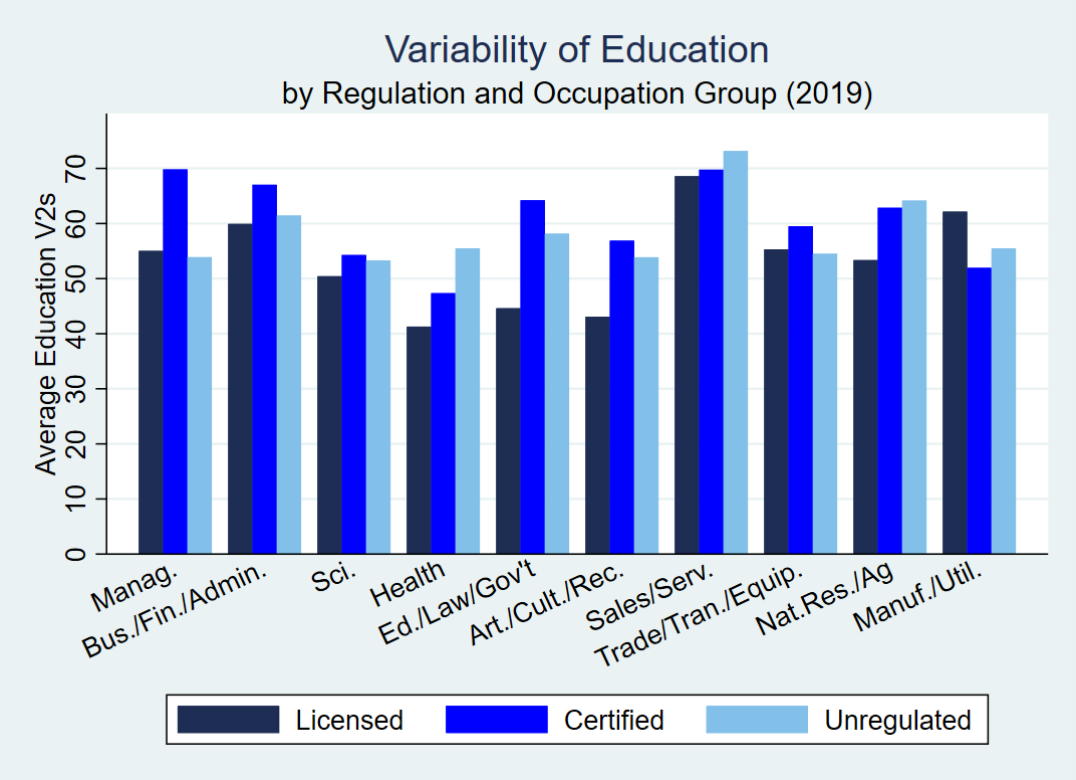
Figure 2-4



On the other side of the graph are occupations that have noticeably lower average proportions of graduates (with the exception of certified and licensed art and culture occupations). The proportions in these groups of occupations range from a high of 70% and a low of less than 10%, with licensed manufacturing being zero. It is also interesting that the three groups on the right side of the graph have lower proportions generally (as expected) and

regulation appears to have little to no bearing on the proportion of university graduates. The exception to this is art and culture, in which the one licensed occupation, has the second highest proportion of all groups. This indicates that it is possible for an occupation to have high numbers of educated workers but be both mostly unregulated and have lower rates of pay on average. It is important to note that for all of the five occupations on the right side of the graph, provincial coverage as indicated in Figure 2-1 tends to be lower. Overall these data do suggest that there is an association between level of education and occupational regulation, specifically, that licensed occupations do tend to have noticeably higher levels of education on average but only in those occupations on the left that also tend to have higher licensing coverage and generally higher levels of education.

Figure 2-5



The other component of our hypothesis regarding licensing coverage is that occupations which are regulated, particularly with high coverage, would tend to have more specific educational requirements. Looking at Figure 2-5 it is clear that the overall pattern seen in Figure 2-4 is much more subtle and is, for the most part, reversed. So, the occupations on the left tend

to be somewhat lower in the scale, ranging from a low of 40 to a high of 70 (on a 0 to 100 scale). Those occupations on the right are slightly higher in general but also they appear to vary less in relation to regulation, ranging from just above 40 to a high of over 70, suggesting consistent and high variation in level of education. The only exception is art and culture which seems to follow a pattern more similar to those on the left.

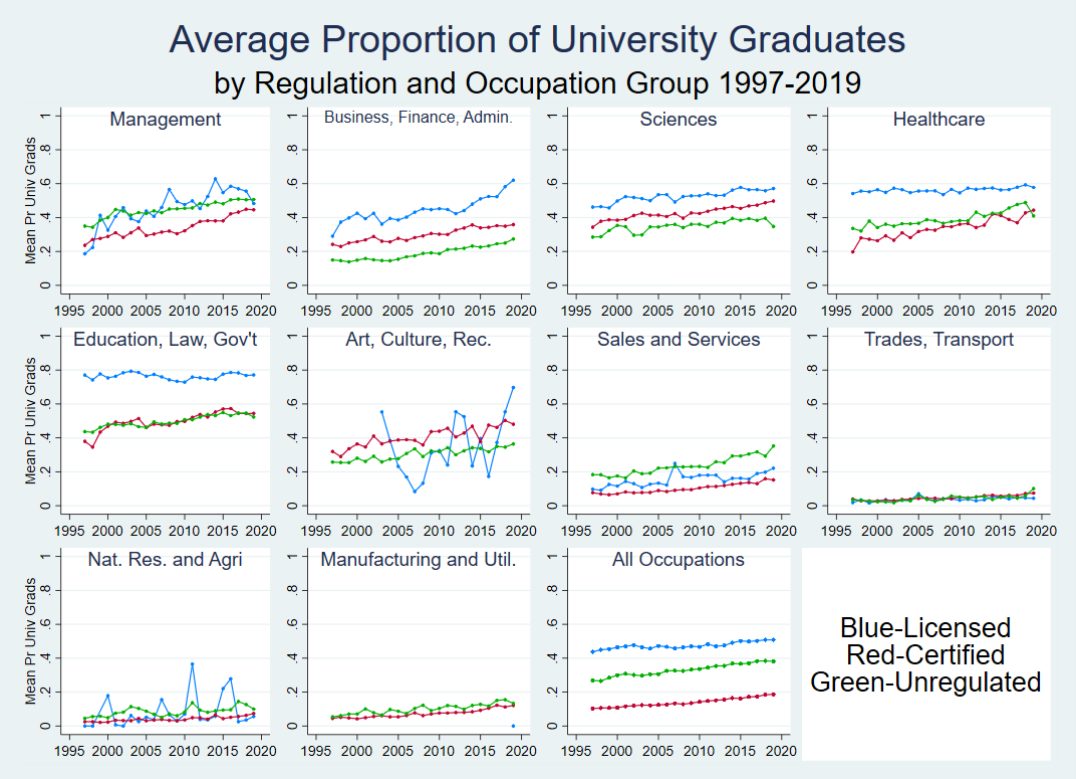
It is interesting that the licensed occupations which, in Figure 2-4 had the higher levels of education appear to also have the lowest levels of variability in level of education relative to the certified and unregulated within their group (with sciences being the exception, expected given the highly technical nature of those occupations). This is somewhat consistent with what was predicted in the previous section, that those occupations that are licensed, and particularly those with high coverage, tend to have more specific educational requirements. Similarly, those occupations on the right side, with lower levels of coverage, tend to have more variance in level of education on average but still generally less so among those that are licensed. You will notice that those occupations where the difference between licensed and non-licensed occupations is small or nonexistent tend to be occupations that either have more specific and technical educational requirements (i.e., sciences) or, like sales and services, have lower levels of education (as seen in Figure 2-4) combined with a lack of specific educational requirements. So sales and services are limited in potential variance because they are near the floor of the education scale. Overall, while the observed differences are visually distinguishable, they are generally small in size, indicating that the relationship between education variability and occupation type and regulation is limited. The data represented in this and the previous graph therefore, lends only modest support to the hypothesised relation between education and the regulation of occupations.

The data presented up to this point have focused only on the year 2019 but the results discussed above raise the question: have things changed significantly over time? One of my primary hypotheses is that the effects of licensing and its relationship to education would change over time and that its wage effects would also change as a result. Figure 2-6 presents the average proportion of university graduates subdivided by occupational group and regulation[9] from 1997

[9] Note that occupations in these graphs are grouped into licensed, certified, or unregulated if they are regulated in the given year, so the occupation-provinces included in the licensed group can change over time.

to 2019. Each line represents change over time in the proportion of university graduates averaged across detailed occupations that are licensed, certified, or unregulated in each occupational group. It is clear from this graph that the five occupation groups with generally higher levels of education have tended, over this time, to have consistently higher proportions. Additionally, in the case of business and finance, sciences, healthcare, as well as education, law, and government, licensed occupations seem to have always had higher levels of university graduates on average. There is also noticeable change in the proportions of university graduates in certified and unregulated occupations in healthcare and education, law, and government, suggesting an overall trend of increasing university educational attainment among workers in these unlicensed occupations and therefore, change in levels of education can occur independently of regulation.

Figure 2-6

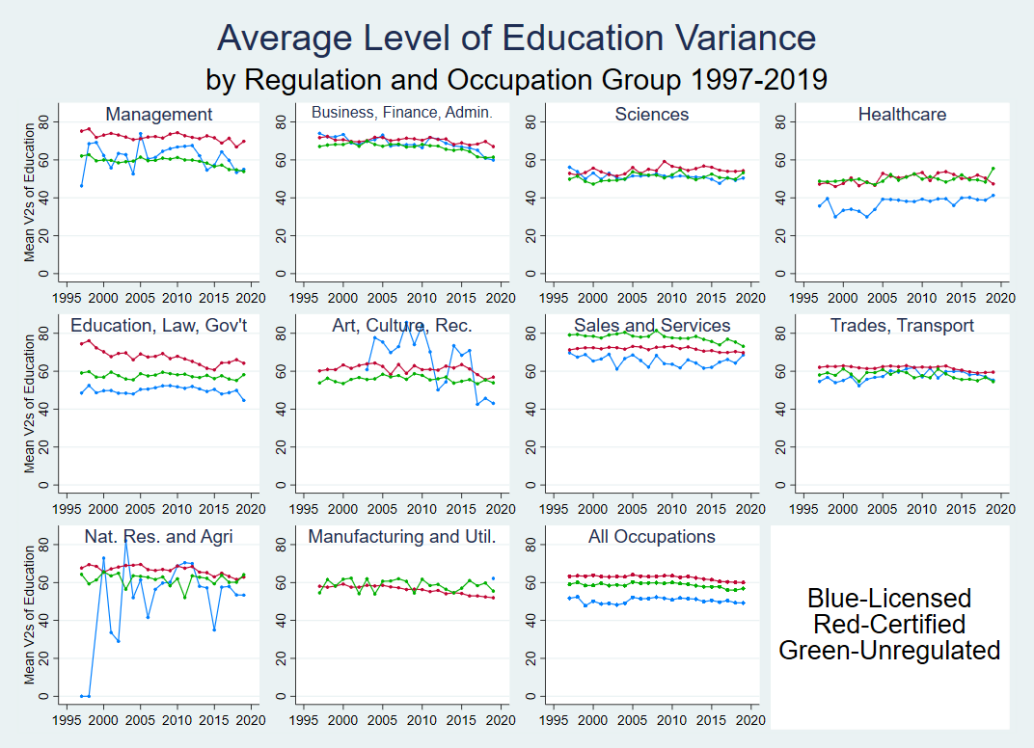


Looking at the lower education occupational groups, it is clear that trades, natural resources, and manufacturing have not changed much in the last ~30 years and there has never been much difference between those that are regulated. As before, art and culture seems to be

something of an exception, but it is important to keep in mind that this instability is the result of a small and variable sample size in each year for the one licensed occupation in one province in this skill group. Overall, it is clear from the final graph (which displays an overall average of all licensed, certified and unregulated occupations) that licensed occupations have tended to have the highest educated work forces while certified have remained the lowest. Based on the fact that certified occupations have had both the lowest education and the lowest wages on average, it seems that the hypothesis that certification is a lesser form of licensing may not reflect its actual effect on the Canadian labour market. Instead it would seem that certification as a regulatory form has little effect on education or wages and rather than considering it to be a step toward licensing it may be more realistic to conclude that it is a marginal characteristic of an occupation that does not bring about upward mobility.

Once again when we look at Figure 2-7 we can see that several occupations, those with lower average education levels tend to have high variability in level of education and demonstrate limited differences by regulation. They generally appear to experience only a small decline over time, with the possible exception of licensed natural resource occupations which experience significant fluctuations in education variance. The first five occupation groups in this graph, the ones that tend to be higher in proportion of university graduates, appear to have differing patterns in education variability (V2s) values. Management, business, finance and administration have high levels of variance generally from ~55 to 80 (on a 0 to 100 scale) and with limited differences by regulation. Healthcare and sciences show a similar pattern of mid range variance and little change over time but licensed health occupations are consistently lower by around 10 points, unsurprisingly suggesting specific education requirements among licensed healthcare occupations. Finally, among education, law, and government is the only group to show notable differences between regulation types with the unlicensed falling between the high 50's to the high 70's and with the licensed staying near 50. This indicates that licensing has consistently had the lowest variance of education, which is what we would expect, as licensing often imposes specific educational requirements as part of its regulation.

Figure 2-7



This is generally consistent with the overall trend in licensed occupations, which have the lowest V2s values throughout this period. Despite this overall trend, it appears that the effect of licensing differs across groups, with some showing no difference at all while some appear significant. Looking at the final graph, it is quite clear that on average the labour market has trended only slightly downward in variability of education, and while licensed occupations have been the lowest and have maintained their difference relative to certified and unregulated occupations. Based on the small and inconsistent effect of licensing on this measure it is not clear that we can come to a conclusion about the effects of licensing on the variability of education, raising doubt that there is a relationship between these two variables among occupations grouped in this manner.

Conclusion

We have shown the extent of licensing in the Canadian labour market and how much licensing varies between provincial jurisdictions. This is important in that it indicates how significant licensing may be to wage inequality in general but also how much potential there is for this effect to vary in significant ways between occupations and between provinces. It is also

very clear that there are substantial differences between occupation groups in terms of level of education. In some cases (but not all) it appears that education does in fact differ in relation to regulation, reflecting variability in the effect of licensing which results from differences in licensing as well as labour allocation processes across occupations. Based on the statistics presented in this chapter it appears that licensed occupations tend to have higher levels of education (indicated by proportion of university graduates) but only in 'high skill' occupations that also have higher licensing coverage. This is however, complicated by occupational differences in the variability of education, which shows an inconsistent relation to regulation across these groups of occupations. From this it appears that licensing may only affect educational variability among very few and very specific occupations, suggesting a need for further investigation.

Finally, we have been able to show that there is significant inter-occupation group variability in wages. It is generally the case that licensed occupations have the highest average wages when compared to both certified and unregulated. However, it is clear that regulation does not always produce social closure effects (at least in terms of average wages), as there are cases where licensed occupations do not appear to have higher wages on average. While the effects of licensing appear to be more complex, having the expected effect on wages and education in some occupations but not in others, it is clear that occupations form an important part of the structure the labour market and of wage inequality in Canada. So, there is tentative support for the concept of disaggregate structuration, the structure of modern markets can best be defined by smaller groupings such as occupations. However, based on the results in this chapter alone we cannot explain inter-occupation wage variability using data grouped by occupational group and regulation. The subsequent chapters of this dissertation will attempt to determine how licensing contributes to wage inequality within and across detailed occupations.

Chapter 3: Licensing and Wage Inequality

Licensing forms part of the structure of modern labour markets and it has been argued that this plays into the significant increase in economic inequality observed in many countries in recent decades. Based on structural theories of inequality, social structures like labour markets give rise to and shape inequality through three interrelated processes (Sørensen, 1996; Weeden, 2002). These include the definition of different positions within the division of labour; variability in rewards and other properties between these positions; and the behaviours that result from these differences as individuals are allocated into these positions. The second of these is not as widely considered as the other two in economic and sociological research. This presents an opportunity to discover new and important insights into inequality by examining the properties of different positions within social structures like labour markets. Occupational licensing is one such occupational property that is commonly thought to generate rents and thus contribute to inequality through social closure. This chapter examines the extent to which licensing contributes to economic inequality in Canada by measuring the wage effects of the legal requirement to hold a license in different occupations.

Social closure involves practices that shape access to positions in a social structure as well as the distribution of rewards between those positions. Licensing is both common in modern labour markets and is thought to be a significant contributor to social closure within occupations (Gittleman & Kleiner, 2016; Kleiner & Krueger, 2010; Kleiner & Soltas, 2018; Weeden, 2002). In the last several decades licensing has become more prevalent and increasingly normal in modern labour markets, contributing to structural change and shaping income inequality. In 2019, 90 of the 502 occupations for which I have data[10] are licensed in at least one province, meaning that ~18% of the occupational structure of Canada may be subject to the wage effects of licensing. Licensing functions as a social closure mechanism by using the power of the state to restrict the legal right to practice in a given occupation thus excluding those who don't meet certain criteria from working in the occupation. This chapter explores the social closure effects of occupational licensing on wages while controlling for the effects of other occupation and region characteristics. In order to understand how both individual and structural factors contribute to economic inequality, I employ a two level random effects model which

[10] https://noc.esdc.gc.ca/Home/Welcome/5bfe48ef9961405f8882476835e93bbb And https://www.cicdi.ca/935/RepertoireProfessions.aspx?sortcode=2.25.26.27.30.31

nests individuals inside labour markets defined by occupation and region. Using occupation-province as a second level unit allows me to measure the effect of licensing by enabling the comparison of licensed and unlicensed occupation-regions in a given year (2019). This method allows me to control for the effect of other occupation and region characteristics on wages, such as the differing human capital requirements of occupations and regional variation in the cost of living. Using a random effects approach, I am able to determine whether or not licensing itself generates a wage premium through the production of rents in certain occupations and also whether the wage effect of licensing is shaped by other occupation characteristics.

Licensing and Occupational Closure

Labour markets can best be conceptualized as a hierarchically structured social system consisting of positions that differ in size and accessibility (Sørensen, 1996). It is generally recognized that these positions shape the distribution of income by the fact that they influence individual behaviours like educational attainment, which then affect outcomes (i.e., wages) for those individuals. However, it is commonly overlooked that positions in the labour market have certain properties that are independent of the individuals within them and that also shape outcomes for those individuals (Sørensen, 1996). This implies that some portion of wage distribution is derived solely from the effects of the structural properties of labour markets. This means that there are at least two significant contributing factors to income inequality. One is individual characteristics like skills and education while the other has nothing to do with individual efforts and derives solely from the characteristics of the position an individual occupies in the labour market. I would add to this that individual characteristics can interact with those of the positions in a social structure and that this interaction is responsible for a third component of wage determination.

Perhaps the most important and most common structural characteristic that shapes wage inequality in modern labour markets is rent (Sørensen, 1996). Rent is broadly defined as a payment for possession of a resource. This concept can be extended to include positions in a social structure as 'resources' with properties that can generate rent (Sørensen, 1996). This is the case when such positions are in limited supply as this generates zero sum competition and excludes some individuals from accessing the position and any associated rewards. When it comes to a labour market, rent is often generated through social closure rather than by natural

limitations on the supply of a given position. Social closure describes mechanisms used by incumbents of a position to monopolize that position, excluding outsiders and protecting themselves from competition (Weber, 1978; Weeden, 2002). Occupational closure is a specific instance of social closure whereby occupational groups define the social conditions of the occupation and the ability of its members to exert the control necessary to create and maintain the barriers that exclude others and protect their rewards. Occupational closure is generally accomplished by elites, that is, those with high paying jobs in high status occupations; but it is commonly carried out through institutions that lend the closure some measure of legitimacy (Van de Werfhorst, 2011).

The sub-division of the labour market into non-competing groups is important in defining its structure in ways that matter for economic inequality. Individual occupations are the most realistic and empirical way to describe the true structure of modern labour markets as they are themselves defined by the realities of production (Hauser & Warren, 1997). Thus occupations best represent the 'positions' referred to by Sorensen and are therefore the 'location' where rent in modern labour markets is produced, and where the segmentation of modern labour markets is commonly institutionalized (with the creation of licensing bodies being one obvious example) (Grusky & Sorensen, 1998).

Licensing creates a right to practice in an occupation, giving authorization to carry out certain tasks or to identify oneself with certain occupational titles (Kleiner & Krueger, 2010; Redbird, 2017; Weeden, 2002). Licensing entails a set of pre-requisites for entry into the occupation which may include things like specific or general educational qualifications, apprenticeship, and examinations which are believed to serve as barriers to entry thus, making occupational licensing a form of social closure. Because these restrictions are enforced by the state, there are legal consequences for practicing without a license, which is why licensing is considered to be the most effective form of occupational closure (Redbird, 2017). The claim that licensing entails social closure and therefore contributes to economic inequality in Canada is what this chapter primarily aims to investigate.

It is interesting however, that there is contradictory evidence. Weeden (2002) and Kleiner and Kruger (2010) for example, both find that licensing has a significant effect on wages in the U.S. Redbird (2017) however, compares U.S. occupations over 30 years and finds no

evidence of a wage premium in licensed occupations, raising doubts that licensing functions as a social closure mechanism. One possibility is that the wage effect of licensing is dependent on institutional differences between occupations as well as such things as market forces and demographics. Redbird's (2017) analysis does not identify these contextual factors (outside of licensing coverage) and therefore cannot explain potential variation in the effects of licensing across occupations. The implication is that licensing may have variable effects on wages and functions as social closure in some occupations but not in others. One possibility commonly discussed in existing research (see Weeden, 2002) is that if an occupation is licensed in some jurisdictions but not others, its ability to act as a barrier to entry is undermined by the possibility fact that labour supply can flow toward the unlicensed jurisdictions. Thus, it is believed that lower coverage will result in less social closure and therefore a reduced or non-existent wage premium. Another possibility proposed by Redbird (2017) is that licensing encourages the development of other institutions within an occupation (i.e., vocational schools) and that these alter the supply effects of licensing over time. This could have the effect of making entry into an occupation more bureaucratic but not necessarily exclusionary. This idea suggests that older licensing requirements will exert less social closure because they are more likely to have experienced the development of occupation based institutions that facilitate labour supply. However, it is also possible that once an occupation is licensed for the first time in one jurisdiction, coverage will increase over time as other jurisdictions follow suit, thus increasing social closure effects over time. It would seem that these two ideas are incompatible and this suggests that things like the coverage of licensing[11] or the number of years that the licensing requirement has been in place may determine the wage effects of licensing in ways that are complex and likely to vary between occupations.

This chapter explores some of these possibilities and aims to accomplish four things. First, it measures the simple wage effects of licensing as an occupation-province effect, while controlling for individual characteristics. Second, it examines the wage effects of voluntary certification, another perhaps less effective social closure mechanism. Third, it attempts to clarify the true wage effects of licensing by controlling for other potential occupation and region characteristics that contribute to these wage differences. This is intended to clarify the causal

[11] Coverage refers to the number of jurisdictions within a country where an occupation is licensed. It could also be conceived as the proportion of the population in an occupation that is required to hold a license.

link between licensing and observed wage differences. Finally, this chapter explores the ways in which licensing effects on wages may be conditional on other occupation characteristics (i.e., coverage and date of enactment of licensing, or human capital requirements) or on the characteristics of individuals within those occupations (i.e., immigrant status or gender). It is through this approach that this chapter aims to explain how rather than simply if licensing shapes the distribution of wages within and across occupations in Canada.

Data and Methods

The primary source of data for this chapter is the micro data files for the Statistics Canada Labour Force Survey in 2019. This survey consists of a nationally representative monthly sample of Canadian households including individuals aged 15 or older. The total weighted sample size of the LFS for 2019 is 21,197,235 giving us the estimated size of Canada's total active labour force in 2019, with 3,616,684 of those being in licensed occupations leaving 17,580,551 in the unlicensed sector.

Individual Level Data

The LFS provides all individual level data for this analysis including the dependent variable: hourly earnings. Because I am working with the micro data file earnings values are not top coded, and therefore adjustments to the top of the wage distribution are not needed. Additionally, the effects of log normalizing the dependent variable only has minor effects on the residual distribution, suggesting minimal improvement to model fit. The analysis focuses on non-logged models but log normalized versions of key models are included in Appendix 3-A. Finally, it is worth noting that the LFS does not include observations on wages for self-employed individuals and therefore self-employed people are not included in these models.

All of the individual level covariates included in the models come from the LFS and are measures commonly included in typical earnings functions. These include primarily demographics and measures of human capital. The categories and summary statistics for these variables can be found in Table 3-1. Looking at Table 3-1 it is clear that licensed occupations have substantially higher average wages, about $9 per hour more than unlicensed occupations. It is also interesting that other differences in means, standard deviations and proportions between licensed and unlicensed occupations appear to be mostly limited. There is a slightly higher proportion of women in licensed occupations, ~52% compared to ~47%, while there is almost no

difference in the proportion of immigrants. As expected average years of education is slightly higher in licensed occupations, though perhaps not by as much as I would have thought, only amounting to ~1.5 years.

Table 3-1: Individual Level Variables in Licensed and Unlicensed Occupations (2019)

	Licensed		Unlicensed	
	Mean/Pr	(SD)	Mean/Pr	(SD)
Dependent Variable - Hourly Earnings	35.059	(14.483)	26.363	(13.553)
Female	0.524	(0.499)	0.465	(0.499)
Living in CMA	0.829	(0.376)	0.789	(0.408)
Immigrant	0.261	(0.439)	0.250	(0.433)
Highest Level of Education				
Grade 10 or lower	.013	(.112)	0.065	(0.246)
Grade 11 to 13, non-graduate	.010	(.099)	0.038	(0.192)
Grade 11 to 13, graduate	.078	(.269)	0.205	(0.404)
Some postsecondary	.033	(.179)	0.073	(0.261)
Postsecondary certificate or diploma	.097	(.295)	0.100	(0.300)
Community College	.217	(.413)	0.228	(0.420)
University Cert. Below Bachelor	.027	(.163)	0.024	(0.153)
Bachelor's degree	.333	(.471)	0.186	(0.389)
Above bachelor's degree	.192	(.394)	0.080	(0.272)
Years of Education (estimated)	15.384	(2.215)	13.942	(2.288)
Work Experience (years)	20.535	(13.183)	21.243	(14.888)
Union Member/Covered	0.428	(0.495)	0.277	(0.447)
Parttime	0.134	(0.341)	0.201	(0.401)
Non-Permanent	0.106	(0.308)	0.132	(0.339)
Establishment Size >500 Employees	0.398	(0.489)	0.337	(0.473)
Firm Size >500 Employees	0.680	(0.467)	0.610	(0.488)
Industry				
Agriculture, Forestry, and Fishing	.003	(.054)	0.024	(0.152)
Mining	.021	(.143)	0.013	(0.112)
Construction	.079	(.270)	0.079	(0.270)
Manufacturing	.046	(.209)	0.099	(0.299)
Transportation, Communications, and Utilities	.033	(.178)	0.086	(0.281)
Wholesale Trade	.009	(.094)	0.037	(0.189)
Retail Trade	.058	(.234)	0.129	(0.335)
Finance, Insurance, and Real Estate	.134	(.341)	0.045	(0.207)
Services	.572	(.495)	0.435	(0.496)
Public Administration	.045	(.207)	0.054	(0.225)
Population Size	3616684		17580551	

Interestingly average years of work experience is smaller among licensed occupations however only by less than 1 year and this measure is highly variable as shown by the standard deviations. There are also some small differences in job/market characteristics. Unionization is much higher among licensed occupations, at 43% compared to 28% among unlicensed. Job security also is slightly better on average in licensed occupations with both part time and non-permanent jobs

being less prevalent. Among licensed occupations part-time and non-permanent work represent only 13.4% and 10.6% respectively of jobs in licensed occupations whereas among unlicensed occupations they represent 20.1% and 13.2% of all jobs Finally, the one clear difference between licensed and unlicensed jobs is how many there are. The estimated size of the licensed workforce in Canada in 2019 is ~3.6 million while the unlicensed sector consists of around 17.6 million. So, overall pay, job quality, and education appear to be higher among licensed occupations but they are also the clear minority of all jobs in the labour market.

Occupation-Province Level Data

The micro data file for the Labour Force Survey is particularly useful for this kind of research because it includes 4 digit detailed occupation codes for each observation. These codes are combined with province to create the 2nd level variable into which each individual is nested in my models. The use of occupation+province as the 2nd level variable was chosen over the use of simple occupation (See Appendix 3-B for comparison) because it most accurately reflects how labour markets are structured both in the sense that labour supply and demand operates within occupations as well as within geographic areas but also because occupational regulation (specifically licensing) is under provincial jurisdiction and therefore varies across provinces in almost all occupations (one exception is most occupations to do with air travel: pilots, mechanics, traffic controllers etc. which are regulated under the auspices of Transport Canada). This approach comes with the added advantage that regulations can be coded as categorical variables which make for slightly more parsimonious models. Additionally, coverage (an important factor in the effects of licensing) can still be included in these kinds of models and is therefore included the analysis below.

Variables 1 through 5 in Table 3-2 summarize the market and demographic characteristics of occupation-provinces with means (or proportions) and their standard deviations weighted by group size. Each variable is derived from measures included in the LFS. The proportion variables describe the average proportion of women, immigrants, and union members across all occupation-provinces. The occupations-province unemployment rate is the average

proportion of those within a given occupation code, in a given province who are identified as unemployed but still in the labour force[12].

Table 3-2: Descriptive Statistics - Occupation-Province Level Variables (2019)*

			Bivariate Correlations								
	Mean/Pr	(SD)	1	2	3	4	5	6	7	8	9
Demographics and Market Characteristics											
1 Proportion Female	50.334	(22.862)	1.00								
2 Proportion Immigrant	22.151	(12.515)	0.03	1.00							
3 Proportion Union	53.375	(23.520)	-0.01	0.12	1.00						
4 Occupation-Province Unemployment	3.122	(2.819)	-0.21	-0.13	0.00	1.00					
Social Closure Variables											
5 Variance of Education Level	73.053	(11.167)	-0.07	0.10	0.28	0.12	1.00				
6 Licensed Only	.152	(.359)	0.05	0.05	-0.07	-0.16	-0.39	1.00			
7 Voluntary Certification Only	.536	(.499)	-0.09	0.05	0.23	0.22	0.31	-0.39	1.00		
8 Licensed and Certified	.018	(.133)	0.10	0.02	-0.20	-0.14	-0.44	0.55	-0.39	1.00	
9 Years Enacted	48.974	(46.730)	-0.23	0.10	-0.10	-0.17	-0.47	0.31	-0.01	0.01	1.00
Occupations-Provinces (M)	4645										
*Weighted by occupation-province size											

The remaining variables in Table 3-2 represent the social closure mechanisms that are the central interest of this chapter. Variables 6 through 8 describe the proportion of all occupation-provinces that are subject to that form of regulation while Table 3-3 provides their frequencies. The final variable in Table 3-2 describes the average number of years that each license requirement has been in place. This mean is quite high because there are some occupations that have been licensed in Canada for hundreds of years, but there is also a lot of variation in this measure as indicated by its standard deviation (See Chapter 5 for more details).

Table 3-3: Occupation-Province Frequencies by Regulation type

Regulation	Freq.	Percent	Cum.
Unregulated	1,578	33.97	33.97
Licensed Only	717	15.44	49.41
Certified Only	2,328	50.12	99.53
Licensed and Certified	22	0.47	100
Total	4,645	100	

In addition to the variables that operate at the level of occupation-province there are some that exist at the level of occupations and that are constant across provinces. Statistics for these variables are included in Table 3-5, though only 1, 5, 6, and 7 are included in the models. The

[12] Note: In the LFS an individual is given an occupation code if they have been employed in that occupation within the preceding 12 months, so this measure does not include people who may still be in the labour pool for a given occupation but have been out of work for more than one year.

first of these variables is a characteristic of licensing that is thought to be important in determining the capacity of a licensing to act as a social closure mechanism: coverage. Coverage in this case measures the percentage of an occupation's total employed labour force that is required to hold a license (See Chapter 2 for details).

Table 3-5: Descriptive Statistics - Occupation Level Variables (2019)

			Bivariate Correlations							
	Mean/Pr	(SD)	1	2	3	4	5	6	7	8
Coverage Variables										
1 Licensing Coverage	17.058	(34.295)	1.00							
2 Union Coverage	23.295	(21.818)	0.27	1.00						
3 Reserved Title Coverage	69.810	(36.824)	0.31	0.16	1.00					
4 Voluntary Certification Coverage	88.522	(24.723)	-0.66	-0.08	-0.25	1.00				
ONET Variables										
5 Ability	2.542	(.281)	0.36	0.21	0.34	-0.29	1.00			
6 Knowledge	2.440	(.555)	0.33	0.12	0.50	-0.19	0.71	1.00		
7 Skill	2.630	(.491)	0.34	0.07	0.47	-0.24	0.73	0.91	1.00	

Occupations

*Weighted by occupation size

The three remaining occupation level variables in Table 3-5 are all derived from the O*NET 23.2 occupational database (onetcentre.org), which contains a rich collection of variables describing work and worker characteristics for a wide range of occupations. Each of these variables represent an abstract measurement of 'how much' or what 'level' of ability, knowledge, and skill are typically required to do a job, and is based on surveys of people within these occupations (See Chapter 2 for details).

Analysis

In the simplest terms, the claim that this chapter aims to investigate is that occupational licensing functions as a social closure mechanism, granting a wage premium to those who are in licensed occupations. Social closure is a phenomenon that operates at the level of occupations (and jurisdictions). The ideal way to test this would be to compare licensed occupations to unlicensed but otherwise identical counterparts. While the realities of actually existing markets and data preclude such a straightforward approach, this chapter is effectively able to compare licensed and unlicensed occupations/jurisdictions while controlling for most of the important commonly recognized characteristics that affect wage differences between occupations. This is

accomplished through the use of a 2 level random effects model consisting of individual workers at level one, nested inside occupation-provinces at level two.

Each model presented has the same basic structure and takes the form of a two level random intercept/random effect model. The baseline model presented in Table 3-7 serves as a basic initial model against which all other models can be compared. This baseline model represents a more traditional approach to the study of wage distribution, effectively representing the findings one would expect from a classic human capital human capital or sociological analysis. Because these models regress unadjusted wages (instead of the natural logarithm as in Appendix 3-A) the interpretation of the coefficients is straightforward. At level one, each coefficient represents the average of the average difference in wage per unit of the variable while at level two the coefficients represent the difference in occupation-province average wage per unit of the variable. So, female at level one represents the average difference in women's wages relative to men average across all occupations provinces, while %female represents the change in occupation-province average wage per unit change in the % of women in an occupation-province.

This model is useful as it provides a baseline measure of between occupation-province variation in wages in the form of a standard deviation. A standard deviation of 9.2 ($/hr) is substantial and the intra-class correlation (ICC) based on the variance components ($\rho = \frac{\tau_{00}}{(\tau_{00} + \sigma^2)}$) is .521, indicating that ~52% of the variation in hourly earnings occurs between occupation-provinces. This is substantial and indicates that any analysis of wage variability should consider the role of occupations and geography.

Table 3-7 Random Intercept Model and Random Effect Model with Market and Human Capital Variables at Level Two

	Baseline		MHC	
	B	SE	B	SE
Level One Covariates:				
Female	-2.417***	(0.150)	-2.371***	(0.151)
Immigrant <1 Year	-2.174	(1.871)	-2.121	(1.867)
Immigrant 1-19 Years	-3.199***	(0.178)	-3.190***	(0.179)
Immigrant 20-39 Years	-1.721***	(0.244)	-1.753***	(0.241)
Immigrant 40-59 Years	-0.056	(0.523)	-0.006	(0.535)
Immigrant 60-79 Years	-6.196***	(1.479)	-6.180***	(1.515)
Non-CMA	-0.803***	(0.129)	-0.773***	(0.127)
Less than High School Grad	-0.880***	(0.178)	-0.807***	(0.178)
Post Secondary Certificate	1.738***	(0.175)	1.747***	(0.171)
Community College	1.726***	(0.138)	1.687***	(0.137)
University Certificate	2.707***	(0.402)	2.745***	(0.396)
Bachelor's Degree	3.696***	(0.189)	3.568***	(0.188)
Above Bachelor's Degree	7.189***	(0.289)	7.049***	(0.283)
Potential Years of Work Experience	0.148***	(0.005)	0.149***	(0.005)
Union	1.766***	(0.166)	1.841***	(0.164)
Part Time	-1.667***	(0.174)	-1.677***	(0.168)
Non-Permanent	-2.399***	(0.174)	-2.384***	(0.173)
Firm >500 Employees	2.179***	(0.142)	2.083***	(0.139)
Establishment >500 Employees	1.612***	(0.205)	1.635***	(0.205)
Agriculture, Forestry, and Fishing	-0.704	(1.218)	-0.619	(1.210)
Mining	6.191***	(0.776)	6.183***	(0.775)
Construction	0.978*	(0.447)	0.973*	(0.445)
Transportation, Communications, and Utilities	1.726***	(0.439)	1.681***	(0.440)
Wholesale Trade	0.324	(0.450)	0.272	(0.451)
Retail Trade	-2.759***	(0.395)	-2.750***	(0.395)
Finance, Insurance, and Real Estate	0.019	(0.504)	-0.036	(0.511)
Services	-1.267***	(0.343)	-1.283***	(0.343)
Public Administration	1.357**	(0.423)	1.242**	(0.419)
Level Two Covariates:				
% Female			-0.019***	(0.005)
Occupation-Province Unemployment (0-100)			-0.038*	(0.015)
%University Graduates			0.075***	(0.006)
Ability			2.780***	(0.767)
Knowledge			1.222**	(0.392)
Skill			6.164***	(0.626)
Constant	24.181***	(0.329)	21.562***	(0.372)
Random Effects:				
SD(Constant)	9.217***	(1.015)	7.057***	(1.018)
SD(Resdiual)	8.466***	(1.010)	8.406***	(1.010)
N	611,763		599,397	
M	4,501		4,373	
Degrees of Freedom	28		34	
Log Likelihood	-3833446.774		-3710627.403	

Note: The difference in N is due to the ONET varaibles which are not available for all occupations

The Market/Human Capital (MHC) model introduces level two covariates for market characteristics, demographics and human capital at the occupation-province level. Largely the results of this model support the arguments found in human capital theory and classic market theory. All of the human capital measures indicate higher average earnings among those occupations with higher numbers of university graduates amounting to $0.70 for each one percent increase in university graduates (equating to a 0.02% increase based on the log normalized model in Table 3A-1 in Appendix 3A). This suggests that educational attainment differences between occupations are associated with monetary rewards on average across occupations. Also, the ONET variables measuring occupation levels of skill ability and knowledge all indicate strong occupation human capital effects, ranging from $1.2 to as much as $6.2 (or 4.7% to 21.9% from Table 3A-1) increase in occupation average wages per unit increase in these measures. Also, as expected occupation-provinces with higher unemployment do typically have lower average wages amounting to a drop of almost $0.40 (or 0.2% from Table 3A-1) per percentage increase in unemployed individuals in the occupations. While the effect is small this result does indicate that supply and demand operate to some extent within occupation/geographic units.

The results for the percentage of women in an occupation are somewhat more complicated. In the MHC model the coefficient is small in size but significant, suggesting that per percent increase in the percentage of women in an occupation-province average wages decline by ~0.02 dollars per hour (equating to 0.1% from Table 3A-1). However, in a model with %female as the only coefficient (not included in these results), it is even smaller and non-significant. Additionally, in a model with all of the MHC level two variables but with %female excluded, the only notable difference in results compared to this model is that ability becomes a little larger and statistical significance is not affected at all. Overall, this indicates that the proportion of women in an occupation is not strongly or consistently associated with wage differences on its own. Furthermore, the other model specifications suggest that %female may be associated with occupation based measures of human capital. This is not consistent with the devaluation hypothesis and instead appears to be more consistent with the argument made by Tam (1997), that specialized human capital better explain these wage differences. There does appear to be a correlation between %female and ability and these results suggest that the proportion of women in an occupation may be correlated with certain human capital differences

raising doubts that the proportion of women in an occupation "causes" the wage effect we have observed. Instead the devaluation hypothesis would predict an overall average effect of the proportion of women across all occupations (i.e. not controlling for human capital) as the main argument behind this hypothesis is that the work that becomes associated with women (independent of any other effect) leads that work to be devalued. This conclusion is in contrast to those of Redbird (2017) and Weeden (2002) who both find some support for devaluation however, it is worth pointing out that they don't appear to analyze the issue in as much detail, nor do they consider alternative interpretations of the simple wage effect of %female. Finally, it is also worth pointing out that the size of the SD(constant) is much smaller in this model and the ICC has fallen to .456 suggesting that these human capital and market variables collectively explain almost 6.5% of between occupation-province variation in wages.

Social Closure Models

The models appearing in Table 3-9 represent the competing theory of social closure as an alternative to market and human capital approaches to explaining wage variability. As expected at level one the model is identical to the MHC and baseline models and the coefficients differ only slightly. Thus my comparison of the two sets of models can focus on coefficients and explained variance at level two. At level two the first SC model includes covariates for variability of education and a three category variable that includes two forms of occupational regulation: licensing and certification on their own as well as their combined effect (discussed more fully in the data and methods section).

Table 3-8: Example Occupations-Licensed Only (n=59)

NOC Code	Occupation Name	Number of Jurisdictions
1113	Securities agents, investment dealers and brokers	13
2154	Land surveyors	13
2244	Aircraft instrument mechanics, technicians and inspectors	13
2272	Air traffic controllers and related occupations	13
3131	Pharmacists	13
3142	Physiotherapists	9
3217	Electromyography (EMG) Technologist	13
3232	Acupuncturists (Practitioners of natural healing)	5
3234	Paramedical occupations	10
6231	Insurance agents and brokers	13

First, it is interesting to note the results from a model that includes a simple binary of license as the sole level two variable. In this model (not included in Table 3-9) the coefficient

for licensing is 6.298 indicating that without controlling for any other occupation or region characteristic, licensed occupation-provinces have a higher average wage than non-licensed occupation-provinces by over 6$ per hour on average. The finding of a wage premium among licensed occupations is consistent with most existing research which finds that licensed occupations tend to be more highly paid (by varying amounts) on average relative to non-licensed occupations. However this model does not indicate whether or not licensing is responsible for this difference. With no other controlling variables we cannot be certain that licensed occupations simply do not tend to have higher human capital or some other characteristic that results in higher average wages. Looking at the names of the sub-sample of licensed occupations in Table 3-8 we can see that licensed occupations do tend to be highly technical and require high levels of education. This highlights the possibility that the licensing wage premium is actually due to their tendency to be jobs requiring high levels of human capital.

Table 3-9 Random Effect Models with Social Closure Variables at Level Two

	Social Closure		Years Enacted		Licensing Coverage	
	B	SE	B	SE	B	SE
Level Two Covariates:						
Level of Education Variance (Centered)	-0.052***	(0.007)	-0.050***	(0.007)	-0.047***	(0.007)
License Only	2.668***	(0.443)				
Voluntary Certification Only	-5.288***	(0.309)	-5.299***	(0.309)	-5.555***	(0.329)
License and Certification	1.343	(1.437)				
Licensing-Years Since Enactment						
License 1-19 Years			1.221	(0.807)		
License 20-39 Years			0.047	(0.596)		
License 40-59 Years			2.234	(1.217)		
License 60-79 Years			7.286***	(2.025)		
License 80-99 Years			6.923***	(0.839)		
License 100+ Years			5.085**	(1.631)		
License Years Unknown			2.172**	(0.777)		
Licensing-Coverage						
License >0-19%					-1.609*	(0.691)
License 20-39%					-2.334***	(0.661)
License 40-59%					-3.170***	(0.960)
License 60-79%					-3.704***	(0.814)
License 80-100%					3.862***	(0.503)
Constant	25.677***	(0.433)	25.712***	(0.432)	26.005***	(0.447)
Random Effects:						
SD(Constant)	8.499***	(1.015)	8.432***	(1.015)	8.415***	(1.015)
SD(Residual)	8.466***	(1.010)	8.466***	(1.010)	8.466***	(1.010)
N	611,763		611,763		611,763	
M	4,501		4,501		4,501	
Degrees of Freedom	32		37		35	
Log Likelihood	-3833081.149		-3833049.350		-3833038.846	

The models pictured in Table 3-9 demonstrate that there is further complexity in the wage effects of occupational licensing. First it is worth noting the variable for education variance in all three models, which measures the variability of educational attainment in each occupation-province and serves as an indication of credentialing (i.e., lower variation suggests more specific education requirements to work in that occupation). The effect is negative and small in size (amounting to 5 cents (or 0.2% from Table 3A-2) per unit increase variation but keep in mind its scale: 0 to 100 with an average of ~ 73 and a standard dev of ~11) but it is significant and is also consistent with our hypothesis; that occupations with higher variability in educational requirements would experience less social closure and therefore have lower earnings on average. Thus we find support for the theory that education itself can act as a social closure mechanism (though perhaps a weaker one when compared to occupation regulations like licensing).

Table 3-10: Example Occupations-Certified Only (n=266)

NOC Code	Occupation Name	Number of Jurisdictions
4412	Home support workers, housekeepers and related occupations	13
5241	Graphic designers and illustrators	13
7512	Bus drivers, subway operators and other transit operators	13
7531	Railway yard and track maintenance workers	13
8261	Fishing masters and officers	13
9222	Supervisors, electronics manufacturing	13
9446	Industrial sewing machine operators	13
9462	Industrial butchers and meat cutters, poultry preparers and related	13
9537	Other products assemblers, finishers, inspectors (eg.clocks watches)	13
9614	Labourers in wood, pulp and paper processing	13

We can see in the Social Closure model that those occupation-provinces that are licensed but not certified do still have a wage premium but now only amounting to an average difference of 2.7$ (or 10.4% from Table 3A-2) per hour compared to completely unregulated occupations. It is however important to keep in mind that this effect is estimated while education variability is held at its mean. What is interesting is that occupations that are certified appear to have lower wages on average, and by a significant amount: approximately 5$ (or 15.3% from Table 3A-2) per hour. This is not consistent with existing research (i.e. Weeden (2002)) nor my expectations. I anticipated that certification would function as a lighter form of social closure, but instead it appears to either cause or be associated with lower wages. I cannot be certain as to why this would be the case, but it may reflect the problem of 'slippage' (see Redbird, 2017; Weeden,

2002). The basic idea of slippage is that because we lack individual measures of licensing and certification we cannot know for certain how many individuals in an occupation are certified and the uncertified sector within an occupation-province will drag down that occupation's average wage and thus lead to downward bias in our estimate of certification wage effects. This occurs even though certification may have a wage premium among those individuals in that occupation that are certified. This raises some doubt about our ability to effectively measure the effects of certification in these models. This also applies to licensing but because licensing is non-voluntary it is reasonable to expect that in most occupations the number of unlicensed individuals practicing is relatively small. If we look at Table 3-10 we can see that they make up a very large portion of the labour market (266 occupations), and from the small sub-sample of certified occupation titles in this table they appear to vary significantly in terms of technical and educational requirements as well as wages. Just the ten in this table include occupations in natural resources, skilled and unskilled labour across a variety of industries. Based on the diversity of these occupations we can see that certification is much more common in the Canadian labour market but also appears to be less strongly associated with high human capital requirements than is seen among licensed occupations. We might conclude from this that certification does not function as an effective means of social closure but it is also possible that the average wage penalty of these occupations would be even larger were it not for certification. This question may be addressed in the models included in Table 3-16. Finally, note that among those occupations that are both licensed and certified there is no significant wage effect. This may be because certification draws wages down while licensing draws wages up and these effects somehow balance each other or, more likely, this simply reflects the very small numbers of occupations that fit into this category. We can see from Table 3-11 that all three are in the medical profession but are not among those medical occupations that tend to be highly educated and highly paid. Overall we can, despite the complications introduced in this model, still confirm that licensing is associated with a wage premium and therefore may act as a social closure mechanism while certification appears to not have similar effects on wages.

Table 3-11: Example Occupations-Licensed and Certified (n=3)

NOC Code	Occupation Name	Number of Jurisdictions
3012	Registered nurses and registered psychiatric nurses	10
3141	Audiologists and speech-language pathologists	1
3219	Other medical technologists and technicians (except dental health)	8

One final thing to note is that the intra class correlation for the basic Social Closure model equates to .501, indicating that these variables only explain about 2% of wage variability between occupation-provinces (the ICC for the Baseline model was .521). This suggests that either occupational regulation does not explain much between occupation wage variability or there is something about these regulations that we have not yet accounted for in this model. This is investigated further in the next two models.

Licensing Coverage and Years Enacted

The other two Social Closure models included here are intended to explore the possibility that licensing wage effects vary in relation to two key characteristics of licensing requirements alluded to in the literature. First, as discussed in my review, Redbird (2017) speculates that licensing effects will vary over time due to the development of occupational institutions that facilitate the entry of new workers into an occupation more and more efficiently as time passes, once a licensing requirement is enacted. Based on this idea I have hypothesized that the social closure effects of licensing will generally be highest among occupations that have not had the time to experience the development of these kinds of institutions and therefore the wage premium associated with licensing will be highest among those most recently enacted and decline the longer an occupation has been licensed (Note this may be complicated by the effects of coverage as discussed below).

Based on the date enacted information I have gathered for the majority of licensed occupations in Canada I created a categorical variable in which licensed occupations are grouped based on the number of years since a licensing requirement was first enacted for that occupation in a given province. All licensed occupations are grouped into 20 year spans, top coded at 100 years, and with 13 being unknown. Note that the variable also includes certified occupations, but in these two models those that are both licensed and certified are not in their own category and are included with the other licensed occupations. This was done both to keep the number of coefficients manageable and because very few occupations are both licensed and certified. Also, it is clear from these results that the overall effect of certification has not changed with the addition of years enacted or coverage, suggesting that there is no relation between them.

Looking at the results for the Years Enacted model, it is immediately clear that the effect of years enacted does not conform to my expectations. It appears that among licensed

occupations, those that have been licensed for less than 60 years on average have no significant effect on hourly earnings. Meanwhile those occupations that have been licensed for between 60 and 100 years enjoy an approximate 7 dollars per hour (or 23.7% from Table 3A-2) wage premium relative to unregulated occupations. Interestingly, it also appears that this premium declines among occupations that have been licensed for more than 100 years, but is still significant at 5$ (or 12.9% from Table 3A-2).

Table 3-12:Example Occupations-Number of Years Since License Enacted (80-100 years) (n=7)

NOC Code	Occupation Name	Number of Jurisdictions
2142	Metallurgical and materials engineers	13
2244	Aircraft instrument mechanics, technicians and inspectors	13
2271	Air pilots, flight engineers and flying instructors	13
3111	Specialist physicians	13
3112	General practitioners and family physicians	13
4112	Lawyers (Lawyers and Quebec notaries)	13
7315	Aircraft mechanics and aircraft inspectors	13

Contrary to my hypothesis, these results indicate that the wage effect of licensing is most significant among those occupations that have been licensed the longest while more recently licensed occupations enjoy no wage premium when compared to unregulated occupations. This may indicate that somehow licensing becomes more effective as a social closure mechanism over time or that the benefits of licensing do not extend to newly licensed occupations possibly because of limited coverage which takes time to increase. It is also possible that there is something special about older licensed occupations. The oldest licensed occupations in Canada are listed in Table 3-12 and it includes some of the most established professional occupations that are both highly technical and come with high educational requirements. It is possible that there is something unmeasured about these old professions that explain their high wages but when we compare these occupations to those in Table 3-13 there are two notable differences. The first is that the older professions in Table 3-12 have not only been licensed for a long time but also have achieved complete coverage in the Canadian labour market while the more recently licensed occupations in Table 3-13 appear to have significantly less coverage in many cases. It is also interesting that some of the occupations in Table 3-13 (and those with lower coverage in Table 3-15 as well) appear to be adjunct to older licensed occupations (i.e., dental assistants and respiratory therapists are occupations that are associated with established licensed professions like dentists and physicians). Thus it may be that the difference in wage effects observed between old and more recently licensed occupations reflects differences in coverage or simply

the effect of being licensed for many years. Alternatively, the types of occupations that appear in these two lists suggest that in some cases more recently licensed occupations may have been licensed due to their association with older licensed professions. So, maybe dental assistants are becoming licensed not because of the efforts of dental assistants themselves but because dentists want the assistants they hire to have a particular kind or level of education and a minimum level of competence. These things may be at least partially responsible for the wage effects observed in these models.

Table 3-13: Example Occupations-Number of Years Since License Enacted (1-19 years) (n=7)

NOC Code	Occupation Name	Number of Jurisdictions
1228	Immigration consultants, representatives (immigration, border services)	13
2151	Architects	11
2225	Landscape and horticulture technicians and specialists	7
3214	Respiratory therapists (cardiopulmonary technologists)	8
3232	Acupuncturists (Practitioners of natural healing)	5
3236	Massage therapists	4
3411	Dental assistants	2

It is however important to keep in mind that this model compares occupation average wages in 2019. This is important as this type of model does allow us to distinguish between occupations that have always had higher compensation and those whose pay has changed due to the enactment of a licensing requirement and we may instead need to compare a licensed occupation to itself over time in order to both control for other between occupation differences and to properly measure the true effects of time since enactment (this is done in Chapter 5). Another thing to note is the size of the standard errors for some of these coefficients. The fact that several standard errors among the older licensed groups are pretty sizeable suggesting more variability of wages within these categories and this raises some questions about the reliability of the relation between this variable and wages. It may be that there are other variables that can better explain the stronger wage effect among older licensed occupations. Perhaps there is something that is more common among those occupations that have been licensed the longest. One significant possibility appears in the next model: licensing coverage.

The coverage model is very similar to the date enacted model with the only major difference being that licensing is modeled at level two as groups of occupation-provinces based on the percentage of the occupation's work force nationwide that is in a jurisdiction where a license is required (variable described in more detail in Chapter 2).

Table 3-14: Example Occupations-High Licensing Coverage (80 to 100%) (n=58)

NOC Code	Occupation Name	Number of Jurisdictions
121	Insurance, real estate and financial brokerage managers	13
2144	Geological engineers	13
2145	Petroleum engineers	13
2244	Aircraft instrument mechanics, technicians and inspectors	13
3141	Audiologists and speech-language pathologists	8
3214	Respiratory therapists (cardiopulmonary technologists)	8
3222	Dental hygienists	10
3231	Opticians	10
4033	Educational counsellors	13
7315	Aircraft mechanics and aircraft inspectors	13

The results of the coverage model are significantly different from those in the date enacted model. First, they are almost all negative for occupations that have coverage below 80%, ranging from -1.6$ (no significant difference on the log normalized model in Table 3A-2) among 0 to 19% coverage occupations to -3.7$ (or 9.4%) among the 60 to 79% coverage occupations. But, interestingly the final group, with coverage from 80 to 100% (10 examples listed in Table 3-14) inverts this trend with a wage premium of 3.8$ per hour (or 14.7%) on average. This indicates that licensing does not on average confer a wage premium among those occupations with incomplete coverage and in fact these occupations appear to have lower average wages compared to unregulated occupations (See Table 3-15 for examples). It is only among those occupations with the highest levels of coverage that licensing may act as social closure, granting a significant wage premium relative to unregulated occupations.

Table 3-15: Example Occupations-Low Licensing Coverage (1 to 19%) (n=8)

NOC Code	Occupation Name	Number of Jurisdictions
1224	Property administrators	1
2211	Chemical technologists and technicians	4
2232	Mechanical engineering technologists and technicians	4
2251	Architectural technologists and technicians	3
3143	Occupational therapists	3
3211	Medical laboratory technologists	3
3411	Dental assistants	2
8222	Contractors and supervisors, oil and gas drilling and services	1

It seems plausible based on the tables presented above that coverage correlates with date enacted, and if so, these results suggest that it is coverage rather than date enacted that modifies the social closure effects of licensing thus better explaining variation in the wage effects of licensing across occupations. However, it is also possible that both coverage and date enacted shape the wage effects of licensing such that newly licensed occupations start with low coverage

and then eventually coverage reaches 100%, maximizing closure effects. These issues will be further investigated in subsequent chapters. One final thing to note about these models is their ICC which comes to .499 and .4985 respectively, indicating that in explained variance terms these models are not significantly better than the basic Social Closure models despite the interesting and statistically significant results.

Full Models

The models in Table 3-9 include 2nd level covariates from both the MHC and SC models. These models allow me to assess the question of whether or not the social closure effects indicated in the previous models can be dismissed on the basis that licensing and its wage effects correlate with human capital and/or other occupational market characteristics which, if true, would mean that licensing does not act as social closure but that licensed occupations tend to have higher human capital or other characteristic that explains the wage differences observed in the Social Closure models.

The first model is the full model, which combines the 2nd level covariates from the MHC model and the first SC model but also adds cross level interactions of licensing with immigrant and female. First, looking at the market and human capital variables we can see that very little has changed from the MHC model. With the exception of knowledge the size of each coefficient has changed only a little from the earlier models and statistical significance has not changed at all. Knowledge appears to no longer be statistically significant in this model which suggests it somehow relates to one of the variables included from the SC model. It seems likely that this would be education variance, implying that knowledge may be more or less relevant to wages based on the variability of educational attainment in a given occupation, and specifically not important among occupations with average levels of educational variability.

Table 3-16 Random Effect Models with Market, Human Capital, and Social Closure Variables at Level Two

	SC Model		Full Model		Full-Years Enacted		Full-Coverage	
	B	SE	B	SE	B	SE	B	SE
Level Two Covariates:								
% Female			-0.024***	(0.005)	-0.023***	(0.005)	-0.024***	(0.005)
Occupation-Province Unemployment (0-100)			-0.031*	(0.015)	-0.031*	(0.015)	-0.031*	(0.015)
% University Graduates			0.068***	(0.006)	0.069***	(0.006)	0.066***	(0.006)
Ability (Centered)			2.616***	(0.771)	2.585***	(0.761)	2.744***	(0.769)
Knowledge (Centered)			0.655	(0.387)	0.681	(0.393)	0.745	(0.389)
Skill (Centered)			6.068***	(0.620)	6.059***	(0.620)	5.978***	(0.621)
Level of Education Variance (Centered)	-0.052***	(0.007)	-0.010	(0.006)	-0.010	(0.006)	-0.009	(0.006)
License Only	2.668***	(0.443)	0.127	(0.481)				
Voluntary Certification Only	-5.288***	(0.309)	-2.170***	(0.323)	-1.848***	(0.266)	-2.123***	(0.281)
License and Certification	1.343	(1.437)	-1.301	(1.443)				
Licensing-Years Enacted								
License 1-19 Years					1.110	(0.734)		
License 20-39 Years					-0.157	(0.559)		
License 40-59 Years					0.812	(1.074)		
License 60-79 Years					2.745	(2.084)		
License 80-99 Years					0.676	(0.789)		
License 100+ Years					-1.885	(1.691)		
License Years Unknown					0.500	(0.660)		
Licensing-Coverage								
License >0-19%							-1.095	(0.633)
License 20-39%							-1.747**	(0.611)
License 40-59%							-0.259	(0.973)
License 60-79%							-0.517	(0.746)
License 80-100%							0.479	(0.476)
Cross Level Interactions:								
Female#License Only			0.818	(0.502)				
Female#Certification Only			0.736*	(0.339)				
Female#License and Certification			2.211*	(0.937)				
Immigrant#License Only			-0.421	(0.600)				
Immigrant#Certificaiton Only			-0.384	(0.462)				
Immigrant#License and Certification			0.000	(.)				
Constant	25.677***	(0.433)	22.978***	(0.474)	22.693***	(0.452)	23.054***	(0.463)
Random Effects:								
SD(Constant)	8.499***	(1.015)	6.994***	(1.018)	6.987***	(1.018)	7.345***	(1.018)
SD(Residual)	8.466***	(1.010)	8.406***	(1.010)	8.406***	(1.010)	8.406***	(1.010)
N	611,763		599,397		599,397		599,397	
M	4,501		4,373		4,373		4,373	
Degrees of Freedom	32		44		43		41	
Log Likelihood	-3833081.149		-3710449.752		-3710584.778		-3710585.118	

It is around the closure variables that we can see the greatest change from the earlier models. With the exception of certification none of the SC variables is statistically significant in this model (note: this remains true in a model without the cross-level interactions). There are two things we can draw from this result. First, the negative wage effect of certification appears not to be completely due to human capital and market characteristics. This indicates that

certification has a negative wage effect, amounting to approximately $2 per hour (or ~6% from Table 3A-3) independently of these factors. It is difficult to know for certain why this happens but based on these results and the conclusion we came to based on the example occupations from Table 3-10 it appears that certification does not correlate with human capital and is instead present in a very large and diverse group of occupations. It is possible that many of these occupations pursue certification as a way to enhance wages, but it also possible that certification is pursued to gain other benefits (i.e., to enhance demand for services). So, certification may lower wages in favour of other benefits or it may simply fail to raise wages relative to unregulated occupations. These results do suggest that certification is not a viable social closure mechanism in terms of its effects on wages. This may be because it is voluntary, and could have more significant wage effects if it were to see widespread adoption within a certified occupation. Second, the lack of statistical significance among the licensing variables suggests that licensing does not act as social closure and is instead correlated with one or more of the MHC variables included in this model. This raises some doubt about my earlier conclusions, and suggests that those observed wage effects may have been caused by variables that were unmeasured in the Closure models.[13] It is however, also possible that licensing does have closure effects in certain occupations and further analysis will be required to determine if that is the case and under what circumstances licensing has significant wage effects (i.e., it may be that licensing has social closure effects in occupations with certain human capital or market characteristics which if true would suggest the interaction of institutional and market based factors in wage determination).

It is also worth noting the results of the cross level interactions in this model. We can see that the crossed effect of being female and being in certified as well as a licensed and certified occupation is associated with a sizeable wage premium. This suggests that women in certified occupations may be less negatively affected in terms of hourly earnings relative to men in these kinds of occupations, though why this occurs is unclear. This may reflect differences in the

[13] One limitation of the approach employed in this chapter stems from the fact that it attempts to identify a licensing wage effect by comparing wages between occupations and provinces and the problem with this approach is that the influence of inter-provincial variation in wages remains hidden. An alternative approach relies on a model with fixed occupation and province effects to exploit the fact that some occupations are not licensed in all provinces. This was attempted using a regression model with occupation fixed effects as an absorbing estimator. The results of these models are provided in Appendix 3D but they suggest that only a small but significant portion of the observed licensing wage effect is due to inter-provincial wage variability. When compared to the results of the combined models in Table 3-16 we can see that while provincial wage variability does contribute to the observed licensing wage effect, the more substantial contributing factor appears to be inter-occupational differences in human capital and educational requirements.

kinds of occupations that men and women tend to work in that are certified but not licensed. Given the large standard errors there may be reason to doubt the reliability of these results. Finally, looking at the variance components for this model we can see that it is not significantly better in explained variance terms relative to the MHC model, which had an ICC of .456 while this model is .454. This suggests that there remains a significant portion of between occupation-province variability in wages that is not explained by the variables included in this model.

Full Models with Licensing Coverage and Date Enacted

The other two models included in Table 3-9 are mostly the same as the first, but with the cross-level interactions dropped and licensing included in the same form as the coverage and date enacted models discussed above.

These models further demonstrate the pattern already established in the previous model; with the inclusion of human capital and market variables the effects of licensing observed in the Social Closure models seem to disappear. This suggests that licensing has little to no effect on wages when this effect is estimated while controlling for the MHC variables and this is despite accounting for two characteristics of licensing which I have argued could shape the social closure capabilities of licensing. We are therefore left with the same conclusion from the full combined model, that is, that licensing either does not act as social closure and the licensing effect observed in the Social Closure model reflects the tendency of licensed occupations to be high in human capital. Alternatively, it may be that licensing does have social closure effects but that this effect occurs through education, possibly through the formalization of credential requirements. Either way, it does appear that licensing and the human capital measures included in these models are collinear, and it is not easy to separate their effects with cross-sectional data. Fully exploring the relationship between licensing and human capital measures may be beyond the scope of this chapter, but it is clear that further investigation is needed to come to a more conclusive understanding of the social closure effects of licensing in Canada. The next chapter explores the possibility that the social closure effects of occupational regulation are dependent on the basis by which labour is allocated into a given occupational market, with some being based on human capital and others by social closure.

Discussion and Conclusions

Occupational licensing is an important part of the structure of modern labour markets. My data indicate that in the last 40 years Canada has seen the enactment of at least 308 new licensing requirements, with 116 of those in just the last 20 years. This is out of a total of 740 separate licensing requirements across the country (excluding the territories) (see Table 3-4). It is clear that licensing has been expanding in the Canadian labour market. Theorists and researchers have tended to be critical of occupational licensing; arguing that it is a means of carrying out social closure, excluding outsiders in order to monopolize employment opportunities and reduce competition in order to protect rewards. It is generally argued that this has significant adverse effects on the labour market; reducing employment (Kleiner & Soltas, 2018), raising prices for consumers (Shapiro, 1986), and contributing to economic inequality through the generation of rents (Kleiner & Krueger, 2010; Weeden, 2002). The fact that recent decades have also seen significant rising economic inequality has led many to believe that the increasing prevalence of licensing (likely in conjunction with other forms of regulation) is a contributing factor to this increasing inequality.

More recently some researchers have sought to investigate the connection between occupational licensing and wage inequality. These attempts have primarily drawn upon stratification sociology and the concept of social closure, which in this case would explain modern trends in wage inequality as resulting from the generation of rent through exclusion within and between positions in the labour market (Sørensen, 1996). Licensing is generally regarded as a set of practices that are intended to carry out this kind of exclusion and my research represents an attempt to address weaknesses in the predominant theories of inequality which tend to focus on individual level characteristics as the primary (or sole) explanation for differences in wages. Theoretical traditions like human capital theory, classic market theories, and functionalism explain wage variability as arising from differences in individual skills, and abilities, or from the forces of supply and demand. While these theories have made notable contributions to our understanding of wage distribution they have struggled to provide satisfactory explanations for persistent wage inequalities between groups of workers in modern economies. The use of stratification sociology and specifically the concept of social closure is argued (by Weeden, 2002 and Redbird, 2017 for example) to offer a way to address the weaknesses of traditional theories but not necessarily by acting as a competing theory and

instead providing an explanation for inequality that can compliment individual focused theories. Specifically, (Weeden, 2002) employ such an approach and concludes that licensing does have social closure effects, generating a wage premium for licensed occupations, and that this functions in combination with things like differences in technical complexity (i.e., human capital) to shape the reward structure in the United States.

However, there is some debate regarding the conclusion that occupational licensing functions as social closure with some arguing that its effects on the labour market are more complex. Redbird (2017) in particular comes to a conclusion that contradicts the prevailing theory and argues that with additional controls her analysis is able to negate the finding that licensing generates a wage premium in United States. Redbird (2017) suggests that the commonly observed wage premium associated with licensed occupations may simply reflect the tendency of licensed occupations to also have higher skill requirements, broader licensing coverage, and a history of higher earnings (pp. 617-618). Note however that Redbird (2017) only concludes that an *aggregate* wage premium is not observed. This indicates that there is no wage premium among licensed occupations on average compared to unlicensed occupations but by extension this also means that some occupations do have above average earnings while others have below average earnings relative to unlicensed occupations. This is important because it forces us to recognize that the effects of licensing are likely more complex both in terms of its effect on wages but also other aspects of modern labour markets, going well beyond the simple question of whether or not licensing functions as social closure. Thus, Redbird's conclusion that licensing does not act as social closure may be premature, but the indication that its effects are complex is useful and consistent with Weeden's argument that the benefits of licensing are not universal across all licensed occupations.

In this chapter I have sought to analyse the wage effects of licensing in more detail than much of the existing research with the intention of addressing some of the issues raised in the debate over the labour market effects of licensing introduced by Redbird's findings. My approach is based on the understanding that the effects of licensing are complex and that its effects on wage distribution in particular are not constant across all licensed occupations and are likely dependent on other occupational characteristics. The aim of this chapter is to explore both if and under what conditions does licensing have or not have social closure effects in Canada.

Specifically, I hypothesized that the ability of a licensing requirement to act as social closure and generate a wage premium that is distinct from the effects of technical complexity may be dependent on how many jurisdictions in which that occupation is licensed. I have also hypothesized that licensing and its wage effects will change over time as new institutions develop within that occupation to facilitate labour supply in concordance with licensing requirements.

The results of my analysis do confirm some of findings from existing research. First, as argued by Redbird (2017), Weeden (2002), and myself the intra-class correlation coefficients across all of my models indicate that between occupation and province wage variability is substantial. This demonstrates that any analysis of economic inequality in modern economies must account for the fact that occupational market characteristics are a significant factor in wage disparities across Canada. Second, it is straightforward to replicate the finding that, with no other occupation characteristics accounted for; licensed occupations do have significantly higher wages on average.

However, my results go beyond this relatively simple finding and show that there is indeed significant potential for further complexity in the wage effects of licensing. One way in which this may function is that specific educational requirements, as indicated by the variable measuring variability of educational attainment, appears to be associated (inversely) with modestly higher wages. This suggests that a somewhat weak credentialing effect may operate in conjunction with the social closure effects of licensing so, if licensing imposes more specific educational requirements this introduces the possibility that the social closure effects of licensing occurs through this mechanism. It could also be that licensed occupations only accomplish social closure through this mechanism and it may therefore explain some of the hypothesized variation in the wage effects of licensing. Of course, it is also possible that this education variability effect is not associated with licensing and reflects an occupational characteristic that is independent of licensing. Further research is required to determine among which occupations this education variability effect occurs.

Perhaps the most intriguing findings from my analysis come from the coverage and date enacted analysis. The models that introduce control variables for human capital and education show us that in the context of a cross sectional analysis, date enacted does not appear to have the

effects that would be expected based on Redbird's (2017) speculation about this issue. It does appear however, that older licenses do have higher wages on average, but the potential causal relationship between licensing and education and their effect on wages cannot be captured using this kind of model. To understand the true effects of licensing on wages and the possible role played by education requires longitudinal data and methods beyond the scope of this chapter (See Chapter 5).

The coverage model also provides results that are promising and may indeed help to explain some of the variation in the wage effects of licensing across occupations. Based on my results it is clear that licensing only functions as social closure in those occupations that have very high degrees of coverage and is actually negative among licensed occupations with lower coverage. This result is consistent with my hypothesis that the wages among some licensed occupations will be below average while others are above. The observed coverage effect suggests that licensing may not be able to achieve closure effectively if the same occupation is unlicensed in a nearby jurisdiction (another province in Canada) and thus, licensing does act as social closure but only in a way that is detectable when coverage becomes nearly complete. I would suggest that this occurs because at higher levels of coverage prospective workers cannot simply move to another province and thus the barrier presented by licensing actually prevents people from entering the occupation, resulting in a labour supply restriction. How licensing with lower levels of coverage results in below average earnings is difficult to explain. Perhaps low level coverage does more than simply fail to restrict labour supply and affects supply and/or demand in some unknown way that results in lower wages. Based on the occupations with the lowest levels of coverage listed in Table 3-15 it appears that low coverage occupations may be those that are somewhat technical but only require a two year diploma rather than an advanced university degree as seen in many of the occupations with high coverage in Table 3-14. It is likely that these occupations are lower paid either due to lower human capital requirements or some unmeasured characteristic and that their attempts to close the occupation through licensing have not (yet) had any positive effect on wages. Another possibility is that licensing requirements in lower coverage occupations are not as strictly enforced which would result in a larger unlicensed sector within a given occupation-province thus dragging down average wages in that occupation-province. It also remains possible that there is something special about those occupations that have managed to achieve full licensing coverage and it may be that this

unknown characteristic explains both the apparent wage premium associated with high coverage licensed occupations as well as the wage penalty associated with lower coverage licensed occupations.

There is however, some doubt about these conclusions raised by my own analysis. The combined models which include both closure variables and human capital/market and demographic variables at the level of occupation-province consistently result in lower estimated wage effects among the license variables in each model. Specifically, when I include measures of human capital at the occupation-province level, licensing ceases to have any detectable effect on wages. This suggests that licensing does not (on average) act as social closure and licensing may in fact be correlated with human capital differences between occupations. Even more interesting is that this appears to extend to the coverage and date enacted licensing variables, suggesting that the wage effects associated with these variables may also be due to a correlation with the other occupational characteristics included in these models. However, as noted in my analysis, one of the limitations of this model is that the imposition of additional control models can have the effect of obscuring the effect of another variable, if the effects of that variable systematically vary in relation to the added control. Put simply, I cannot rule out the possibility that licensing does under certain (currently unknown) conditions act as social closure. It may be that licensing acts as social closure only among occupations that also have specific human capital characteristics. Further analysis of how licensing wage effects vary in relation to other occupation characteristics is required to come to a definitive conclusion on this issue. The results of this analysis appear to be somewhat consistent with those of Redbird (2017), and I can tentatively confirm that much of the observed licensing wage effects in existing research may actually reflect other occupations characteristics, such as human capital requirements and credentialing effects.

The unique contribution of my research to this topic comes from a couple of key things. First, the data I have on licensing and occupations is very high quality when compared to some of the existing research. My data on licensing in particular does not suffer from mismatch between different occupational groups and missing data; issue that affect both Redbird (2017) and Weeden (2002). The occupations identified by my licensing data match up to the real occupations as they are defined in the legislation that mandates licensing requirements, and those

instances where I lack 5 digit occupation codes are relatively rare. Second, due to the data have been able to gather from online sources and access from Statistics Canada, my models are able to present a highly comprehensive analysis of the wage effects of a number of important occupation characteristics, including those that indicate human capital differences as well as social closure, market forces, and demographics. This comprehensiveness allows me to come to the conclusions I have with reasonable certainty that the observed effects of licensing and other occupation characteristics cannot be easily dismissed as reflecting other unmeasured variables; though this is still a possibility. One significant limitation of this analysis is its reliance on cross-sectional comparisons. The use of a longitudinal approach, or the ability to better control for contextual factors that shape occupational differences in wages are worth pursuing to more clearly establish the real wage effects of licensing and other occupation characteristics.

Overall, I can conclude from this analysis that, counter to expectations, the wage effects of licensing in Canada are at least much more limited than is suggested by most existing research, despite the rather large effect observed in the SC model. The inclusion of appropriate controls in a series of two level random effects models shows us that a significant portion of the reported wage premium associated with licensing may in fact be due to other occupation characteristics, like credentialing effects and occupation level rewards to human capital due to higher levels of technical complexity and education specificity that may be more prevalent among occupations that are also licensed. Further, Appendix 3C includes models that use occupation as an absorbing estimator, and these models indicate that in addition to the effects of education, a portion of the wage premium associated with licensing can be explained by inter-provincial differences in wages. This suggests that licensing does not simply act as an exclusionary social closure mechanism. Instead, somewhat consistent with Redbird's (2017) conclusion, it appears that the effects of licensing are more complex than this. I cannot rule out the possibility that licensing does act as social closure under specific currently unidentified conditions but I can conclude that this effect is not observed on average in Canadian occupations especially when we control for human capital and credentialing effects. Subsequent chapters in this dissertation endeavour to address some of the limitations of the present work and examine in more detail the wage effects of licensing, human capital and other occupational characteristics.

Appendix 3A – Log Normalized Versions of Key Models

Table 3A-1 Log Normalized Two Level Random Intercept Market and Human Capital Model

	LNMHC	
	e(B)	SE
Level One Covariates:		
Female	0.930***	(0.004)
Immigrant	0.877***	(0.006)
Years in Canada	1.002***	(0.000)
Non-CMA	0.979***	(0.004)
Less than High School Grad	0.962***	(0.007)
Post Secondary Certificate	1.071***	(0.006)
Community College	1.069***	(0.005)
University Certificate	1.099***	(0.014)
Bachelor's Degree	1.133***	(0.007)
Above Bachelor's Degree	1.242***	(0.010)
Potential Years of Work Experience	1.005***	(0.000)
Non-Union	1.105***	(0.006)
Part Time	0.909***	(0.005)
Non-Permanent	0.914***	(0.005)
Firm >500 Employees	1.071***	(0.005)
Establishment >500 Employees	1.046***	(0.006)
Agriculture, Forestry, and Fishing	0.966	(0.034)
Mining	1.170***	(0.022)
Construction	1.034*	(0.014)
Transportation, Communications, and Utilities	1.045***	(0.013)
Wholesale Trade	1.020	(0.014)
Retail Trade	0.894***	(0.012)
Finance, Insurance, and Real Estate	0.991	(0.015)
Services	0.955***	(0.009)
Public Administration	1.038**	(0.013)
Level Two Covariates:		
% Female	0.999***	(0.000)
Occupation-Province Unemployment (0-100)	0.998**	(0.001)
%University Graduates	1.002***	(0.000)
Ability	1.123***	(0.026)
Knowledge	1.047***	(0.014)
Skill	1.219***	(0.025)
Constant	20.585***	(0.233)
SD(Constant)	1.259***	(0.005)
SD(Residual)	1.301***	(0.002)
N	599397	
M	4373	
Degrees of Freedom	31	
Log Likelihood	-99834.375	

Table 3A-2: Log Normalized Random Intercept Models With Social Closure Variables at Level Two

	LN Social Closure		LN Years Enacted		LN Licensing Coverage	
	e(B)	SE	e(B)	SE	e(B)	SE
Level Two Covariates:						
Level of Education Variance (Centered)	0.998***	(0.000)	0.998***	(0.000)	0.998***	(0.000)
License Only	1.104***	(0.014)				
Voluntary Certifiation Only	0.847***	(0.008)	0.846***	(0.008)	0.843***	(0.009)
License and Certification	1.061	(0.053)				
Licensing-Years Since Enactment						
License 1-19 Years			1.067**	(0.025)		
License 20-39 Years			1.036	(0.020)		
License 40-59 Years			1.091*	(0.038)		
License 60-79 Years			1.237***	(0.057)		
License 80-99 Years			1.237***	(0.030)		
License 100+ Years			1.129**	(0.051)		
License Years Unknown			1.090***	(0.025)		
Licensing-Coverage						
License >0-19%					0.991	(0.022)
License 20-39%					0.970	(0.022)
License 40-59%					0.930	(0.038)
License 60-79%					0.906***	(0.026)
License 80-100%					1.147***	(0.016)
Constant	23.158***	(0.030)	23.173***	(0.030)	23.293***	(0.310)
SD(Constant)	1.317***	(0.004)	1.315***	(0.004)	1.314***	(0.004)
SD(Residual)	1.302***	(0.002)	1.302***	(0.002)	1.302***	
N	611763		611763		611763	
M	4501		4501		4501	
Degrees of Freedom	29		34		32	
Log Likelihood	-106321.770		-106303.000		-106290.665	

Table 3A-3 Log Normalized Two Level Models with Market, Human Capital and Social Closure Variables

	LN Full Model		LN Years Enacted		LN Coverage	
	e(B)	SE	e(B)	SE	e(B)	SE
Level Two Covariates:						
% Female	0.999***	(0.000)	0.999***	(0.000)	0.999***	(0.000)
Occupation-Province Unemployment (0-100)	0.999**	(0.001)	0.999*	(0.001)	0.999**	(0.001)
%University Graduates	1.002***	(0.000)	1.002***	(0.000)	1.002***	(0.000)
Ability	1.113***	(0.027)	1.115***	(0.027)	1.115***	(0.027)
Knowledge	1.027*	(0.013)	1.028*	(0.014)	1.027*	(0.013)
Skill	1.216***	(0.025)	1.216***	(0.025)	1.215***	(0.025)
Level of Education Variance (Centered)	1.000	(0.000)	1.000	(0.000)	1.000	(0.000)
License Only	1.023	(0.012)				
Voluntary Certifiation Only	0.939***	(0.008)	0.940***	(0.008)	0.935***	(0.008)
License and Certification	1.021	(0.031)				
Licensing-Years Since Enactment						
License 1-19 Years			1.058**	(0.022)		
License 20-39 Years			1.026	(0.018)		
License 40-59 Years			1.039	(0.030)		
License 60-79 Years			1.051	(0.050)		
License 80-99 Years			0.997	(0.023)		
License 100+ Years			0.897*	(0.043)		
License Years Unknown			1.026	(0.021)		
Licensing-Coverage						
License >0-19%					1.001	(0.021)
License 20-39%					0.978	(0.020)
License 40-59%					1.011	(0.041)
License 60-79%					0.994	(0.026)
License 80-100%					1.024	(0.014)
Constant	21.430***	(0.292)	21.376***	(0.292)	21.528***	(0.298)
SD(Constant)	0.228***	(0.005)	0.228***	(0.005)	0.228***	(0.005)
SD(Residual)	0.236***	(0.002)	0.362***	(0.002)	0.263***	(0.002)
N	599397		599397		599397	
M	4373		4373		4373	
Degrees of Freedom	35		40		38	
Log Likelihood	-99791.053		-99782.420		-99790.529	

Appendix 3B – Models with Occupation at Level Two

An alternative to the use of Occupation-Province as a level two variable would be to use occupation on its own and then include province as a level one covariate. This would require that occupation regulations be coded only in terms of coverage (i.e. how much of the occupation is licensed across the country) rather than as a simple binary. Models of this type were tested and produced results that are consistent with the occupation province models. These results are included here for comparison.

There are three things worth noting about these models and how they differ from the occupation-province models. First, the coefficients at level one do differ in size but only slightly and the pattern of statistical significance is nearly identical. The one important difference at level one of these models is that province is included here as a covariate (with Ontario as the base category) and clearly has a large effect in many provinces. In contrast, province is part of the nesting unit in the occupation-province models and thus its contribution to wage variability is contained in the SD(Constant) term which explains why these models have lower intra-class correlation (.43 for this licensing model compared to .50 for the SC model). Second, the licensing coverage effect in these models is most comparable to the licensing coverage model in Table 3-9 and suggests that licensing has a significant effect on wages and this effect grows with the coverage of licensing. Again the effect size differs but not enough to alter the conclusion. Finally, we can see in the full model that the effect of licensing coverage is nearly wiped out by the inclusion of human capital control variables, much like the full models in Table 3-16. Despite these differences the use of occupation models would not fundamentally alter our conclusions about the wage effects of licensing.

Table 3-B: Occupation Models

	Occupation Licensing Model		Occupation Full Model	
	B	SE	B	SE
Level One Covariates:				
Female	-2.476***	(0.189)	-2.431***	(0.193)
Immigrant <1 Year	-1.755	(2.022)	-1.531	(2.035)
Immigrant 1-19 Years	-3.182***	(0.216)	-3.159***	(0.217)
Immigrant 20-39 Years	-1.905***	(0.257)	-1.914***	(0.256)
Immigrant 40-59 Years	-0.286	(0.437)	-0.341	(0.459)
Immigrant 60-79 Years	-3.933***	(1.072)	-3.867***	(1.118)
Non-CMA	-1.018***	(0.188)	-0.984***	(0.189)
Less than High School Grad	-1.011***	(0.197)	-0.975***	(0.196)
Post Secondary Certificate	1.996***	(0.209)	2.037***	(0.208)
Community College	1.782***	(0.181)	1.799***	(0.172)
University Certificate	2.939***	(0.389)	1.524***	(0.436)
Bachelor's Degree	3.560***	(0.241)	1.927***	(0.360)
Above Bachelor's Degree	6.924***	(0.344)	5.314***	(0.464)
Potential Years of Work Experience	0.154***	(0.008)	0.154***	(0.008)
Non-Union	1.736***	(0.251)	1.886***	(0.249)
Part Time	-1.324***	(0.269)	-1.322***	(0.271)
Non-Permanent	-2.922***	(0.290)	-2.867***	(0.294)
Firm >500 Employees	2.775***	(0.204)	2.709***	(0.203)
Establishment >500 Employees	2.073***	(0.266)	2.062***	(0.271)
Agriculture, Forestry, and Fishing	-1.134	(1.044)	-0.186	(0.721)
Mining	6.528***	(0.965)	6.255***	(0.945)
Construction	1.690**	(0.526)	1.647**	(0.515)
Transportation, Communications, and Utilities	1.998***	(0.574)	1.839**	(0.559)
Wholesale Trade	0.569	(0.522)	0.532	(0.519)
Retail Trade	-2.038***	(0.613)	-2.044***	(0.606)
Finance, Insurance, and Real Estate	0.701	(0.677)	0.648	(0.679)
Services	-0.341	(0.476)	-0.353	(0.462)
Public Administration	1.784***	(0.532)	1.627**	(0.527)
Newfoundland and Labrador	-0.865*	(0.358)	-0.736*	(0.364)
Prince Edward Island	-3.444***	(0.484)	-3.814***	(0.466)
Nova Scotia	-3.538***	(0.395)	-3.474***	(0.411)
New Brunswick	-3.722***	(0.286)	-3.688***	(0.281)
Quebec	-1.243***	(0.247)	-1.345***	(0.245)
Manitoba	-1.100***	(0.246)	-1.142***	(0.242)
Saskatchewan	1.134**	(0.392)	0.883*	(0.354)
Alberta	3.854***	(0.319)	3.718***	(0.289)
British Columbia	0.823***	(0.244)	0.818***	(0.241)
Level Two Covariates:				
National Licensing Coverage (%)	0.074***	(0.009)	0.019*	(0.008)
Ability (Centered)			-1.636	(1.720)
Knowledge (Centered)			1.407	(0.752)
Skill (Centered)			9.561***	(1.298)
Occupation Unemployment			0.014	(0.053)
Occupation % Female			-0.034***	(0.010)
Occupation % University Graduates			0.052***	(0.009)
Constant	23.083***	(0.541)	23.727***	(0.673)
Random Effects:				
SD(Constant)	7.419***	(1.043)	4.874***	(1.040)
SD(Residual)	9.826***	(1.021)	9.767***	(1.022)
N	611763		599397	
M	498		481	
Degrees of Freedom	38		44	
Log Likelihood	-435915.927		-419056.873	

Appendix 3C – Regression Models with Absorbing Estimator

The models displayed below are linear regression models that absorb one factor variable with many categories, in this case detailed occupations. These were fit using Stata's *areg* command which essentially allows for the computation of regression coefficients as if each detailed occupation were included as a series of binary variables, thus including occupation as a fixed effect while also allowing for the inclusion of province as an additional fixed effect in the form of a typical categorical variable.[14]

The important thing to note about these results is in the difference between the Licensing and Province models. We can see that there is a small but significant wage effect for licensing in the model which does not control for the influence of province and that this effect disappears when provincial controls are introduced. This suggests two important things. First when we control for the influence of only occupation as in the Licensing model there remains a small but significant difference in the average wages of licensed versus unlicensed individuals. This would suggest that licensing has a small effect on wages that is independent of other occupational characteristics (like education and human capital). However, the fact that this licensing effect is noticeably smaller than that observed in the Social Closure model (Table 3-9) indicates that unmeasured occupation characteristics including education and human capital do explain a larger portion of the licensing wage effect than education and human capital alone. The other thing to note is that this effect disappears when we control for the effect of province suggesting that this small outstanding licensing wage effect identified in the Licensing model above may actually reflect the influence of inter-provincial wage differences. Based on these results we can conclude that the licensing wage effect observed in the Social Closure model is explained by a combination of measured and unmeasured occupation characteristics, such as those included in the Combined models, and the influence of inter-provincial wage variation (and some correlation between province and licensing) as indicated in the models included here.

[14] Note: these models were fit with weights normalized across occupations and provinces to prevent individuals in large occupations or provinces from exerting greater influence over estimation.

Table 3D: Licensing Model with Occupation as Absorbed Estimator

	Individual		Licensing		Province	
	B	SE	B	SE	B	SE
Female	-2.479***	(0.108)	-2.481***	(0.108)	-2.550***	(0.172)
Immigrant	-3.256***	(0.152)	-3.259***	(0.152)	-4.351***	(0.246)
Years in Canada	0.085***	(0.007)	0.085***	(0.007)	0.084***	(0.008)
Non-CMA	-1.315***	(0.093)	-1.312***	(0.093)	-0.931***	(0.176)
Less than High School Grad	-0.981***	(0.131)	-0.981***	(0.131)	-0.921*	(0.291)
Post Secondary Certificate	2.284***	(0.130)	2.284***	(0.130)	2.194***	(0.300)
Community College	1.410***	(0.112)	1.409***	(0.112)	1.844***	(0.175)
University Certificate	2.995***	(0.320)	2.995***	(0.320)	3.106***	(0.484)
Bachelor's Degree	4.047***	(0.154)	4.047***	(0.154)	4.294***	(0.435)
Above Bachelor's Degree	7.237***	(0.208)	7.240***	(0.208)	7.794***	(0.339)
Potential Years of Work Experience	0.139***	(0.003)	0.139***	(0.003)	0.149***	(0.009)
Non-Union	1.588***	(0.107)	1.587***	(0.107)	1.658***	(0.307)
Part Time	-1.443***	(0.128)	-1.441***	(0.128)	-1.676***	(0.193)
Non-Permanent	-3.047***	(0.149)	-3.048***	(0.149)	-2.708***	(0.145)
Firm >500 Employees	2.268***	(0.101)	2.269***	(0.101)	2.177***	(0.212)
Establishment >500 Employees	1.753***	(0.137)	1.755***	(0.137)	1.774***	(0.299)
Agriculture, Forestry, and Fishing	-0.627	(1.086)	-0.598	(1.086)	-0.003	(1.182)
Mining	7.668***	(0.501)	7.667***	(0.501)	6.071***	(0.994)
Construction	1.772***	(0.269)	1.782***	(0.269)	1.145	(0.691)
Transportation, Communications, and Utilities	2.169***	(0.280)	2.165***	(0.280)	1.733**	(0.377)
Wholesale Trade	0.904***	(0.261)	0.900***	(0.262)	0.392	(0.448)
Retail Trade	-2.299***	(0.264)	-2.297***	(0.264)	-2.560***	(0.358)
Finance, Insurance, and Real Estate	0.845**	(0.297)	0.841**	(0.297)	0.480	(0.656)
Services	-0.237	(0.245)	-0.238	(0.245)	-0.674	(0.359)
Public Administration	1.606***	(0.273)	1.603***	(0.273)	1.576*	(0.531)
Licensed			0.467*	(0.222)	-0.180	(0.461)
Newfoundland and Labrador					-0.633**	(0.133)
Prince Edward Island					-4.478***	(0.103)
Nova Scotia					-3.548***	(0.097)
New Brunswick					-3.993***	(0.090)
Quebec					-1.202***	(0.073)
Manitoba					-1.035***	(0.072)
Saskatchewan					0.910***	(0.095)
Alberta					3.746***	(0.041)
British Columbia					0.689***	(0.057)
Constant	24.134***	(0.222)	24.060***	(0.224)	25.039***	(0.378)
N	611763		611763		611763	
Degrees of Freedom	25		26		9	
Log Likelihood	-2270682.762		-2270663.402		-2254135.600	

Chapter 4: Variation in the Wage effects of Education across Occupations in Canada

There has long been an interest in the potential wage effects of labour market regulations like licensing and certification and the question of whether these regulatory institutions have contributed to the trend toward greater economic inequality in modern economies. There has until recently been consensus among theorists and researchers that occupational licensing functions as a social closure mechanism, creating artificial barriers into occupations, generating rent and, as a result contributing to wage differences between occupations. However, in recent years there has been some debate about whether licensing truly acts as a social closure mechanism or if the wage premium associated with licensed occupations simply reflects their tendency to have high educational requirements. It is also important that in some cases the magnitude of the wage effect associated with licensing may be so small that it is not a meaningful contributor to income inequality. Both my own research in Chapter 3 as well as the results of Redbird's analysis of licensing in the United States (Redbird, 2017) suggest that there is no aggregate wage premium associated with licensing once education and human capital differences are accounted for. This raises important questions about the role that education plays in wage determination, within and across occupations in modern markets. Specifically, licensing may result in the social closure of occupations by formalizing credential requirements. It is important to keep in mind that education is known to have an effect on wages outside of licensed occupations. One possibility is that education and its effect on wages differs not just in the strength of its effect but the mechanism through which it has that effect. If this mechanism does vary it is reasonable to think that this difference would be dependent upon the structural and institutional context of the labour market in which it operates. Therefore an exploration how the mechanism through which education affects wages differs across occupations will shed light on how education contributes to income inequality in the structural institutional context of modern labour markets.

The three most common theories used to explain the effect of education on wages are human capital, social closure, and internal labour market theory. From a human capital perspective, education involves the attainment of productivity enhancing skills which are rewarded in a competitive market. In an internal labour market, education instead determines

one's position in a queue where the most educated have the best access to more complex jobs and higher pay. Social closure differs from both, arguing that education functions as a means to exclude individuals from certain kinds of jobs and therefore shapes wages by generating rents. Rather than one being the best or preferred theory, each may accurately describe the effects of education in differing labour market contexts. Operating on a similar idea, Van de Werfhorst (2011) explores variation in education wage effect mechanisms across industries in the Netherlands. Van de Werfhorst uses two level random intercept models to explore the prevalence and wage effects of over-qualification and horizontal job matching[15]. His findings indicate that over-qualification is less common in internal labour market and social closure based industries, while returns to over-qualification are higher in human capital type industries. These results raise an important question: does this variation in the effect of education reflect the particular industry-based institutional apparatus of coordinated market economies of European countries like the Netherlands or do labour market selection mechanisms also vary in this manner in other parts of the world?

This chapter is concerned with the question of whether the mechanisms through which education affects wages also vary within the context of the Canadian labour market. Due to differences in the institutions that define the structure the labour market in North America when compared to many European countries, it is likely that these mechanisms vary systematically across occupations more commonly than across industries[16]. This is due to the fact that labour market institutions based on industries are less well developed, and the education system is less directly tied to industries. Instead, in a country like Canada, institutions and educational systems (examples include credential requirements, licensing, and the roles and impact of unions) may be linked more to occupations than to industries. Thus, this paper employs a conception of the labour market in which the prevalence of these three labour allocation mechanisms and their associated effect on wages is structured around occupations in the modern Canadian labour market.

[15] This refers to the matching of worker qualifications with their job in terms of their field of study rather than level of education.

[16] One example, in the Netherlands collective agreements are negotiated between industry-based unions, industry-based employer organisations, and the state (Van de Werfhorst, pg. 529).

The main goal of this Chapter is to determine if and how the wage effects of education vary across occupations. In particular this chapter will explore if and how the reward mechanism associated with educational attainment differs between occupations based on the extent to which they operate predominantly on the basis of human capital, social closure and internal labour markets. This entails three main goals. One, determine if occupations do in fact differ in terms of the presence of the three mechanisms. Two, measure the extent to which occupations differ in terms of the acquisition of excess education relative to others in the same occupation. Three, determine if rewards to excess education differ between occupations and whether or not that variation can be attributed to the presence of the three mechanisms. The main research questions for this chapter are as follows:

1) Do occupational markets in Canada operate predominantly by one of three labour allocation mechanisms (social closure, human capital, or internal labour markets)?

2) Do occupations differ in the extent to which workers attain additional education relative to others in their occupation, and do these differences vary in relation to the presence of the three labour allocation mechanisms in an occupation?

3) How are the wage effects of excess educational attainment within occupations shaped by the predominance of these labour allocation mechanisms across different occupational markets?

Empirically this chapter focuses on detailed occupations in Canada. The first part of the paper includes a factor analysis of data from Statistics Canada's Labour Force Survey combined with ONET and my database on Canadian occupations. This analysis attempts to measure the prevalence of the three mechanisms in each occupation, estimating one factor for each. The second part of the chapter includes two sets of two level random effect models. The first uses occupation mean centered educational attainment as the dependent variable, and is intended to determine if occupations differ in terms of variation in educational attainment among their workers. In this context higher variation suggests that workers in that occupation are incentivised to acquire additional education, presumably because it pays off in some way (i.e., with higher wages or employment opportunities). The second set of models use hourly earnings as a dependent variable and are centrally interested in the interaction between the factor scores,

measuring the three mechanisms, and individual level educational attainment relative to their occupation. This interaction represents the extent to which excess education pays off more or less in different occupations depending on which of the mechanisms is present in that occupation.

Theory:

Three types of theories explain how the attainment of higher levels of education results in higher wages, each providing a different explanation of the mechanism through which this occurs. The first is human capital theory. Its central argument is that education is essentially an investment with the expectation of a return, at a rate that is determined by a combination of supply and demand as well as compensation for forgone earnings (Becker, 1964; Blaug, 1976; S. Brown & Sessions, 2004; Wang & Sun, 2009). However, the most significant effect of education relating to wages is that it entails the acquisition of productivity enhancing skills and this productivity is rewarded in the labour market with higher wages and employment opportunities (Becker, 1964).

Second, internal labour market theorists argue that education does not involve the attainment of skills nor affect individual productivity, and, even if it did, employers cannot accurately assess the productivity of potential employees. Due to these limitations, some argue that education instead acts as a crude signal of certain characteristics that an employee might have that are important to employers (Blaug, 1976; Spence, 1973). Generally, in an internal labour market training is required for an employee to fill a certain role and education is argued to signal how costly a potential employee will be to train (Arrow, 1973; Blaug, 1976; Thurow, 1975). From this perspective productivity is a characteristic of jobs rather than people and workers compete for access to jobs rather than for wages (S. Brown & Sessions, 2004; Thurow, 1975). Education still factors into this competition in that it orders applicants into a queue, ranking prospective employees by their estimated training cost. Thus, education does not affect one's productivity but instead ones position in this queue and thus the level of complexity and compensation associated with the job they successfully acquire.

Third, social closure theorists argue that the wage effects of education are neither due to the acquisition of productivity enhancing skills nor its relation to estimated training costs, instead it functions as a mechanism for the exclusion of certain individuals from positions within the

labour market. Social closure is the practice of creating barriers to entry into a position by its existing members, in order to create rents by monopolizing opportunities and rewards associated with that position (Kreckel, 1980; Redbird, 2017; Weber, 1978; Weeden, 2002). While social closure is pursued by elites within a given position, it is carried out through institutions that lend closure legitimacy, such as licensing. Education is a widely accepted as a requirement for entry into many occupations but is argued by some to act as a form of exclusion. Accordingly, it is this exclusion and the resulting generation of rents within certain occupations that explains the higher wages associated with higher levels of educational attainment.

One of the main arguments of this chapter is that none of these three theories offers a universally applicable explanation of the mechanism through which education affects wages. Therefore, rather than treating them as competing explanations and choosing a preferred theory, this chapter offers a conception of the labour market in which all three theories apply under the specific structural and institutional conditions that define the various 'positions' (or segments) within the labour market. In this case I argue that occupations are the best way to define those positions in the Canadian context. Thus, these three mechanisms can be understood as a characteristic of occupations. Within each occupation one or more of these three mechanisms could be present to varying degrees implying that some occupations will operate predominantly on the basis of social closure, others may function as human capital markets, and some may be a combination of two or more. The implication of this is that education does not only vary in the extent to which it affects wages across occupations but that education also varies in *how* it affects wages. It is therefore through an analysis of these three mechanisms that we can understand the role education plays in economic inequality.

Market and Institutional Characteristics that Enable Selection by Each Mechanism.

In accordance with the central conception of the labour market described above we can extract a series of expected characteristics that different occupations would/must possess if they rely upon one or more selection mechanism. Using the central arguments of each theory overviewed in the previous section we can determine what conditions would allow an occupation to function according to each mechanism. Below is a short discussion of those occupational market conditions that may be measured using available data.

A human capital occupation would operate according to free market principles, subject to the influence of supply and demand which give rise to the conditions that either allow for or arise from the selection of workers on the basis of human capital. There are three important ways that market forces relate to the characteristics of an occupation. First, in a market where employers use education as an indication of worker productivity, those with the highest education will enjoy the highest wages and employment opportunities. When this form of selection is common there will be an incentive among workers to acquire more education as they compete with others for employment and wages. In such a market you would therefore expect to see higher within occupation variation in the amount of education acquired by workers. It is also expected that the variability of education will differ between occupations, as some are defined by tasks that call for specific skills, while others may not (think of the difference between an auto mechanic and a general labourer).

A second way in which labour demand can shape the labour market in an occupation stems from the kinds of tasks that define the occupation itself. Those occupations that are concerned with the production of goods lend themselves more easily to the acquisition of skills and training that directly affect the productivity of workers (and in ways that are discernible to employers). In those occupations that are service based however, their defining tasks tend to be more generalized in nature and the link between education and productivity in these tasks is more obscure (i.e., they may require general computer skills, communication etc.). Thus it is likely that occupations in goods production are more likely to operate on the basis of human capital when compared to those that are in services.

Finally, in those occupations where tenure tends to be shorter (or at least more variable) employers may need to estimate the productivity of new hires before they hire them. Therefore they are more likely to select workers based on their level of education. These kinds of jobs tend to be more common in smaller organizations. In small firms, employers are less able to offer job specific training, delaying the enhancement of productivity among new hires and being forced to absorb the resulting upfront costs. Larger organizations on the other hand would be more capable of operating in this manner and provide job specific training. It is also likely that employers who are smaller, in goods production, and require productivity from workers at the time of hiring are able to offer terms of employment that are more stable (i.e., full-time and

permanent). In this kind of market, productivity is tied to the worker instead of the job, which suggests that employment can involve more task flexibility allowing employers who select on the basis of human capital to simply redirect workers to different tasks rather than adjusting hours or hiring and firing new people in response to changes in the market.

Conditions that enable or require selection using education as a screening device are principally found in large employers and/or large bureaucratic systems, such as unions and many public sector employers. Thus, we would expect to see selection by this mechanism in those occupations predominated by these kinds of large organisations. At the same time we would expect that self employment is comparably rare in such occupations. Conversely to human capital occupations, the common expectation in larger organization would be that the employment relationship will be longer. By extension, in occupations where their defining tasks tend to be associated with larger organizations, and where the norm is that worker contracts will be long term, employers would be more willing to take on the cost of training at the beginning of employment with the understanding that they will be compensated by eventual high productivity. In this kind of situation employers are likely to use education to estimate training costs rather than worker productivity directly. Further, in a market with these characteristics, standardized education would not be expected, as productivity is associated with the job rather than the person. We would therefore expect to see less job specific education in internal labour market dominated occupations. However, while there is no relation between productivity and education directly, education is still rewarded in these kinds of occupations so there is still an incentive to acquire more as workers compete for access to high productivity and high wage jobs. So, we would expect to see moderate to high variability in levels of education within these kinds of occupations.

Closure operates in settings where credentials are institutionalised strongly enough to regulate supply and demand for workers with those credentials (Weeden, 2002). In the North American setting, this institutionalization is imposed most commonly by occupational licensing which is argued to shape the supply and demand for labour within an occupation by formalizing barriers to entry into the occupation while also shaping demand through promotion of the good or service provided by that occupation (Redbird, 2017; Weeden, 2002). The social closure effects of licensing are debated in the literature but a significant possibility is that licensing

restricts entry into an occupation mostly through the formation of formal agreements around the selection and rewarding of qualifications that are specific to an occupation (i.e., selection would operate on basis of formal or even legal requirements for education and training). Thus licensing is a common and important institutional characteristic that enables labour allocation through social closure in an occupation. In a market that is subject to these formal and specific requirements, education does not signal productivity or worker ability and therefore there is no incentive to acquire any more education than is necessary to gain entry into the occupation. Because of this we would expect that occupations predominated by social closure as a selection mechanism will have the least variation in educational attainment among its workers.

Another characteristic that is important for this kind of institutionalization of occupations is the public versus private sector, wherein the former tends to have more elaborate systems of rules, suggesting that formal credentials are important while the monitoring of productivity may be more difficult. For instance (van der Velden & Wolbers, 2007) found that human capital mattered more in private sector. Additionally, the prevalence of unions, collective agreements, and hiring systems indicate a labour market system in which individual productivity is not the most significant determinant of wages and employment while also potentially creating barriers to entry in order to protect incumbents from competition. Another consequence of social closure for an occupational market is the prevalence of self employment. Self employment is expected to be more common in socially closed occupations for two main reasons. One, individuals with the education and training required to work in their occupation are also likely to have the cultural and economic capital needed to start their own business. Second, the effect of social closure on labour supply may have enough of an effect on competition that the perceived risks of self employment are reduced enough that many in such occupations decide to and succeed in starting their own business. Alternatively, it may be that self employment provides a fallback position for workers in regulated occupations who struggle to find work as an employee due to the effects of those regulations.

The Prevalence of and Wage Returns to Over Qualification

Based on the theories and occupational characteristics discussed above we can formulate some expectations regarding the extent to which workers will seek additional qualifications and

the extent to which those qualification will be rewarded based on the presence and operation of these three mechanisms.

The central argument of human capital theory is that education involves the acquisition of productivity enhancing skills which is then rewarded in the market. This suggests that in any market where the human capital mechanism is prevalent workers are more likely to seek to attain the highest qualifications they can as they compete with other workers in the market for employment and wages. Thus we would expect that over-qualification or variation in level of qualification to be the highest in those markets where the human capital mechanism is dominant. We would also expect that hourly earnings will be most strongly associated with level of education in human capital markets compared to those where the other mechanisms are more prevalent.

One important similarity between human capital and internal labour market is that the job queue systems that operate in internal labour markets result in a preference for the highest educated workers possible. However, because education is seen as an indicator of training costs rather than productivity which is associated with the job itself, it may be that employers would not need to compensate an individual worker for their level of education when compared to less educated individuals in the same market. Thus we would expect to see high levels of over-qualification much like human capital markets but a weaker reward in hourly wages to those with higher qualifications in internal labour market dominated occupations.

Social closure, on the other hand, functions in a very different manner. The systems that operate in a social closure market (licensing, certification, unions) impose rules and regulations on the market that determine who can work in that market. A common means through which this is done is the use of formal education requirements. One expected consequence of this formalization of education requirements is that workers would only be incentivised to acquire the level of education needed to enter the occupation. One of the main reasons for this is that social closure operates at the group (or occupation) level and its effect on employment is based on its exclusionary effect rather than on how it shapes competitive market dynamics within the group. As a result, employers in social closure markets do not treat education as an indicator of productivity or training costs, instead those credentials signify that a worker is 'allowed' to work in that market removing or at least reducing the incentive to acquire education beyond what is

required according to the rules. This means that the wage effects of social closure are expected to operate at the group level, raising wages for all those who are able to enter the market due to the exclusion of those who are not (i.e., rent generation). Thus we would expect that compensation for higher levels of education in social closure dominated occupations is likely to be weakest when compared to those dominated by the other two mechanisms. It is worth noting that some of these expectations are stronger than others. For example the argument about the expected wage effects of education in a human capital market is based on a central component of that theory while the expectation of a lack of within group wage effect of education in socially closed occupations is based on a lack of arguments in the theory regarding within group effects. This is discussed in more depth below.

Based on these three theoretical traditions we can formulate two central hypotheses:

H1-The prevalence of excess education will be highest in human capital markets, moderately high in internal labour market markets and lowest in social closure markets.

H2-The relation between education and wages will be strongest in human capital markets, weak in internal labour market markets and also weak in social closure markets.

Data and Methods:

This chapter has three main goals. The first is to seek a means to measure the prevalence of the three labour allocation mechanisms discussed above across occupations. This is done using a factor analysis to estimate three factor scores, measuring the presence of the three mechanisms in each occupation. The second is to determine if levels of education among workers differ between occupations and whether these differences can be explained by the presence of these mechanisms. Finally, this chapter explores how the differing prevalence of these mechanisms across occupations shapes the role that education plays in wage determination within and across occupations. In order to account for the true effect of these mechanisms, this chapter employs two level random intercept models which allow for an analytical approach that includes both individual level variables and occupation characteristics. These models nest individual workers within detailed occupations and allow the exploration of both how occupations shape the educational attainment of their workers and the ways in which individual

educational attainment interacts with occupation level characteristics to shape employment income.

Indicators of Social Closure, Human Capital, and Internal Labour Markets in Occupations

All of the market and institutional characteristics associated with the three mechanisms described in the previous section vary at the level of occupations. The three mechanisms can therefore be measured as occupation level variables through the use of factor analysis in which those characteristics discussed above function as indicators. Each indicator is drawn from the LFS 2019, the ONET, and my occupation database.

Table 4-0: Description of Indicators for Factor Analysis

Indicator	Description	Predicted Association
Licensing Coverage	percentage of each occupation's nationwide population that is required to hold a license in Canada. It is calculated from the weighted sample size of those in an occupation that are in a province where it is licensed, divided by the weighted sample size of the whole occupation in all 10 provinces	Social Closure ++
On Site Training	ONET variable referring to classroom instruction provided by the employer on a 1-7 scale	Internal Labour Market ++ Human Capital +
On Job Training	ONET variable referring to working with a more experienced employee while carrying out the tasks associated with the job	Internal Labour Market ++ Human Capital +
Level of Education Variance	measures categorical variability in level of education within each occupation on a 0 to 100 scale	Social Closure --
Mean Tenure	the simple average of tenure in months within each occupation	Internal Labour Market ++ Human Capital --
% Firm Size	the percentage of workers in each occupation who work in a firm consisting of greater than 500 individuals, calculated from the weighted sample size of workers in the >500 category within each occupation divided by the weighted sample size of the whole occupation (this same method is used for all % occupation variables in the factor model)	Internal Labour Market ++
% Establishment Size	the percentage of workers in each occupation who work in an establishment consisting of greater than 500 individuals	Internal Labour Market ++
% Union/Covered	the percentage of each occupations work force that are in a union or covered by a collective agreement	Internal Labour Market ++
% Public Sector	the percentage of each occupations work force that are in the public sector	Internal Labour Market ++
% Fulltime	the percentage of each occupations work force that are employed fulltime	Internal Labour Market ++ Social Closure ++
% Self Employed	the percentage of each occupations work force that are self employed	Internal Labour Marekt -- Social Closure ++
% Non-permanent	the percentage of each occupations work force that are in non-permanent employment	Internal Labour Marekt -- Social Closure --
Mean Potential Work Experience	the occupation average of age adjusted based on one's education (potential work experience = age-6-estimated years of education)	Internal Labour Market ++ Social Closure ++
Goods Production/Service	a binary variable classifying each occupation as either goods producing or service related based on the occupation title and description found in the NOC coding system for detailed occupations	Social Closure -- Human Capital ++

Table 4-0, above, describes each variable, as well as how it is expected to relate to each of the three mechanisms; indicated as positive +, strongly positive+ +, negative -, and strongly negative - -. The remaining occupation level variables in Table 4-1 are not included in the factor model but are used as control variables in the two level random effect models. Required years of education was created in a similar manner to the years of education component of the potential work experience variable; by assigning an estimated/typical number of years to each level of education included in the NOC coding system. This includes no education (0 years), high school diploma (12 years), college or equivalent (14 years), and university (16 years). "Mean level of education" is a simple average level of education calculated from the individual level of education variable in the LFS within each occupation. It is calculated using the following formula: mean level of education = 1*mean of(grade0-8) + 2*mean of(grade9-10) + 3*mean of(11-13nongrad) + 4*mean of(11-13grad) + 5*mean of(cert/diploma) + 6*mean of(college) + 7*mean of(bachelor's) + 8*mean of(above bachelor's)

Table 4-1: Occupation Descriptive Statistics

	Mean	SD
Licensing Coverage(%)	16.47	33.82
Reserved Title Coverage(%)	16.39	35.39
Voluntary Certification Coverage(%)	49.42	47.81
On Site Training	2.69	1.35
On Job Training	3.66	1.41
Level of Education Variance(0-100)	72.64	13.46
Mean Tenure (months)	111.52	38.47
% Establishment >500	12.86	12.71
% Firm >500	39.05	23.40
% Union/Covered	26.03	23.23
% Public Sector	20.73	29.00
% Fulltime	78.47	16.42
% Self Employed	14.05	21.07
% Non Permanent	9.07	8.33
Goods Production/Service	0.32	0.47
Control Variables		
Required Years of Education	13.18	3.69
Required Years of Education^2	13.04	39.42
Mean Level of Education	6.49	1.41
Mean Years of Work Experience	22.36	4.78
Mean Years of Work Experience^2	522.86	217.40
Factor Scores		
F1 ILM	1.97	0.95
F2 Social Closure	1.43	0.91
F3 Human Capital	3.63	0.91

Individual Level Variables

The dependent variables for the two level random effect models are hourly earnings from the LFS and occupation centered level of education, which is a group centered effect measuring within occupation deviations from the mean in educational attainment (essentially indicating over-qualification). It is calculated within each occupation as: level of education – occupation mean level of education (described above). This variable is used to measure the over-qualification of individual workers relative to the other workers in their occupation. The remaining individual level variables are included as controls at level one of each model.

Table 4-2: Individual Level Descriptive Statistics

	Mean	SD
Dependent Variables		
Hourly Earnings	27.709	14.061
Occupation Centered Level of Education	0.203	1.908
Occupation Centered Work Experience	-0.619	13.258
Overqualified for Occupation	0.382	0.486
Independent Variables		
Living in CMA	0.806	0.395
Female	0.491	0.500
Immigrant	0.250	0.433
Estimated Years of Education	14.212	2.278
Years of Potential Work Experience	20.117	13.939
Industry:		
Agriculture, Forestry, and Fishing	0.011	0.105
Mining	0.016	0.124
Construction	0.067	0.249
Manufacturing	0.104	0.306
Transportation, Communications, and Utilities	0.079	0.270
Wholesale Trade	0.036	0.185
Retail Trade	0.127	0.333
Finance, Insurance, and Real Estate	0.061	0.240
Services	0.436	0.496
Public Administration	0.063	0.244
Province:		
Newfoundland and Labrador	0.013	0.113
Prince Edward Island	0.004	0.064
Nova Scotia	0.025	0.157
New Brunswick	0.020	0.139
Quebec	0.234	0.423
Ontario	0.386	0.487
Manitoba	0.035	0.184
Saskatchewan	0.030	0.170
Alberta	0.123	0.328
British Columbia	0.131	0.337
Population (weighted sample size)	15981500	

Analysis:

Factor Analysis: Measuring the Three Labour Allocation Mechanisms within Occupations

In order to measure the presence of each mechanism within 461 detailed occupations I use the 16 variables described above to carry out an occupation level factor analysis which produced a three factor model. It was estimated using principle factor analysis, and the loadings were rotated using the promax method due to a minor correlation between the three factors. The results of this model are included in Table 4-3 and the pattern of factor loadings as well as the eigenvalues suggest that the model is a good fit (or at least that the three factors explain significant amounts of the variance across the 16 variables).

In many cases the pattern of loadings appears consistent with theoretical expectations, though there are a few variables that load in unexpected ways[17]. The first factor appears to identify occupations governed strongly by the internal labour market mechanism, having significant positive loadings that form a simple structure (meaning they load significantly on only one factor) on firm and establishment size as well as union and public sector. We can also see a strong negative loading on self employed and a weaker positive loading on fulltime. Other than fulltime loading only weakly on this factor the overall pattern is consistent with expectations. However, there are some variables that were expected to be common in internal labour markets but do not load on this factor, including on-site and on-job training as well as tenure, and to a lesser degree, mean work experience. It is worth keeping in mind that some expectations are stronger than others (reflecting the fact that some variables relate to central components of a theory while others more loosely connected to certain theories). The role of training and the long term nature of employment contracts in ILM's is a key component of the theory so the fact that these variables do not load in this factor is surprising.

The second factor clearly identifies a social closure mechanism. Licensing and reserved title coverage load strongly and positively while voluntary certification loads strongly negatively which is consistent with expectations (reflecting the fact that most occupations that are licensed are not also certified, so the two variables are highly negatively correlated). Also as expected, level of educational variability loads strongly and negatively on this factor, indicating

[17] Loadings are considered significant if they meet the critical value of .239 which is calculated based on the following: CV = $5.152/\sqrt{N-2}$, (Norman & Streiner, 2008, p. 221).

occupations where workers tend to have more similar levels of education which is consistent with social closure theory. Additionally, self employment is quite common among regulated occupations so the slight positive loading on this factor is not a surprise. Finally, the strong negative loading for goods production/service is also expected as social closure tends to be common in service based occupations (commonly called 'professions'). As with the first factor the only unexpected results regarding the social closure are those that do not load significantly in either direction despite expectations that they would. These include non-permanent and work experience, but these were weaker expectations so the results for this factor are overall highly consistent with theory and clearly identify occupations with the characteristics that indicate the presence of a social closure mechanism.

Table 4-3: Three Factor Occupation Model

	F1 ILM	F2 Social Closure	F3 Human Capital	Uniqueness
1 Licensing Coverage(%)	-0.098	0.727	0.066	0.486
2 Reserved Title Coverage(%)	-0.142	0.750	0.056	0.459
3 Voluntary Certification Coverage(%)	-0.116	-0.633	0.053	0.552
4 On Site Training	-0.023	-0.060	0.429	0.814
5 On Job Training	-0.056	0.183	0.435	0.772
6 Level of Education Variance	-0.167	-0.615	-0.103	0.531
7 Mean Tenure	0.206	0.075	0.631	0.545
8 % Establishment >500	0.651	0.119	0.102	0.517
9 % Firm >500	0.891	-0.010	0.148	0.192
10 % Union/Covered	0.760	-0.098	0.069	0.444
11 % Public Sector	0.659	0.165	-0.125	0.474
12 % Fulltime	0.257	0.064	0.688	0.450
13 % Self Employed	-0.633	0.303	0.076	0.586
14 % Non Permanent	0.108	-0.087	-0.645	0.563
15 Mean Potential Work Experience	-0.046	-0.164	0.584	0.634
16 Goods Production/Service	-0.136	-0.460	0.380	0.611
Eigenvalues of Retained Factors	3.288	2.154	1.931	

The pattern of loadings on the third factor is the most unexpected of the three based on central components of the theories. The first thing to note is that the on-site and on-job training variables load moderately positive on the third factor but not on the other two. This is not entirely inconsistent with reasonable expectations based on the theory, however it may point to either an inconsistency between what the factor identifies and what we expected or it may identify some unrealistic expectations that stem from limitations in how some aspects of these theories can be applied to real markets (at least in the context of occupations in modern Canada). Regarding the fact that the training variables do not load on the internal labour market factor, I

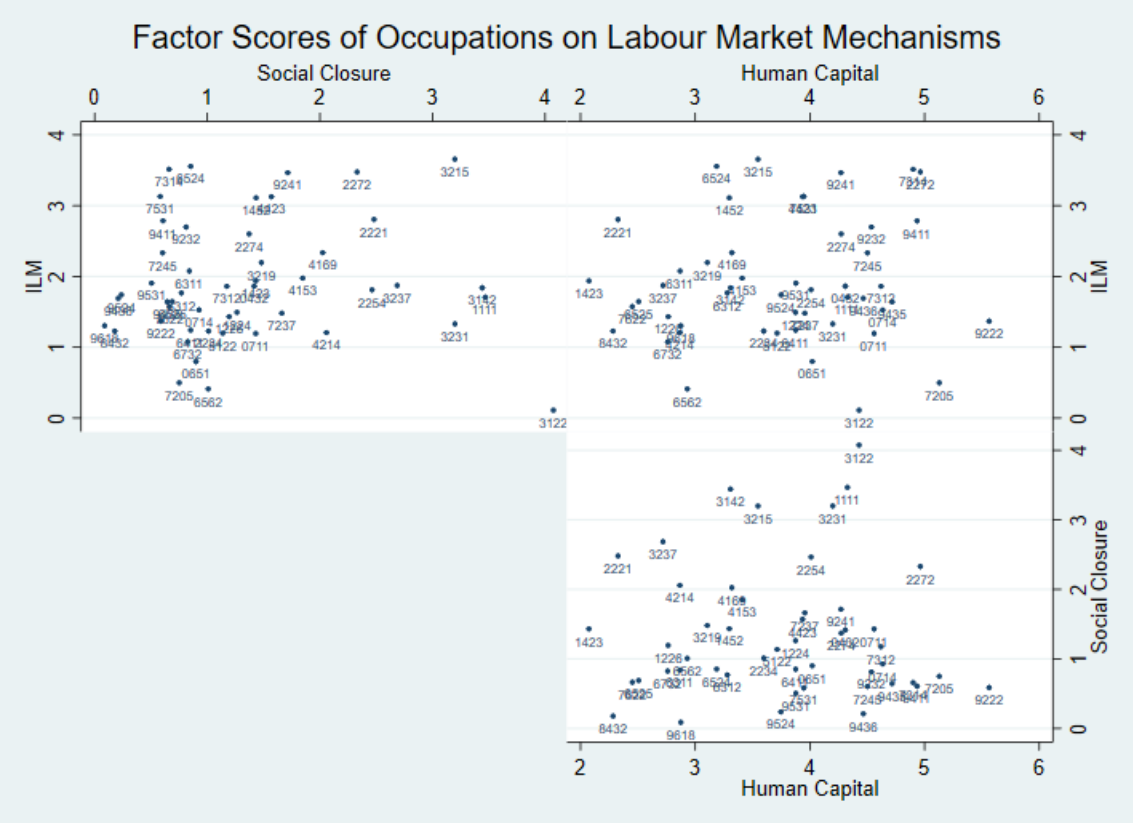
would argue that real internal labour markets may not conform to the simple description of these kinds of markets seen in the core concepts of ILM theory. Specifically, the theory focuses on jobs in an internal labour market that are complex, demanding high amounts of education, and entail stable, fulltime, long term forms of employment with plenty of opportunities for advancement. However, it may be more realistic to expect employment in an internal labour market to be highly variable, especially in terms of things like amount of training, tenure, education requirements, permanence, and so on. It appears reasonable to conclude that not all forms of employment that exist in large firms or in highly unionized public sector organization are safe from *casualization* or *outsourcing*. As a hypothetical example it is likely that certain kinds of clerical workers that require less education (i.e., mail clerks, data entry clerks, accounting clerks, and general receptionists) are both very common in large organizations and they also often do not require much on job training, and may involve more short term, part time, non-permanent forms of work. If true this might explain why some of these variables do not load on the first factor, because they are highly variable in internal labour market dominated occupations and therefore not correlated with the variables that do load on the ILM factor.

The fact that the training variables load on the third "human capital" factor is ostensibly incompatible with the understanding that a human capital based occupation would involve employment relations where one is hired for skills and abilities they already possess (from education and experience) which would make on-job training unnecessary. However, this expectation may be unrealistic and in real human capital type markets employees with education do not (in a modern labour market) possess all they need to start a job without employer provided training in many cases. From this perspective the training variables in the model may reflect the acquisition of employer specific human capital rather than the kind of on-job training hypothesized by internal labour market theorists. Thus this factor may identify occupations that operate on the basis of human capital but not exactly in the way we would expect from traditional conceptions of human capital theory. With this in mind it appears that the loadings on factor three identify occupations where employment tends to be long term, full time and quite stable (permanent), in predominantly goods production related work and with a labour force that has large amounts of potential experience (meaning either older, or less educated, or some combination of the two). It may be reasonable to proceed with the understanding that these occupations do still operate on the basis of human capital in some manner. However, the

differences between the results of this factor model and the theoretical expectations derived from each of the three theories raises the question: What role does education play in these three types of markets? And, will the wage effects of education across occupations also be different from what we expect due to the differences between the expected and observed loadings in this factor model? This question is explored in the next section.

This factor model was used to estimate three factor scores. This produces three variables each with a mean~0 and standard deviation~1. They were rescaled to min=0 and the descriptive statistics for these are included in Table 1. Below is a three dimensional scatter plot illustrating the relative scores of a random sample of 50 occupations in each factor. This plot demonstrates that some occupations are predominated by just one mechanism while others score high in more than one, demonstrating that there is a minor correlation between some of the factors.

Figure 4-1



Random Effect Models: Over-Qualification (Occupation Mean Centered Education)

The models in Table 4-4 have as their dependent variable occupation mean centered education measuring each individual's distance from their occupation mean level of educational attainment which uses the 11-item ordinal scale from the LFS. So, these models are essentially measuring within occupation deviation in levels of education which are expected to differ based on the presence of the three mechanisms. A significant positive coefficient therefore indicates a tendency for workers in that occupation to have a level of education above the mean within that occupation, suggesting a greater prevalence of over-qualification in that occupation.

Table 4-4: Random Intercept Models of Education Relative to One's Occupation Mean

	Required Years			Factor Scores			Full Model		
	B	SE		B	SE		B	SE	
Individual Level Variables									
Female	0.105	(0.005)	***	0.104	(0.005)	***	0.101	(0.005)	***
Immigrant	0.606	(0.006)	***	0.752	(0.006)	***	0.607	(0.006)	***
Non CMA	-0.319	(0.005)	***	-0.357	(0.005)	***	-0.316	(0.005)	***
Agriculture, Forestry, and Fishing	-0.195	(0.041)	***	0.072	(0.033)	*	-0.182	(0.042)	***
Mining	0.166	(0.022)	***	0.212	(0.022)	***	0.175	(0.022)	***
Construction	-0.204	(0.017)	***	-0.139	(0.016)	***	-0.199	(0.017)	***
Transportation, Communications, and Utilities	0.056	(0.014)	***	0.077	(0.014)	***	0.059	(0.014)	***
Wholesale Trade	-0.050	(0.017)	**	-0.045	(0.018)	*	-0.043	(0.017)	*
Retail Trade	-0.125	(0.015)	***	-0.074	(0.015)	***	-0.115	(0.015)	***
Finance, Insurance, and Real Estate	0.118	(0.018)	***	0.120	(0.018)	***	0.125	(0.018)	***
Services	0.137	(0.012)	***	0.154	(0.012)	***	0.152	(0.012)	***
Public Administration	0.341	(0.015)	***	0.373	(0.015)	***	0.350	(0.015)	***
Newfoundland and Labrador	0.079	(0.012)	***	0.082	(0.013)	***	0.080	(0.012)	***
Prince Edward Island	0.011	(0.013)		-0.011	(0.014)		0.012	(0.013)	
Nova Scotia	0.117	(0.010)	***	0.135	(0.011)	***	0.109	(0.010)	***
New Brunswick	-0.066	(0.010)	***	-0.075	(0.011)	***	-0.061	(0.010)	***
Quebec	-0.054	(0.006)	***	-0.058	(0.007)	***	-0.055	(0.006)	***
Manitoba	-0.240	(0.008)	***	-0.241	(0.009)	***	-0.240	(0.008)	***
Saskatchewan	-0.219	(0.008)	***	-0.208	(0.009)	***	-0.222	(0.008)	***
Alberta	-0.168	(0.007)	***	-0.164	(0.008)	***	-0.170	(0.007)	***
British Columbia	-0.051	(0.007)	***	-0.046	(0.007)	***	-0.054	(0.007)	***
Occupation Level Variables									
Required Years of Education	0.294	(0.006)	***				0.333	(0.007)	***
Required Years of Education^2	0.032	(0.000)	***				0.033	(0.000)	***
Factor 1 - ILM				-0.026	(0.008)	**	0.013	(0.023)	
Factor 2 - Social Closure				-0.071	(0.008)	***	-0.318	(0.028)	***
Factor 3 - Human Capital				0.049	(0.008)	***	0.061	(0.025)	*
Constant	-4.368	(0.087)	***	-0.126	(0.036)	***	-4.683	(0.113)	***
Variance Components									
SD (Constant)	0.509	(0.017)	***	0.132	(0.049)	***	0.468	(0.016)	***
SD (Residual)	1.805	(0.001)	***	1.893	(0.001)	***	1.795	(0.001)	***
Log Likelihood	-1607785			-			-1573004		

First, it is worth noting the coefficients for female, immigrant, non-CMA and also public administration. These indicate that women, immigrants and those in public sector jobs tend to be highly educated while those in more rural areas tend be less educated. Secondly, note that the standard deviation of the Constant which represent the variability of the intercept is quite small in each model. This indicates that there is limited inter-occupation variation in the distribution of education around occupation means. Despite this there are some differences and it is clear from the coefficients for the three factor scores in the Factor Scores model that these differences are partially explained by the presence of the three mechanisms which each have statistically significant effects overall. The coefficient for Factor 1-ILM indicates that as the prevalence of this mechanism increases the average deviation of educational attainment within these occupations declines by a negligible amount, while the social closure mechanism has a similar but stronger effect. This suggests that the presence of the social closure mechanism reduces within occupation variability of educational attainment, and the fact that this effect is bigger when controlling for the amount of education needed indicates that this effect is strong among occupations with lower overall levels of education. The coefficient for the human capital factor suggests that the average deviation increases as the presence of the human capital factor increases in an occupation, suggesting that this mechanism is weakly associated with higher levels of over-qualification on average. These results lend partial support to my first hypothesis. The negative social closure effect and the weak but positive human capital effects are consistent with expectations but the negative or negligible internal labour market effect is not consistent with what I expected.

Random Effect Models: Wage Returns to Over-Qualification

The models presented in Tables 4-5 and 4-6 have hourly earnings as their dependent variable. The independent variables of central interest include an occupation's mean education, occupation centered education and work experience, the three factor scores, and interactions between occupation centered effects and the factors. Note that most of these models have occupation mean-centered education as a random effect (or slope) and that while this effect is smaller than the other variance components it significantly affects wage variability across occupations. This random effect and its importance to the key variables in the models are discussed below.

We can see that occupation mean level of education has a very significant and strong effect on wages amounting to between 4.8$ to 3.9$ per level of education (or 12.9 to 17.1% as seen in log versions of these models in Appendix 4A). This is an occupation level covariate and its effect is not surprising, reflecting the tendency for occupations with higher education requirements to also have higher average wages. Occupation centered education is an individual level variable and reflects each workers level of education relative to the mean in their occupation, essentially capturing the effect of over-qualification. Its coefficient indicates that on average being over-qualified within one's occupation does pay off in the form of higher wages amounting to an average increase of $0.87 per level of education (or ~3%), indicating a small but significant and positive rate of return to over-qualification on average. The intra class correlation for this model is 0.376, while the ICC for a null model is 0.504 indicating that with no explanatory variables 50% of the variability in wages takes place in the variation of the intercept. This is meaningful and suggests that a substantial amount of wage variation in the modern Canadian labour market occurs between occupations. The much smaller ICC for this model indicates that the variables included explain a substantial portion of that variance. Further, almost 5% occurs in the occupation centered education slope variance indicating that a small but notable portion of overall wage variability occurs due to differences across occupations in the relationship between individual level of education within one's occupation and the wage rate associated with that extra educational attainment.

The second model titled "Factor Scores Only", simply demonstrates the average difference in wages that occurs due to the increasing prevalence of each of the three mechanisms without controlling for any other occupation characteristic. It is worth noting that the social closure mechanism has a clearly more significant effect on wages compared to the other two. This would suggest that social closure may indeed have the wage effect that occurs due to the hypothesised labour supply effects of social closure. However, the next model titled Factor Scores indicates that this may not necessarily be what is going on. This model includes both sets of covariates from the previous two models, and demonstrates the average effect of the mechanisms while controlling for the influence of each occupation's overall level of education. These results suggest that while each of the mechanisms still has a significant wage effect, the mean level of education effect is stronger than any of them, and the effect of social closure is significantly smaller in this model, possibly reflecting the conclusion from Chapter 3 or the

expectation discussed in the introduction that occupational closure occurs primarily through formal credential requirements.

Table 4-5: Two Level Random Effects Regression of Hourly Earnings with Occupation Mean Centered Education

	Education RS			Factor Scores Only			Factor Scores			Cross Level Interactions		
	B	SE		B	SE		B	SE		B	SE	
Individual Level Variables												
Female	-2.189	(0.030)	***	-2.143	(0.030)	***	-2.149	(0.030)	***	-2.148	(0.030)	***
Immigrant	-1.563	(0.034)	***	-1.554	(0.034)	***	-1.563	(0.034)	***	-1.563	(0.034)	***
Non CMA	-0.454	(0.028)	***	-0.448	(0.028)	***	-0.442	(0.028)	***	-0.441	(0.028)	***
Agriculture, Forestry, and Fishing	-0.703	(0.260)	**	-0.311	(0.268)		-0.246	(0.267)		-0.244	(0.267)	
Mining	8.001	(0.121)	***	7.924	(0.120)	***	7.936	(0.120)	***	7.937	(0.120)	***
Construction	-0.319	(0.094)	***	-0.318	(0.094)	***	-0.298	(0.093)	**	-0.297	(0.093)	**
Transportation, Communications, and Utilities	1.306	(0.080)	***	1.309	(0.079)	***	1.308	(0.079)	***	1.308	(0.079)	***
Wholesale Trade	0.345	(0.095)	***	0.359	(0.094)	***	0.359	(0.094)	***	0.360	(0.094)	***
Retail Trade	-2.898	(0.084)	***	-2.867	(0.084)	***	-2.866	(0.084)	***	-2.865	(0.084)	***
Finance, Insurance, and Real Estate	-0.050	(0.099)		-0.037	(0.099)		-0.044	(0.099)		-0.044	(0.099)	
Services	-1.646	(0.068)	***	-1.591	(0.068)	***	-1.596	(0.068)	***	-1.597	(0.068)	***
Public Administration	2.886	(0.084)	***	2.930	(0.084)	***	2.918	(0.084)	***	2.917	(0.084)	***
Newfoundland and Labrador	-1.448	(0.070)	***	-1.513	(0.071)	***	-1.513	(0.071)	***	-1.512	(0.071)	***
Prince Edward Island	-3.753	(0.076)	***	-3.705	(0.077)	***	-3.705	(0.077)	***	-3.707	(0.077)	***
Nova Scotia	-3.532	(0.058)	***	-3.455	(0.059)	***	-3.456	(0.059)	***	-3.457	(0.059)	***
New Brunswick	-3.840	(0.059)	***	-3.794	(0.060)	***	-3.794	(0.060)	***	-3.794	(0.060)	***
Quebec	-1.490	(0.036)	***	-1.473	(0.036)	***	-1.472	(0.036)	***	-1.472	(0.036)	***
Manitoba	-1.599	(0.047)	***	-1.547	(0.047)	***	-1.545	(0.047)	***	-1.545	(0.047)	***
Saskatchewan	0.035	(0.049)		0.094	(0.050)		0.097	(0.050)	*	0.098	(0.050)	*
Alberta	2.862	(0.043)	***	2.914	(0.043)	***	2.917	(0.043)	***	2.918	(0.043)	***
British Columbia	0.206	(0.041)	***	0.251	(0.041)	***	0.253	(0.041)	***	0.254	(0.041)	***
Occupation Level Variables												
Occupation Mean Education	4.845	(0.192)	***				3.863	(0.267)	***	3.863	(0.267)	***
Occupation Centered Education	0.866	(0.037)	***				0.867	(0.038)	***	0.150	(0.157)	
Factor 1 - ILM				2.243	(0.300)	***	1.149	(0.261)	***	1.149	(0.261)	***
Factor 2 - Social Closure				5.579	(0.319)	***	1.332	(0.395)	***	1.330	(0.395)	***
Factor 3 - Human Capital				2.746	(0.311)	***	2.831	(0.259)	***	2.834	(0.259)	***
Factor 1 - ILM x Occupation Centered Education										0.036	(0.037)	
Factor 2 - Social Closure x Occupation Centered Education										0.386	(0.039)	***
Factor 3 - Human Capital x Occupation Centered Education										0.028	(0.037)	
Constant	0.342	(1.275)		9.140	(1.340)	***	-8.014	(1.624)	***	-8.025	(1.623)	***
Variance Components												
SD (Constant)	6.002	(0.195)	***	6.197	(0.968)	***	5.136	(0.171)	***	5.135	(0.171)	***
SD (Residual)	9.181	(0.008)	***	9.098	(0.999)	***	9.102	(0.008)	***	9.102	(0.008)	***
SD (Occupation Centered Education)	0.773	(0.030)	***				0.767	(0.030)	***	0.669	(0.027)	***

The final model titled Cross Level Interactions adds an interaction effect between the factor scores and occupation centered education, capturing the extent to which excess education pays off differently in occupations predominated by different mechanisms. There are a few important things to note about the results of this model. First, many of the coefficients do not change from the previous model. This includes the factor scores and occupation mean education.

However, occupation mean centered education is now non-significant suggesting that the overall average effect of occupation mean centered education observed in the other models in Table 4-5 is entirely explained by the inclusion of the interaction terms. Finally, note that the only significant interaction coefficient is that for social closure and that it is positive suggesting that the occupation mean centered effect only occurs among socially closed occupations. The results of this model indicate that my second hypothesis is not supported. It appears that having more education relative to others in your occupation is rewarded only in socially closed occupations, amounting to almost $0.39/hour (or ~1.2%) per unit change in level of education and/or presence of a social closure mechanism. However, extra education relative to one's own occupation appears to have no significant effect on wages in occupations predominated by the other two mechanisms. One final, thing to note is that the variance component for the occupation centered education effect is smaller in this model, suggesting that the inclusion of this interaction has explained a small portion of the slope variability associated with occupation mean centered education. So there is between occupation variation in the rate of return to excess education and a small part of that variation is explained by the mechanisms represented by the factor scores.

The second set of models in Table 4-6 builds on the previous models by adding years of potential work experience. Potential work experience as an explanatory variable is not itself the focus of this chapter but it is worth noting that work experience could be related to the three mechanisms. Theoretically speaking, work experience is sometimes considered to be a form of human capital; alternatively it may reflect aging and therefore be related to the operation of internal labour markets or social closure mechanisms (due to seniority systems, or the delayed entry into social closure occupations as a result of requirements for educational credentials). Work experience is however included in these models as an additional control variable, intended to isolate the wage effects of education by controlling for the possibly related (i.e., correlated) influence of work experience. Work experience is included in these models in three ways. One is the average of estimated work experience of each occupation's workforce as a 2nd level covariate. The second is the individual level variable; occupation mean centered work experience measuring individual work experience relative to one's occupation mean. Lastly an interaction of occupation centered work experience and the three factor scores is included to indicate if there is any difference in the rate of return to extra work experience based on the predominance of the three mechanisms.

The first model titled Education and Work Experience is noteworthy for two reasons. First, the inclusion of occupation mean work experience and occupation centered work experience produces coefficients that are statistically significant and while they seem small the effect of several years difference in work experience would be associated with a substantial wage difference and work experience can range from 0 years to more than 50. Second, the inclusion of these two variables has virtually no effect on the education effects whose results are only slightly different from the Education RS model in Table 4-5.

The second model, titled Factor Scores, adds the factor scores for the three mechanisms and produces results that are very similar to the factor scores model from Table 4-5. The effect size of the internal labour market and social closure factors are slightly smaller when compared to the Factor Scores model from Table 4-5, while the size of the human capital factor is a little bigger. These results suggest that the work experience variables included in these models do not relate strongly to the education effects but do seem to be somewhat related to the three mechanisms measured by the factor scores. The change in the coefficients of the three factors suggest that some portion of their wage effect in the previous factor scores model may have been due to how they relate to both the work experience and education of the labour force in occupations predominated by ILMs and social closure. It also suggests that when the effects of work experience and education are controlled for the effects of the human capital mechanism, independent of these two characteristics, is more substantial than the other two mechanisms in explaining between occupation wage differences.

Table 4-6: Two Level Random Effects Regression of Hourly Earnings Models with Education and Work Experience

	Education and Work Experience			Factor Scores			Factor Scores Only			Interaction Model		
	B	SE		B	SE		B	SE		B	SE	
Individual Level Variables												
Female	-2.284	(0.030)	***	-2.234	(0.029)	***	-2.143	(0.030)	***	-2.122	(0.029)	***
Immigrant	-1.932	(0.033)	***	-1.902	(0.033)	***	-1.554	(0.034)	***	-1.905	(0.033)	***
Non CMA	-0.696	(0.027)	***	-0.681	(0.027)	***	-0.448	(0.028)	***	-0.673	(0.027)	***
Agriculture, Forestry, and Fishing	-0.577	(0.257)	*	-0.122	(0.262)		-0.311	(0.268)		-0.076	(0.261)	
Mining	8.248	(0.119)	***	8.163	(0.118)	***	7.924	(0.120)	***	8.214	(0.117)	***
Construction	0.031	(0.093)		0.033	(0.092)		-0.318	(0.094)	***	0.046	(0.091)	
Transportation, Communications, and Utilities	1.474	(0.079)	***	1.475	(0.078)	***	1.309	(0.079)	***	1.451	(0.077)	***
Wholesale Trade	0.463	(0.094)	***	0.426	(0.093)	***	0.359	(0.094)	***	0.417	(0.092)	***
Retail Trade	-2.703	(0.083)	***	-2.672	(0.082)	***	-2.867	(0.084)	***	-2.625	(0.082)	***
Finance, Insurance, and Real Estate	0.105	(0.098)		0.087	(0.097)		-0.037	(0.099)		0.080	(0.096)	
Services	-1.310	(0.068)	***	-1.338	(0.067)	***	-1.591	(0.068)	***	-1.326	(0.066)	***
Public Administration	2.893	(0.083)	***	2.848	(0.082)	***	2.930	(0.084)	***	2.770	(0.082)	***
Newfoundland and Labrador	-1.611	(0.069)	***	-1.720	(0.069)	***	-1.513	(0.071)	***	-1.684	(0.069)	***
Prince Edward Island	-3.825	(0.075)	***	-3.833	(0.075)	***	-3.705	(0.077)	***	-3.823	(0.075)	***
Nova Scotia	-3.616	(0.058)	***	-3.595	(0.057)	***	-3.455	(0.059)	***	-3.595	(0.057)	***
New Brunswick	-3.976	(0.059)	***	-4.000	(0.058)	***	-3.794	(0.060)	***	-3.957	(0.058)	***
Quebec	-1.386	(0.036)	***	-1.413	(0.036)	***	-1.473	(0.036)	***	-1.383	(0.036)	***
Manitoba	-1.495	(0.047)	***	-1.432	(0.046)	***	-1.547	(0.047)	***	-1.444	(0.046)	***
Saskatchewan	0.143	(0.049)	**	0.235	(0.049)	***	0.094	(0.050)		0.261	(0.048)	***
Alberta	3.015	(0.043)	***	3.085	(0.042)	***	2.914	(0.043)	***	3.095	(0.042)	***
British Columbia	0.306	(0.041)	***	0.358	(0.040)	***	0.251	(0.041)	***	0.345	(0.040)	***
Occupation Level Variables												
Occupation Mean Education	4.945	(0.189)	***	3.940	(0.263)	***				3.938	(0.263)	***
Occupation Centered Education	0.786	(0.006)	***	1.026	(0.038)	***				-0.059	(0.157)	
Occupation Mean Work Experience	0.283	(0.057)	***	-0.172	(0.068)	*				-0.168	(0.068)	*
Occupation Centered Work Experience	0.132	(0.001)	***	0.136	(0.001)	***				0.015	(0.004)	***
Factor 1 - ILM				0.953	(0.259)	***	2.243	(0.300)	***	0.895	(0.258)	***
Factor 2 - Social Closure				1.153	(0.397)	**	5.579	(0.319)	***	1.235	(0.397)	**
Factor 3 - Human Capital				3.529	(0.340)	***	2.746	(0.311)	***	3.529	(0.340)	***
Factor 1 - ILM x Occupation Centered Education										0.055	(0.037)	
Factor 2 - Social Closure x Occupation Centered Education										0.497	(0.039)	***
Factor 3 - Human Capital x Occupation Centered Education										0.086	(0.037)	*
Factor 1 - ILM x Occupation Centered Work Experience										-0.003	(0.001)	**
Factor 2 - Social Closure x Occupation Centered Work Experience										0.083	(0.001)	***
Factor 3 - Human Capital x Occupation Centered Work Experience										0.009	(0.001)	***
Constant	-6.674	(1.863)	***	-6.618	(1.759)	***	9.140	(1.340)	***	-6.730	(1.759)	***
Variance Components												
SD(Constant)	5.883	(0.969)	***	5.048	(0.968)	***	6.197	(0.968)	***	5.048	(0.968)	***
SD(Residual)	9.079	(0.999)	***	8.926	(0.999)	***	9.098	(0.999)	***	8.882	(0.999)	***
SD(Centered Education Slope)				0.780	(0.962)	***	1.188	(0.965)	***	0.671	(0.960)	***

The final model introduces an interaction between the three factor scores and occupation centered work experience. This interaction results in only minute changes among the variables that were included in the previous model. It does however introduce some interesting differences when compared to the interaction model from Table 4-5. Most notably, the effect size for the occupation mean centered education social closure interaction is bigger. This suggests that when the effects of work experience are controlled for the rate of return to excess education in social closure occupations is even larger than initially indicated from the previous

interaction model. Additionally, the effect of occupation mean education interaction with human capital factor is now significant at the 0.05 level and with a small positive effect. So, it appears that when work experience effects are accounted for it may pay off to have more education in human capital based occupations, but only by a small amount. While it is also true that the work experience interactions yield statistically significant results, the effects are so small that their practical impact on hourly earnings is very small. Finally, it is worth noting that much like the interaction model from the previous table, the variance of the occupation centred education effect is smaller in this model, suggesting that the inclusion of the interaction terms does explain some differences in the rewards associated with having higher amounts of education and or work experience relative to others in your occupation. Thus, while these results do not conform to expectations it does appear that possessing extra education does pay off differently to a small degree depending on the presence of the three mechanisms in your occupation.

Discussion and Conclusions

Three broadly recognized theories attempt to explain how education affects employment income: human capital, internal labour markets and social closure. Debates in the literature as well as my own findings from Chapter 3 raise the possibility that education plays an important role in the social closure effects of licensing. This also suggests that the effect of education on wage determination occurs through differing mechanisms in different structural and institutional labour market contexts. In this chapter I propose that each of these theories applies to different segments of the Canadian labour market. Van de Werfhorst (2011) employs a similar consolidated theoretical framework in an analysis of education effects across industries in the Netherlands. This chapter elaborates on Van de Werfhorst's work, applying the notion that the mechanism through which education shapes wages varies across sectors of the Canadian labour market, the structure of which is defined by occupations.

This chapter uses descriptions of how education functions according to the three theoretical traditions to select 16 indicators from available data. These indicators are used to generate factor scores intended to measure the prevalence of each of the three mechanisms in Canadian occupations. These factor scores became predictors in two sets of models analysing the effect of these mechanisms on two key outcomes. First, I used two-level random intercept models to explore whether or not over-qualification tends to be more or less prevalent in

occupations based on the presence of each of the three mechanisms in their occupation. The mechanisms were included in these models as 2nd level/occupation level effects using the factor scores. Second, I used random effect models to determine if there is variation between occupations in the returns to over-qualification (by allowing the slope of mean centered education to vary randomly). These models also attempt to determine if the rate of return to extra education is related to the three mechanisms by using cross level interactions of individual occupation centered educational attainment with the three factor scores. Regarding the first set of models, I hypothesized that over-qualification will be most common in occupations predominated by human capital, and to a lesser degree by internal labour markets, while over-qualification would be uncommon in occupations with a high presence of the social closure mechanism. Relating to the second set of models: I hypothesized that being over-qualified would pay off the most in human capital and internal labour market occupations, while it would not pay off at all in social closure occupations. My analysis provides some support for these hypotheses but also some unexpected results.

First, I showed that it is possible to measure the presence of different labour allocation mechanisms described in the theory. I was able produce factors scores that serve as a clear measure of social closure, as well as internal labour markets (though with some slight modifications regarding the role of on job training and the prevalence of casualized employment as discussed on the analysis section). It is important however, to note that the factor referred to as human capital was only partially consistent with expectations. In a market that operates on the basis of human capital we would expect to see workers hired and compensated for productivity enhancing skills they possess *at the time of hiring*, and that those skills are indicated by things like education and work experience. In such a market you would not expect that on job training would be very common, as workers should already have most of the skills they need to do the job. Additionally, due to the theorized competitive nature of a human capital market you would not expect employment relations in such an occupation to take the form of fulltime, long term stable employment. My analysis, however, identified occupations that have both of these characteristics in addition to those that were expected (i.e., that they tend to be in goods production and have a work force with high potential work experience). This raises an important question: what kind of labour allocation mechanism does this factor identify? I believe that this factor does identify a type of labour market that is different from both internal labour markets

and from and social closure. I would also argue that it identifies a market where human capital is a predominant mechanism. However, rather than identifying the 'classic' human capital market it appears to indicate occupations where workers commonly acquire employer specific human capital rather than a market where human capital is acquired only or primarily through education. This would explain the positive loadings on the training variables in Table 4-3 and those indicating long term stable forms of employment (full time, permanent etc.). While human capital still appears to play a central role in these occupations, this deviation from what was expected has implications for the role of education and its relation to wages in occupations where this mechanism is present.

The random intercept models included in Table 4-4 yield results that are somewhat supportive of my hypothesis. The models that only include the factor scores at level two indicate that over-qualification (measured as a mean centered effect) tends to decrease as the presence of both social closure and internal labour market mechanisms increase in an occupation. These results are consistent with theory which suggests that there should be no incentive on average to acquire education beyond what is needed in these kinds of occupations, so my hypothesis is supported on this point[18].

Regarding internal labour markets, my results are not entirely consistent with theoretical expectations. Internal labour market theory has, as a key concept, the idea of a job queue which maintains a competitive dimension within the market. So, because one's position in this queue is determined in theory by education there should be an incentive to acquire more of it, leading to a tendency among the workforce to acquire more education in occupations with an internal labour market mechanism. This does not appear to be the case, so this hypothesis not supported on this point. One possibility relates to the argument that ILM's come with specific and enduring qualification requirements (Blaug, 1976; Spence, 1973). Based on this, it may be that the competitive nature of the job queue cannot be detected amongst those who are already employed in an internal labour market. The result of this would be that those employed in occupations with a high presence of ILM's have similar levels of education because those at the top end of the education distribution are selected while those with less education tend not to be hired at all and

[18] It is worth noting that this result could also reflect a ceiling effect whereby many occupations that tend to function according to social closure also tend to have education requirements at the upper end of the scale. In such a case it would be impossible to be overqualified. This is discussed more below.

are therefore not even in the occupation. A second possibility is that perhaps internal labour market theory ignores the diversity of employment positions within private employers, unionized workplaces, and the public sector. It is important to remember that any singular internal labour market would consist of a number of occupations and this chapter is focused on occupations, so many occupations that are predominated by ILM's could certainly involve lower skill levels requiring only basic education and with little benefit coming to those with higher credentials (i.e., a clerical worker could certainly work in a large organization but for those who do, their chances of being hired and/or promoted may have little to do with their educational attainment).

Finally, the human capital factor score is the only variable in the occupation mean centered models with a consistently significant and positive coefficient. This indicates that over-qualification tends to be more common in occupations where the human capital mechanism is present. Human capital theory argues that a labour market functions as a competitive system where education would afford a worker with a competitive advantage regarding hiring, and compensation. In such a market there would be a significant incentive to acquire as much education as possible. The results for the human capital factor in these models are consistent with this expectation. The positive coefficient suggests that workers in occupations where the human capital mechanism is present tend to have levels of education above their occupation mean. Overall, the results of these models are supportive of the hypotheses concerning the effects of human capital and social closure on educational attainment within occupations but not so supportive regarding the effects of the internal labour market mechanism.

The final section of the analysis, with the random effect wage models in Tables 4-5 and 4-6 produce several unexpected findings about the relationship between education and wages in relation to the three mechanisms. Firstly, it is worth noting that each of the models with occupation centered education, but no interaction effects suggest that overall, having education higher than others in your occupation is associated with higher earnings. This is not surprising but what is interesting is that this effect disappears in the models that include the interaction terms. This suggests that the average effect of over(or under)-qualification on wages is explained completely by its relation to the three mechanisms. In both interaction models, the interaction between the internal labour market factor and occupation centered education is not significant meaning that it does not pay off to have a level of education that is higher than the

mean in occupations where the internal labour market mechanism is present. This is does not support my hypothesis and raises doubts about certain aspects of internal labour market theory as it applies in this case (i.e., where the presence ILM's are measured in occupations). It seems likely that the lack of a wage effect in internal labour market dominated occupations reflects the same issues that were discussed above. My analysis includes individuals who are either employed in a given occupation and therefore may not be able to capture the function of the job queue. This is because the job queue would include people who are not yet employed in the occupation and it is also where the competitiveness of educational attainment would play out in markets where ILM's are common. It may also simply reflect a limitation in internal labour market theory itself; that it does not adequately capture the breadth of employment relations and the role that education plays within ILM's across multiple types of occupations.

Estimates of the effect of the social closure mechanism in an occupation also do not entirely support my hypothesis. First, note that the size of the coefficient for the main effect of the social closure factor is significantly affected by the inclusion of the education variables. This suggests something consistent with expectations; that the mechanism through with social closure occurs in occupations is education (assuming for the moment that this wage difference does not reflect the impact of human capital). This however, only identifies the expected between-occupation effect of social closure. The coefficients for the interaction between social closure factor and occupation mean centered education are consistently significant across both interaction models and have the biggest effect size of all the interaction coefficients. These results are counter to expectations and suggest that in occupations where the social closure mechanism is present over-qualification or extra education appears to come with a notable rate of return in hourly wages, or that lower levels of education come with lower wages. Social closure theory does not generally include arguments for a within group effect (see page 16 for discussion of a *pure structural effect*) which is the basis for my hypothesis. However, one possible explanation for these results is simply that social closure can, despite the arguments of social closure theorists, create barriers within an occupation or through some unknown means, generate rewards for those with higher qualifications relative to others within an occupation. An alternative explanation is that this within group effect could occur due to the operation of a human capital mechanism *within* occupations where social closure is present. This would

suggest that even in an occupation dominated by social closure, human capital can still play a role in wage determination.

Another possibility relates to the potential ceiling effect that could have affected the results of the occupation mean education models in Table 4-3. A large portion of occupations scoring highly in social closure are at the top end of the education scale, while a significant number are at the lower end of the education scale. So, the wage effect I have observed in these models could therefore be due to those occupations that actually have lower average levels of education as well as a fair number of over-qualified workers. The positive interaction effect in these models indicates that higher education pays off in occupations with a social closure mechanism, highlighting a possible limitation in existing theory regarding how social closure affects wage determination. Whether it is social closure or a human capital effect, the theoretical expectation that education would not pay off within a socially closed occupation appears to be incorrect.

The results regarding the human capital mechanism are somewhat supportive of my hypothesis, but there are some complications. First, it is interesting that the introduction of the occupation mean education effect has very little influence on the coefficient for the human capital factor, while having a very significant effect on the social closure factor. At the same time the introduction of the work experience mean does appear to have an effect on human capital, but very little influence on the other two factors. This suggests that the effect of an occupation's average level of education on wages does not vary in response to change in the presence of a human capital mechanism but that there is some kind of relation between this mechanism and the effect of average years of potential work experience. Recall that work experience is age accounting for education, so those occupations with a higher mean may also have a work force with more tenure. The change in the coefficient for work experience when the factor scores are added to the model could indicate that the influence of work experience on the occupation is partially dependent on the presence of the human capital mechanism. This is interesting as it could be an indication that education still has a small effect on average wages in human capital occupations but that it is overshadowed by effect of experience and/or tenure. The occupation level effect of work experience is somewhat consistent with what you would expect in an occupation where education functions as human capital. However, the result of the

interaction between the human capital factor and occupation mean centered education is only partially supportive of my hypothesis.

In the first interaction model in Table 4-5 the interaction between the human capital factor and occupation mean centered education is not significant. This suggests that education is not associated with higher earnings within occupations where the human capital mechanism is predominant. However, this interaction becomes significant in the interaction model in Table 4-6 which introduces the work experience variables. While the effect size is small, this change between the two models indicates that if extra education pays off in human capital occupations it is only to a small degree, and when we control for the influence of average work experience, which may be more influential. This likely reflects the conclusion we came to regarding the factor analysis; that the 'human capital' factor identifies occupations that are somewhat different from expectations. It makes sense that educational attainment would play a diminished role in employment relations and wage determination in occupations where workers commonly acquire employer specific human capital through training and long term stable employment. Overall, these results indicate that the mechanism identified as human capital in my model does not function in the classic sense of human capital theory where one is hired and compensated for the skills and abilities they possess from their education *at the time of hiring*. Instead while education does pay off in these kinds of occupations to a small degree, the more significant factor would appear to be the kind of human capital they acquire from experience and training when working for one employer for a significant amount of time.

This chapter has demonstrated that we can identify the presence of different labour allocation mechanisms. But it also reveals that these mechanisms do not conform to 'pure' conceptions seen in the theories. Real markets are more complex, consisting of more than one mechanism or of just more complexity in how that mechanism plays out and shapes wage inequality. The application of this approach to the Canadian context has produced very different results when compared to Van de Van de Werfhorst (2011) findings in the Netherlands which were more consistent with theoretical expectations. Firstly, Van de Werfhorst (2011) appears to have been able to identify a human capital mechanism more consistent with the theory. He also found that it was common for workers in ILM industries to be overqualified, while it was less common in industries dominated by social closure. Additionally, he found that returns to over

qualification were lowest in social closure and ILM industries but higher in those governed by human capital. The differences in results between the two countries indicate how significant international variation in labour market institutions can be to the realities of employment, the role and importance of education, and the mechanisms through which wage inequalities are created and maintained[19]. This indicates that education and labour market related policies that work in one country may not have the desired effects in another. But one thing that is true in both cases is that it can be important and useful to explore in more nuanced terms, the role that education plays in the labour market and economic inequality so that policy and institutions can be crafted in such a way that both interests of workers can be advanced while inefficiencies in the labour market (labour shortages, unemployment etc.) can be addressed.

In conclusion, this chapter has identified the presence of three different labour allocation mechanisms within occupations in the Canadian labour market. Despite the fact that the characteristics of the mechanisms identified by my factor analysis differ from theoretical expectations, occupation trends in educational attainment do partially conform to predictions based on theory. So, from this we might conclude that while the realities of labour allocation systems are different from what I expected, (particularly regarding human capital) they do have the expected effect on educational attainment among workers. This chapter has also showed that the effect each mechanism has on wage returns to education differs significantly from what I would predict based on theory. Each of the three theories struggles to capture some of complexities of real labour markets and how the identified mechanisms affect educational attainment and wage inequality within and across occupations. Any attempts to study the role of education or these three mechanisms cannot expect to find labour markets that conform to a 'pure' conception of a labour market according to any of the three theories. Future research on this topic could explore in more detail the unexpected and complex ways that these three mechanisms operate in real labour markets in a North American context.

[19] Differences in available data are also likely to be responsible for some of the differences in our results.

Appendix 4A – Log Normalized Versions of Key Models

Table 4A-1: Two Level Hourly Earnings Models With Occupation Mean Centered Education Log Version												
	Education and Work Experience			Factor Scores			Factor Scores Only			Interactions		
	B	SE		B	SE		B	SE		B	SE	
Female	0.929	(0.001)	***	0.930	(0.001)	***	0.933	(0.001)	***	0.932	(0.001)	***
Immigrant	0.930	(0.001)	***	0.931	(0.001)	***	0.943	(0.001)	***	0.931	(0.001)	***
Non CMA	0.980	(0.001)	***	0.980	(0.001)	***	0.989	(0.001)	***	0.980	(0.001)	***
Agriculture, Forestry, and Fishing	0.981	(0.008)	*	0.988	(0.009)		0.982	(0.009)	*	0.989	(0.009)	
Mining	1.233	(0.005)	***	1.231	(0.005)	***	1.221	(0.005)	***	1.232	(0.005)	***
Construction	0.998	(0.003)		0.998	(0.003)		0.985	(0.003)	***	0.997	(0.003)	
Transportation, Communications, and Utilities	1.038	(0.003)	***	1.038	(0.003)	***	1.032	(0.003)	***	1.037	(0.003)	***
Wholesale Trade	1.006	(0.003)		1.005	(0.003)		1.002	(0.003)		1.004	(0.003)	
Retail Trade	0.887	(0.002)	***	0.888	(0.002)	***	0.882	(0.002)	***	0.888	(0.002)	***
Finance, Insurance, and Real Estate	0.987	(0.003)	***	0.986	(0.003)	***	0.982	(0.003)	***	0.986	(0.003)	***
Services	0.947	(0.002)	***	0.946	(0.002)	***	0.938	(0.002)	***	0.946	(0.002)	***
Public Administration	1.113	(0.003)	***	1.112	(0.003)	***	1.115	(0.003)	***	1.110	(0.003)	***
Newfoundland and Labrador	0.929	(0.002)	***	0.926	(0.002)	***	0.933	(0.002)	***	0.927	(0.002)	***
Prince Edward Island	0.864	(0.002)	***	0.863	(0.002)	***	0.867	(0.002)	***	0.863	(0.002)	***
Nova Scotia	0.866	(0.002)	***	0.866	(0.002)	***	0.870	(0.002)	***	0.866	(0.002)	***
New Brunswick	0.858	(0.002)	***	0.857	(0.002)	***	0.863	(0.002)	***	0.857	(0.002)	***
Quebec	0.951	(0.001)	***	0.950	(0.001)	***	0.948	(0.001)	***	0.951	(0.001)	***
Manitoba	0.935	(0.001)	***	0.936	(0.001)	***	0.932	(0.001)	***	0.936	(0.001)	***
Saskatchewan	0.999	(0.002)		1.001	(0.002)		0.996	(0.002)	*	1.001	(0.002)	
Alberta	1.108	(0.002)	***	1.111	(0.002)	***	1.104	(0.002)	***	1.111	(0.002)	***
British Columbia	1.020	(0.001)	***	1.021	(0.001)	***	1.017	(0.001)	***	1.021	(0.001)	***
Occupation Mean Education	1.171	(0.007)	***	1.129	(0.009)	***				1.129	(0.009)	***
Occupation Centered Education	1.029	(0.000)	***	1.035	(0.001)	***				1.023	(0.005)	***
Occupation Mean Work Experience	1.009	(0.002)	***	0.992	(0.002)	***				0.992	(0.002)	***
Occupation Centered Work Experience	1.005	(0.000)	***	1.005	(0.000)	***				1.004	(0.000)	***
Factor 1 - ILM				1.043	(0.008)	***	1.087	(0.010)	***	1.042	(0.008)	***
Factor 2 - Social Closure				1.040	(0.012)	**	1.194	(0.012)	***	1.042	(0.012)	***
Factor 3 - Human Capital				1.149	(0.012)	***	1.110	(0.011)	***	1.149	(0.012)	***
Factor 1 - ILM x Occupation Centered Education										1.000	(0.001)	
Factor 2 - Social Closure x Occupation Centered Education										1.012	(0.001)	***
Factor 3 - Human Capital x Occupation Centered Education										0.999	(0.001)	
Factor 1 - ILM x Occupation Centered Work Experience										1.000	(0.000)	***
Factor 2 - Social Closure x Occupation Centered Work Experience										1.002	(0.000)	***
Factor 3 - Human Capital x Occupation Centered Work Experience										1.000	(0.000)	***
Constant	8.447	(0.508)	***	8.229	(0.437)	***	12.945	(0.531)	***	8.222	(0.436)	***
SD (Constant)	0.190	(0.006)	***	0.152	(0.005)	***	0.190	(0.006)	***	0.152	(0.005)	***
SD(Residual)	0.298	(0.000)	***	0.295	(0.000)	***	0.302	(0.000)	***	0.294	(0.000)	***
SD (Occupation Centered Education)				0.022	(0.001)	***	0.037	(0.001)	***	0.020	(0.001)	***
N	611763			599397			599397			599397		
M	498			481			481			481		
LL	-129228			-120001			-133963			-119064		

Table 4A-2: Occupation Mean Centered Education Models Log Version																
	Null			Individual			Required Years			Factor Scores			Factor Scores Only			
	B	SE		B	SE		B	SE		B	SE		SE			
Female				1.019	(0.003)	***	1.020	(0.003)	***	1.020	(0.003)	***	1.020	(0.003)	***
Immigrant				1.409	(0.005)	***	1.408	(0.005)	***	1.410	(0.005)	***	1.410	(0.005)	***
Non CMA				0.871	(0.003)	***	0.870	(0.003)	***	0.870	(0.003)	***	0.870	(0.003)	***
Agriculture, Forestry, and Fishing				1.104	(0.031)	***	1.104	(0.031)	***	1.099	(0.032)	**	1.099	(0.032)	**
Mining				0.953	(0.012)	***	0.953	(0.012)	***	0.953	(0.013)	***	0.953	(0.013)	***
Construction				0.923	(0.009)	***	0.924	(0.009)	***	0.922	(0.009)	***	0.922	(0.009)	***
Transportation, Communications, and Utilities				0.986	(0.009)		0.987	(0.009)		0.985	(0.009)		0.985	(0.009)	
Wholesale Trade				0.947	(0.010)	***	0.948	(0.010)	***	0.946	(0.010)	***	0.946	(0.010)	***
Retail Trade				0.973	(0.009)	**	0.974	(0.009)	**	0.974	(0.009)	**	0.974	(0.009)	**
Finance, Insurance, and Real Estate				1.011	(0.011)		1.013	(0.011)		1.011	(0.011)		1.011	(0.011)	
Services				1.023	(0.008)	**	1.024	(0.008)	**	1.026	(0.008)	***	1.025	(0.008)	***
Public Administration				1.078	(0.010)	***	1.080	(0.010)	***	1.080	(0.010)	***	1.080	(0.010)	***
Newfoundland and Labrador				0.962	(0.007)	***	0.955	(0.007)	***	0.955	(0.007)	***	0.955	(0.007)	***
Prince Edward Island				1.038	(0.008)	***	1.037	(0.008)	***	1.039	(0.008)	***	1.039	(0.008)	***
Nova Scotia				1.110	(0.007)	***	1.100	(0.007)	***	1.104	(0.007)	***	1.104	(0.007)	***
New Brunswick				1.009	(0.006)		1.011	(0.006)		1.010	(0.006)		1.010	(0.006)	
Quebec				0.862	(0.003)	***	0.862	(0.003)	***	0.864	(0.003)	***	0.864	(0.003)	***
Manitoba				0.959	(0.005)	***	0.960	(0.005)	***	0.962	(0.005)	***	0.962	(0.005)	***
Saskatchewan				0.937	(0.005)	***	0.941	(0.005)	***	0.944	(0.005)	***	0.944	(0.005)	***
Alberta				0.933	(0.004)	***	0.936	(0.004)	***	0.938	(0.004)	***	0.938	(0.004)	***
British Columbia				0.992	(0.004)		0.991	(0.004)	*	0.993	(0.004)		0.993	(0.004)	
Required Years of Education							1.059	(0.023)	**	1.003	(0.022)				
Required Years of Education^2							0.994	(0.001)	***	1.000	(0.001)				
Factor 1 - ILM										0.936	(0.022)	**	0.936	(0.022)	**
Factor 2 - Social Closure										0.757	(0.024)	***	0.752	(0.019)	***
Factor 3 - Human Capital										0.976	(0.025)		0.974	(0.024)	
Constant	1.053	(0.027)	*	1.042	(0.027)		1.453	(0.138)	***	1.948	(0.232)	***	1.942	(0.203)	***
SD (Constant)	0.559	(0.018)	***	0.556	(0.018)	***	0.527	(0.017)	***	0.481	(0.016)	***	0.481	(0.016)	***
SD (Residual)	0.823	(0.001)	***	0.805	(0.001)	***	0.805	(0.001)	***	0.807	(0.001)	***	0.807	(0.001)	***
N	430743			430743			423376			415352			415352		
M	499			499			498			480			480		
LL	-528731			-519261			-510142			-501262			-501262		

Chapter 5: A Growth Curve Analysis of Wages and Education in Canadian Occupations Licensed Between 1997 and 2019.

In recent decades, licensing has become more and more common in the Canadian labour market, with the rate of licensing accelerating in the 1980's, 90's and early 2000's. Between 1997 and 2019, 134 new licenses were enacted across 63 occupations. As of 2019 there are 740 different licenses in Canada requiring approximately 18% of workers to hold a license in order to legally work in their occupation. Much of the published literature on licensing argues for the theory that licensing functions as a social closure mechanism; restricting entry into the occupation in order to generate rents for its incumbents. Several studies find empirical evidence of a wage premium associated with licensing, lending some support to this theory (Gittleman & Kleiner, 2016; Kleiner & Krueger, 2010; Weeden, 2002). However, more recent literature raises some doubts about this conclusion (Redbird, 2017; Zhang, 2019). Additionally, my own research suggests that the effects of licensing may be more complex than simply having or not having a social closure effect on wages. A key conclusion from chapters 3 and 4 is that licensing does appear to have a relation to education and/or human capital in Canadian occupations, and this relationship complicates the effect of licensing on wages. Ultimately, much of the uncertainty surrounding the question of licensing and its social closure effects stems from the fact that most of the existing research is cross-sectional.

The primary criticism of the cross-sectional approach in much of existing research on licensing wage effects is that, regardless of whether a wage premium is observed or not, a cross-sectional model cannot determine what the wages in a licensed occupation would be if it were not licensed. As a result you could never be sure that it is licensing rather than some other (possibly unobserved) occupation or geographic characteristic that is responsible for the observed wage difference between licensed and unlicensed occupations. The ideal way to discover the true effect of licensing on wages would be to compare a licensed occupation to one that is unlicensed but otherwise identical. Using real world data the closest we can get to this is to examine an occupation's wages before and after the enactment of a licensing requirement. The enactment of new licenses presents a natural experiment, and a longitudinal framework is an effective way to approach this kind of data. It allows for control over the potential effects of unmeasured time invariant differences between occupations as well as provinces that could affect

wages and bias our conclusions about the effects of licensing. It also presents the opportunity to explore the effects of measured time varying covariates which may affect wages and vary alongside licensing, in particular, education.

This chapter contributes to the debate on the topic of occupational licensing and whether or not it functions as a social closure mechanism in modern markets. Many studies find evidence of a wage premium associated with licensing. Weeden (2002) uses multi-level models of individuals nested in occupations in the U.S. and finds an average wage premium of 8.5% for licensing (p. 80). Kleiner and Krueger (2010) use log wage regression models of individuals in the U.S. and find a wage premium ranging from 11 to 15% among those who report being required to hold a license (p. 13). Gittleman and Kleiner (2016), using cross-sectional fixed-effect models on individual level data, find that those who hold a license have a wage premium of 14 to 18% (p. 169). Zhang (2019) also uses fixed-effect models on individuals in Canada but concludes that most of the wage premium associated with licensing is due to unobserved factors correlated with licensing. However, much of the published literature on this topic employs cross-sectional methods and is therefore affected by the limitations discussed above. One of few exceptions is Redbird (2017) whose analysis of occupations in the U.S. employs a multi-level longitudinal model run on 502 occupations separately, and finds that there is no wage premium associated with the enactment of a new license. Additionally, Gittleman and Kleiner (2016) employ a non-parametric model measuring change in wages among individuals who move into and out of licensed occupations, finding no statistically significant effect (p.157).

This chapter also brings together the findings of the previous two chapters, while addressing the uncertainty of both the published literature as well as the findings in chapter 3 and 4 stemming from their methodological limitations. Chapters 3 and 4 indicate two important things about licensing in Canada. The first is that, in a cross-section, licensing has very little independent effect on wages once education, human capital, and region effects are accounted for. Second, from Chapter 4 we know there is a relationship between social closure and educational attainment within and across occupations. This suggests a potential explanation for the contradiction that is apparent from existing literature, that is, that licensing has more complex effects on occupations than typically expected, going beyond simply affecting labour demand or supply, and actually shaping the institutional character of occupations. It is possible that the

effects of the enactment of a new license may have significant effects only in certain market and/or institutional contexts. Another important possibility is that the institutional effects of licensing change over time within an occupation. This chapter addresses the methodological limitations of much of the existing literature as well as in Chapters 3 and 4, which make it difficult to properly identify the independent effect of licensing on wages. The longitudinal approach of this chapter also allows a deeper exploration of the causal relationship between licensing and education, as well as how they shape the wage distribution over time within and across occupations and regions, giving us a clearer understanding of how licensing contributes to economic inequality and the institutional structure of labour markets in Canada.

Using the Labour Force Survey and my occupation database, I created a dataset consisting of repeated measures of average wages, level of education, licensing and other characteristics of occupation-provinces covering a time period in which a significant number of new licenses were enacted. These data present an opportunity to conduct a longitudinal analysis to address many of the limitations in most of the existing research. In particular, I determine how the enactment of a new licensing requirement affects wages, what role education plays in this, and how this process unfolds over time. This can be done by examining how average wages and level of education change over time in detailed occupations across 10 provinces as a function of change in licensing characteristics.

This chapter has two goals. The first is to determine if the enactment of a new license in Canadian occupations is associated with a subsequent change in average wages. In particular it investigates if and how the overall wage level of newly licensed occupations changes, as well as how the pattern of change differs before and after enactment. It also explores the argument that the social closure effect of licensing may be dependent on circumstances, such as the amount of time since enactment or the proportion of the occupation that is covered by licensing requirements. The second goal is to determine if there is a relationship between the enactment of new license and the level of or pattern of educational attainment in an occupation. This explores the idea that licensing may act as social closure and thus affects wages, *not* directly, but through the formalization of educational requirements. This would be signified by a change in the level of or pattern (i.e., variation) of educational attainment among occupation members after a new license is enacted. Briefly, the two primary research questions that guide this chapter are:

1) How does the enactment of a licensing requirement affect wages within and across occupations, and how does this effect change over time?
2) Does the enactment of a licensing requirement in an occupation affect educational attainment in that occupation and does this effect change over time?

Using annual data on occupation-provinces, the combination of detailed occupation and province in Canada from 1997 to 2019, this chapter explores how wages and education change over time in response to changing license requirements. This makes sense because, with rare exception, licensing falls under provincial jurisdiction. These data reveal 134 new licences across 64 occupations, thus providing ample opportunity to measure the effects of the enactment of new licences. The chapter is in three sections. The first is a descriptive exploration of new licensing requirements in this time period, as well as patterns of change in wages and education among licensed and unlicensed occupation-provinces. The second is a growth curve analysis of average wages among occupation-provinces over time, with key independent variables being licensing, licensing coverage, years since enactment, and education. These models determine if the enactment of a new license is on average associated with a change in the level of or pattern of change in average hourly earnings in occupation-provinces with a new license. The third section is a growth curve analysis of average level of education among occupation-provinces over time also with licensing characteristics as independent variables. For occupation-provinces these models measure change in average levels of education in the years after a new license is enacted. Together these models explore how the enactment of a new license shapes both wages and the institutional characteristics of an occupation in the years following enactment.

Literature Review - The Social Closure Effects of Occupational Licensing:

Social closure describes situations where individuals in positions in a social structure, such as the labour market, attempt to monopolize the opportunities associated with that position by creating barriers to entry (Kreckel, 1980; Redbird, 2017; Weber, 1978; Weeden, 2002). Groups attempt to do this when they face competitive pressures affecting their livelihood, and where they are capable of creating barriers to reduce competition and maximize rewards. Occupational closure is a particular form of social closure. Occupations constitute positions within the larger social structure of the labour market and their members form social groups which possess certain shared characteristics. These characteristics help to define the social

conditions of the occupation as well as the ability of its members to attain the necessary influence to create barriers that exclude outsiders (Weber, 1978; Weeden, 2002). The exclusionary effect of these barriers limits the supply of workers which is the primary means through which rent is generated in a given occupation (Redbird, 2017; Sørensen, 1996; Weeden, 2002). Occupational licensing is generally thought to be one of the more common social closure mechanisms in modern labour markets (Gittleman & Kleiner, 2016; Kleiner & Krueger, 2010; Kleiner & Soltas, 2018; Redbird, 2017; Weeden, 2002; Zhang, 2019). This is because licensing of occupations creates the right to practice in that occupation, and because this is enforced by the state it is illegal to practice without a license (Redbird, 2017; Weeden, 2002). The combination of enforcement by the state as well as the pre-requisites one must have in order to attain this right and get a job, create an artificial barrier to entry which is thought to limit the supply of labour and thus accomplish social closure, generating rent in licensed occupations.

As indicated above, the findings of empirical studies on the wage effects of occupational licensing are inconsistent. This may reflect methodological differences, but it may also be that the theory of social closure, in so far as it applies to occupations and licensing, requires elaboration in order to properly account for the true effects of licensing in modern labour markets. One potential explanation for the apparent contradiction in the literature is that licensing has more complex effects on occupations. The effect of licensing on occupations may go beyond simply affecting labour demand or supply, and actually contribute to, while also interacting with, the established institutional character of occupations. One possibility is that the enactment of a new license may have significant effects only in occupations with certain market and institutional characteristics. So, if a new license is enacted where other institutions that shape labour supply are already highly developed, it may have very little impact on wage levels. In contrast, if entry into an occupation is not as highly institutionalized, a new license could have significant institutional effects and therefore also bigger effects on wages or other employment outcomes. As a result, the effect of new licences could vary across occupations, regions, and nations based on the type and capabilities of labour market institutions that already operate in those markets.

Another possibility is that licensing may have institutional effects that change over time within an occupation, something rarely discussed in the literature. For example, the enactment

of a new license may formalize the educational requirements of employers in an occupation, and this formalization may then motivate the development of preparatory educational programs associated with that occupation. This development could shape labour demand and supply in an occupation in such a way that any independent effects of licensing will change over time as this institutional development takes place. This could also explain the apparent relationship between licensing and education touched upon in the previous two chapters. This also hints that the wage effects of licensing change over time, making it difficult or even impossible to understand that effect using cross-sectional methods.

This chapter explores the wage effects of licensing on Canadian occupations while accounting for these two potential complicating factors. The possibility that the true effect of licensing can only be understood when observed over time is addressed with the use of longitudinal models and data. Multi-level growth curve models allows for an examination of how average wages in newly licensed occupation-provinces change both immediately and several years after enactment. In addition, the data used in this chapter presents an opportunity to account for the role of other institutional forms that can vary between occupations as well as over time and which may also be related to licensing. Most notably this includes level of education as a possible conditional factor affecting the change in wages introduced by licensing. It also includes additional models in which both level of and variability of education function as outcome variables, and is observed before and after the enactment of a license. Using the empirical findings of existing research as well as social closure theory and the two addendums to that theory suggested above, I can formulate 4 hypotheses:

H1 – Average wages differ between licensed and unlicensed occupations, with the newly licensed experiencing an interruption in their growth pattern in the years after the enactment of a new license, in the form of a 'jump' in wages. Wage levels may then continue on a new higher trajectory, or fall back to their original trajectory.

H2 - Average level of education is expected to increase more in an occupation-province in the years after the enactment of a new license when compared to unlicensed occupations.

H3 – Variability of education is expected to drop upon enactment of a new license or decline over the years after.

Data and Method:

Because most licensing is under provincial jurisdiction in Canada, in order to analyse the effect of the enactment of a new license, data on wages and other key variables are needed at the level of occupation and region. The data used in this chapter are based on annual samples of the Labour Force Survey from 1997 to 2019. All individual level variables were aggregated to produce means, standard deviations, proportions and other measures at the level of occupation-province. This results in a dataset consisting of repeated observations of key variables on occupation-provinces across 23 years, to which I linked my occupation dataset providing information on licensing. This marks a significant change from the previous chapters which included data only for 2019.

If occupational licensing has social closure effects, this should be detectable as a change in average wages among newly licensed occupations. The expectations regarding the effects of social closure on within-occupation wage variability are less certain. Much of the existing theory about social closure (i.e., Sorensen, 1996) suggests that it functions as a group level effect only and therefore should not be associated with a difference in the standard deviation of wages. However, in Chapter 4 I discovered that social closure has varying wage effects within socially closed occupations. Based on this we might expect that newly licensed occupations will also experience a change in the variability of wages and therefore, the occupation-province standard deviation of wages is included as a dependent variable in this analysis.

Education is also a very important factor to consider in relation to the effects of social closure. It has been argued by some (Redbird, 2017, for example) that education may have social closure effects on its own. So, it may be that education functions as an intervening variable in the wage effects of licensing; the implication is that licensing promotes change in education which then affects wage levels in that occupation. If so, its inclusion in wage models may explain some of the wage effects of licensing. In addition to Redbird's (2017) speculation, my own findings in chapters 3 and 4 suggest that there is a relationship between the pattern of education in an occupation and the enactment of a license. However, there is some uncertainty about the causal relationship between licensing and education. It may be that licensing promotes change in education, or it may be that licensing is more likely in occupations with certain educational characteristics. If licensing is the proximate cause of observed wage differences in

licensed occupations and education functions as the mechanism through which that occurs, then I would expect to find two things. First, a portion of the wage effect of licensing is explained by the inclusion of education in wage models. Second the enactment of a new license is associated with a change in average level of education combined with a change in variability of education in the education models.

These data allow the use of growth curve models which are two level hierarchical models where time is modelled at level one, usually using polynomials. Level two contains variables describing occupation-provinces, whose coefficients measure average differences in the dependent variable (i.e., differences in the intercept). In these models a cross-level interaction can be used to describe differences in the rate of change in the dependent variable (i.e., slope differences). This type of model is ideally suited to the analysis of this kind of data and can also address a significant limitation in almost all of the existing research on this topic. Specifically, growth curve models allow for an analysis of average wages across both time and occupations and provinces while accounting for the effect of newly enacted licenses. In these models licensing, as well as education, can function as a time varying covariate (TVC), a variable that changes over time and may result in changes in the dependent variable, thus allowing an empirical approach that can control for the influence of variables which may be correlated with licensing and cannot be properly accounted for in a cross-sectional fixed-effects model. This approach therefore allows for an exploration of how the enactment of a license affects wages as well as education in occupation-provinces. It also enables accounting for the influence of education both as an occupational characteristic that can change over time and act as a possible conditional factor in the wage effects of licensing. Thus this chapter is able to address the most significant empirical limitations of much of the existing research on this topic.

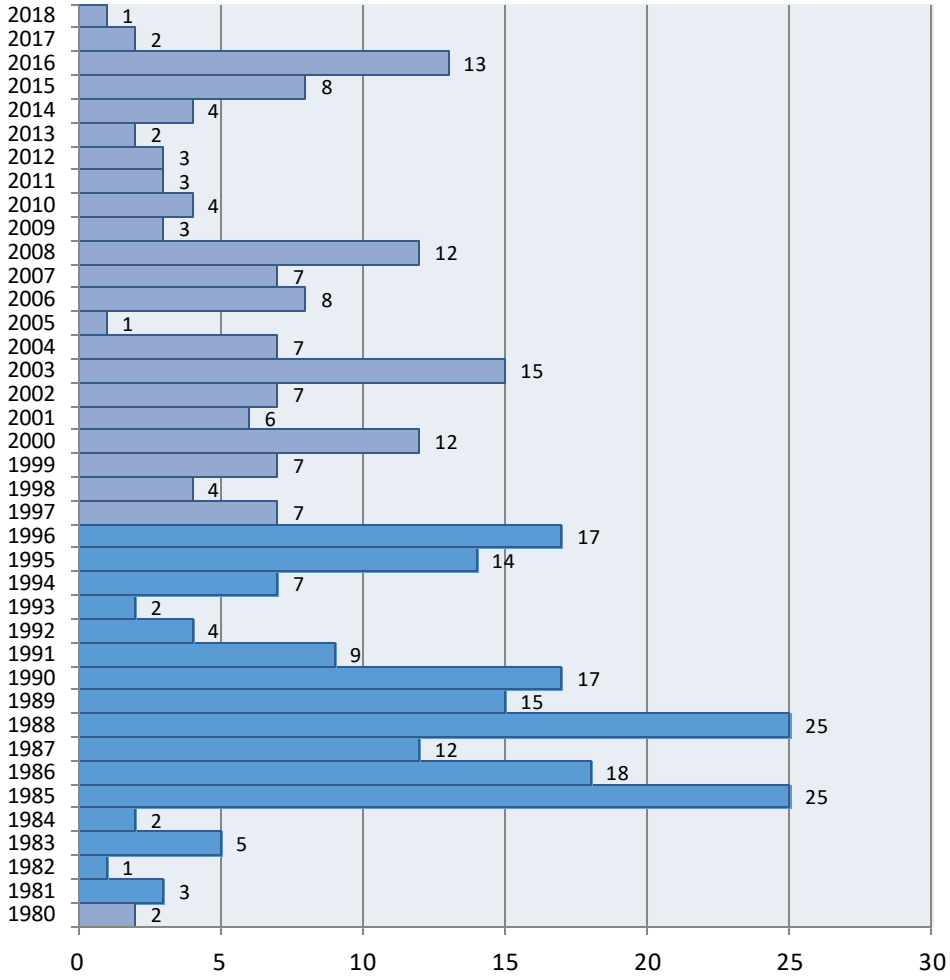
There are specific components of these models that are the focus of this analysis and can provide evidence on the hypotheses listed above. Regarding Hypothesis 1, the main effect of licensing (where new licenses are identified separately) indicates a difference in wages either on average or at the intercept when compared with unlicensed occupations. Additionally, an interaction of licensing with time indicates an estimated difference in the rate of change in wages over time. This is also true of the 'after enactment' coefficients in the years enacted spline models described more below. A similar approach applies in the analysis of Hypothesis 2 and 3,

using models of education level and education variance. The coefficients for licensing in these models indicate differences in education associated with the enactment of a new license, and when significant, lend support to the argument that licensing has institutional affects, and this effect may help to explain some of the wage premium associated with licensing. Finally, using education as a TVC in the wage models provides information about Hypothesis 4. The introduction of the main effect of education may result in change in the estimated effect of licensing. This could indicate that a portion of the estimated wage effect of licensing is not independent of education but rather affects wages through education. Further, an interaction between education and licensing can indicate the extent to which the effect of education varies between licensed and unlicensed occupations. In concert with the education models I can conclude that licensing leads to change in education, and then, using the coefficients for education as a TVC in wage models, measure the extent to which the wage premium associated with licensing is due to licensing on its own (i.e., the extent to which licensing is a social closure mechanism itself) and/or through its effect on education (i.e., licensing is a social closure mechanism through the social closure effects of education).

An Exploration of Modern Licensing in Canada

It is apparent from Figure 5-1 and its associated data in Appendix 5A that 1985 represents the beginning of a modern trend in occupational licensing, consisting of a substantial wave (or many small waves) of new licenses being enacted from 1985 up until 2018. This section provides an overview and discussion of the differences between newly licensed occupation-provinces and those that have been licensed for many years. This focuses on the type of occupation, differences in licensing coverage, differences in the province where the license is enacted, and differences in skill levels. Its purpose is to determine if occupations licensed in different periods have different characteristics and attempt to uncover some of the context for the modern post-1985 trend in occupational licensing.

Figure 5-1: Licenses by Year 1997-2019



From the information in Table 5-1 it is clear that the oldest licenses in Canada are unsurprisingly in the 'classic' professions, like engineers, doctors, lawyers. Each of these occupations achieved full coverage well before 1985 with sheriff/bailiff and oil and gas contractors only ever being licensed in Quebec. Those occupations that are licensed both prior to and after 1985 represent occupations that experience an expansion of existing licenses in the post '85 period. There are some occupation types that appear in both this and the post '85 group (i.e., paramedical, and trades) while others do not appear in the post '85 group at all (i.e., finance related and education) suggesting that for some occupations in this group the establishment of new licenses reflects a longer running historical trend toward regulation and/or social closure in

certain professions, generally those with higher levels of education, status, earnings or those for whom the claim of protecting public interest is viable.

Table 5-1: Occupation Types Across Three Timeframes	
Timeframe of Enactment	Occupation Type (examples)(# of occupations)
Licensed Prior to 1985 Only:	Engineers(civil, mechanical, aerospace etc.) (11); Land Surveyors(1); Air Travel Related(pilots, air traffic controllers etc.)(4); Doctors(2); Lawyers(1); Sheriff/Bailiff(1); Oil and Gas Contractors(1)
Licensed Prior to and After 1985:	Finance Related(real estate agents, auditors etc.)(5); Chemists(1); Natural Resource Professions (forestry professional, agricultural consultants)(2), Architects(1); Dentists(1); Veterinarians(1); Paramedical(chiropractors, physiotherapists, denturists)(6); Adjuncts to Medical/Dental (radiation technologists)(2); Nurses(1); Social Services (social workers)(3); Education (teachers, counselors)(3); Trades(electricians, elevator mechanics)(3)
Licensed After 1985 Only:	Immigration Consultants(1); Adjuncts to Sciences and Engineers (chemical/mechanical engineerin technologist and technician)(12); Urban Planners(1); Paramedical (respiratory therapist, sonographer)(3); Adjuncts to Medical/Dental (medical labratory technologist, dental hygienist)(8); Social Services (marriage councelors, interior decorators)(3); Personal Services (hair stylist)(2); retail sales person(1); Trades (steamfitters, automotive service technicians)(10); Logging Supervisors(1)

Among the after 1985 licenses, the most notable occupations are those that I describe as adjuncts to the science and medical professions which (along with a few others) only experience two licenses prior to 1985. This suggests that these occupations have become licensed as a result of a strictly modern trend in Canadian occupational licensing. At first it would appear that this could be explained simply as a extension of a desire for licensing from already licensed professions, implying that these adjunct professions are becoming licensed because the primary profession with which they work desire assistants and technicians that are licensed. The exact nature of this process is beyond the scope of this analysis but it is likely that it reflects a more generalized trend rather than emerging from an association of two occupations. As an example, if the process was simply that chemists desired to work with licensed chemical technicians we would expect similarity in the licensing coverage of the two. However, chemists are only licensed in Alberta and Quebec, whereas chemical technicians are licensed in Alberta, New Brunswick, Manitoba, and British Columbia but not in Quebec. This suggests that whatever force is behind the licensing of these occupations it is not emerging *only* from the relation between two closely related occupations. Another thing that suggests the influence of a more general trend in licensing in this time period is the licensing of a handful of occupations that are

both previously unlicensed and are in low skill, low status fields where arguments for the protection of public interest would be weak. Examples include hair stylists, licensed in four provinces, and retail sales persons, licensed in British Columbia. The fact that these kinds of occupations have achieved licensing indicates the influence of two things about modern Canadian Society. One is the increasing perception among workers that licensing is the only viable means to protect their economic interests, with existing unions being in decline and the formation of new ones being infeasible for many. Another is the possible increasing cultural/political acceptance of licensing as an acceptable institutional and regulatory mechanism, as well as acceptance of arguments that it protects the public interest (i.e., licensing hair stylists may ensure better hygiene).

Table 5-2: Maximum Licensing Coverage Achieved and NOC Skill levels by Timeframe

	Pre '85 Only	Pre '85 with Post '84 Licenses	Post '84 with Prior Licenses	Post '84 Only
Max. Coverage	# of Occupations	# of Occupations	# of Occupations	# of Occupations
1	2	12	0	15
2	0	7	2	3
3	0	4	2	4
4	0	7	4	11
5	0	2	4	3
6	0	0	1	0
7	0	1	1	2
8	0	2	6	1
9	0	1	1	1
10	19	0	15	2
Total	21	36	36	42
Skill Levels of Occupation-Provinces by Timeframe				
1	0	0	0	0
2	1	0	0	5
3	41	43	68	131
4	150	65	90	6

In addition to differences in the types of occupations that become licensed in each of these timeframes, there are differences in the level of coverage achieved by each group of occupations, and these differences highlight the possibility that some licenses are enacted as part of different but overlapping historical trends. Table 5-2 indicates the maximum level of coverage achieved for each occupation in each timeframe. The 1st is not surprising, but the inversion of the pattern between the remaining three is noteworthy. This inversion indicates first, that those occupations that see new licenses enacted prior to and after 1985 are part of a longer running historical trend of licensing being expanded in occupations that are (mostly) high

skill, and high status but were not part of the classic regulated occupations. These occupations were first licensed in a wide range of years prior to '85 and have simply seen the continued expansion of licenses within those occupations in the post '84 era. This is indicated by the fact that very few of the occupations in the 2nd column achieved high levels of coverage in that time while the 3rd column indicates that a majority of those same occupations do achieve high and even full coverage by 2018.

Secondly, the pattern in the right most column is similar to the 2nd column. This suggests that those occupations experiencing licensing for the first time in this period, represent a new trend where licensing is occurring in occupations that are not exclusively high status or high skill. This is further indicated by the differences in the NOC skill levels of occupations in each column. It is clear that the skill levels of licensed occupations has shifted away from being mostly among those requiring university level education (level 4) in the pre '85 period to mostly those requiring College or equivalent (level 3), particularly if they are newly licensed after 1984. Most of these occupations have achieved licensing in four or fewer provinces. Together the differing characteristics of these occupations suggest that newly licensed occupations are becoming licensed due to something about this historical period that has lowered the barrier to the establishment of a license while also expanding the incentive to pursue licensing in certain Canadian occupations.

Table 5-3: Number of Licenses by Province in each Timeframe

Pre '85 Only		Pre '85 with Post '84 Licenses		Post '84 with Prior Licenses		Post '84 Only	
Province	# of Licenses	Province	# of Licenses	Province	# of Licenses	Province	# of Licenses
QC	21	QC	26	ON	24	AB	26
BC	19	NB	17	BC	23	MB	22
AB	19	AB	15	NS	21	NB	20
SK	19	SK	12	AB	18	BC	18
MB	19	NL	12	PEI	17	NS	17
ON	19	MB	7	MB	16	ON	10
NL	19	NS	7	SK	14	SK	8
NS	19	ON	6	NB	11	NL	8
NB	19	BC	3	NL	10	QC	7
PEI	19	PEI	3	QC	4	PEI	6

Another factor to consider is the influence of regional differences on occupational licensing. This raises the question: are the most recently enacted licenses the result of the specific economic or social conditions in certain provinces in the post 1984 period? Table 5-3

lists the province of enactment for each new license in each timeframe. Once again the first column is not surprising, but there are some interesting patterns that emerge among the other three. First it is clear that Quebec stands out as the most unusual pattern, topping the list in column three, but being near the bottom in the other two. Alberta is among the top four in all three columns, New Brunswick shifts from the top to the bottom and back again, while Manitoba starts in the middle and rises to the top in the 3rd. Fully explaining why provinces might differ in rates of licensing in each timeframe is beyond the scope of this analysis; however there are two things that occur to me as possible explanations for some of these differences. One factor worth considering is differences in cultural attitudes about government intervention and regulation in markets. Historically, Quebec has appeared more accepting of government bureaucracy and regulatory market institutions, and this may explain why it is most prominent in the pre '85 period. Why they are at the bottom of list in the post '84 period is less clear. Perhaps there has simply been less room for the expansion of existing licenses in Quebec. Another factor that may affect the prevalence of licensing is the development of certain industries and the expansion of their associated occupations. It is clear from Table 5-2 that many of the post '84 licenses are in the adjunct science professions, and these new licenses occur almost exclusively in Alberta, Manitoba, New Brunswick, and British Columbia. While further investigation would be required to confirm this, it may be that these provinces have experienced economic development in the post 1984 period in industries that employ scientific/technical workers (i.e., perhaps in natural resources like oil and gas), while other provinces (like Quebec) have not experienced this economic trend and therefore has seen fewer new licenses in the same period.

Overall it is clear that those occupations becoming licensed in the 1985 to 2018 period are part of a distinct modern trend in occupational licensing, often consisting of entirely new licenses in different types of occupations that have yet to achieve high levels of coverage. These new licenses appear to represent a somewhat different process when compared to much older licenses. There is a weak relation between license enactments and province, suggesting a possible association to regional economic and cultural differences. There is also a clear difference in the typical level of skill required to work in the more recently licensed occupations. These new licenses appear to be linked to what I suspect are differences in economic development which has lent certain types of occupations the opportunity to pursue licensing. This likely reflects the expansion of certain occupations and their associated industries in the

post 1984 period affording new groups of workers with the economic and cultural capital to successfully lobby for licensing of their occupation. It is also probable that these economic factors have coincided with changes in attitudes and acceptance of regulatory institutions like licensing. Given the timing of this modern licensing trend is seems likely that it is one consequence of macro-economic changes that have taken place in this era. These include things like trade liberalization, the decline of unions, and the shift toward a service based economy. In this context licensing may have become both more acceptable and more necessary as a means for workers to protect their economic interests. Ultimately it is clear from the differences between older licensed occupations and those licensed more recently, that we should not expect the wage effects of newly enacted licenses to resemble the wage differences observed among occupations that have been licensed for many years.

Descriptive Statistics

The dependent variables include the average and standard deviation of wages as well as the average[20] and variability[21] in level of education. Each of these measures is calculated at the level of occupation-province in each year and adjusted for inflation to the year 2016 using the annual provincial consumer price index, producing a dataset consisting of repeated measures of these variables on between 4,645 and 4,782[22] occupation-provinces across 23 years. Both wage measures are included in dollars per hour. Table 5-4 indicates that both the mean and standard deviation of wages among all occupation-provinces have increased significantly since 1997. The standard deviation of these measures has also increased, suggesting an increase in between

[20] Mean level of education is calculated using the following:
Mean level of education = 1*mean of(grade0-8) + 2*mean of(grade9-10) + 3*mean of(11-13nongrad) + 4*mean of(11-13grad) + 5*mean of(cert/diploma) + 6*mean of(college) + 7*mean of(bachelor's) + 8*mean of(above bachelor's).

[21] Variability in level of education is calculated using the following:

$$V_2 = 1-\sqrt{1-(1-f_0^2-f_1^2-\cdots f_k^2)},$$

This is then standardized to a 0 to 1 scale as follows:

$$V_{2s} = V_2 \,/\, 1-(1/\sqrt{k}),$$

This measure relies in the relative frequencies of each category in the variable, so k is the number of categories and f_k is the frequency of the kth category divided by the total of the frequencies (Allaj, 2018).

[22] This varies because some occupation-provinces are based on small samples and therefore do not appear in the LFS in every year.

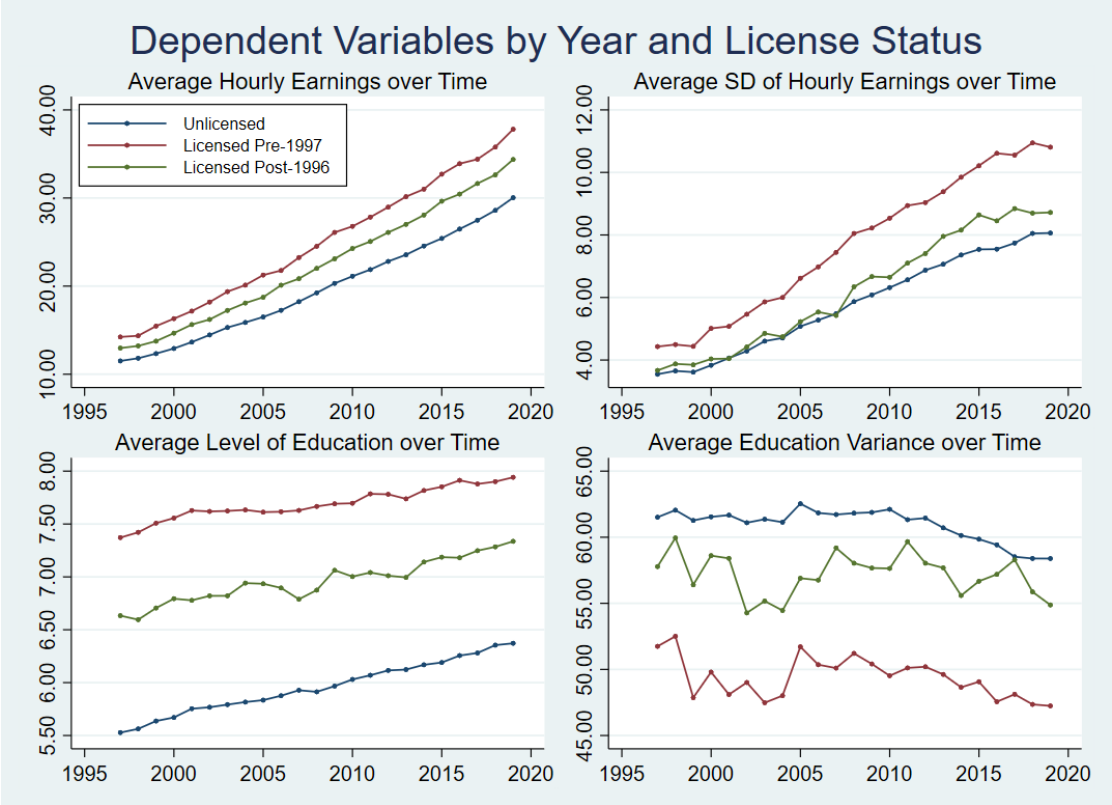
occupation-province variability in both cases. Mean level of education is based on 8 ordered categories, where a mean of 6 indicates that college is the average level of education of an occupation-province's workforce. Table 5-4 demonstrates that the overall average level of education in Canada has increased by almost one point during this time period. Variability in level of education is measured using the V2s coefficient which relies on relative frequencies in each category (see footnote 2), and for this analysis it is rescaled to span 0 to 100. We can see that the overall average of this measure has declined by a small amount, suggesting a slight trend toward less variation in levels of education. Additionally, the standard deviation of this measure indicates a slight decline in between occupation-province differences over the same period.

Table 5-4: Descriptive Statistics Dependent Variables by Year

	Mean Wages		SD Wages		Gini Wages		Mean Education lvl		Education Variance	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1997	11.79	(3.91)	3.63	(1.91)	0.18	(0.05)	5.72	(1.75)	60.53	(25.32)
1998	12.08	(3.88)	3.73	(1.88)	0.18	(0.05)	5.76	(1.72)	61.13	(24.84)
1999	12.66	(4.28)	3.69	(1.98)	0.17	(0.05)	5.83	(1.78)	59.94	(25.24)
2000	13.27	(4.54)	3.94	(2.09)	0.17	(0.05)	5.87	(1.80)	60.42	(24.93)
2001	14.02	(4.79)	4.15	(2.24)	0.17	(0.05)	5.95	(1.77)	60.35	(24.47)
2002	14.85	(5.15)	4.40	(2.32)	0.17	(0.05)	5.96	(1.78)	59.81	(24.83)
2003	15.72	(5.47)	4.72	(2.55)	0.17	(0.05)	5.98	(1.77)	59.95	(24.50)
2004	16.32	(5.62)	4.82	(2.55)	0.17	(0.04)	6.01	(1.74)	59.76	(24.43)
2005	16.99	(5.92)	5.22	(2.81)	0.18	(0.05)	6.03	(1.70)	61.40	(23.40)
2006	17.74	(6.11)	5.44	(2.98)	0.17	(0.05)	6.06	(1.72)	60.66	(23.51)
2007	18.76	(6.41)	5.65	(3.06)	0.17	(0.05)	6.10	(1.68)	60.61	(23.89)
2008	19.78	(6.87)	6.08	(3.34)	0.17	(0.04)	6.10	(1.69)	60.77	(23.74)
2009	20.91	(7.25)	6.29	(3.45)	0.17	(0.04)	6.15	(1.68)	60.72	(23.04)
2010	21.73	(7.55)	6.53	(3.49)	0.17	(0.04)	6.21	(1.65)	60.84	(23.17)
2011	22.50	(7.62)	6.80	(3.75)	0.17	(0.04)	6.25	(1.66)	60.27	(23.64)
2012	23.46	(8.11)	7.09	(3.86)	0.17	(0.05)	6.29	(1.67)	60.32	(22.95)
2013	24.25	(8.23)	7.30	(4.02)	0.17	(0.05)	6.29	(1.65)	59.63	(23.03)
2014	25.24	(8.72)	7.61	(4.16)	0.17	(0.04)	6.35	(1.67)	58.94	(23.13)
2015	26.20	(9.12)	7.81	(4.28)	0.17	(0.04)	6.37	(1.68)	58.78	(23.12)
2016	27.27	(9.53)	7.85	(4.48)	0.16	(0.04)	6.43	(1.64)	58.27	(23.27)
2017	28.23	(9.70)	8.03	(4.55)	0.16	(0.04)	6.45	(1.66)	57.56	(23.74)
2018	29.38	(10.04)	8.34	(4.74)	0.16	(0.04)	6.52	(1.62)	57.30	(23.80)
2019	30.90	(10.67)	8.34	(4.79)	0.15	(0.04)	6.55	(1.63)	57.23	(23.71)
All Years	20.15	(9.25)	5.97	(3.76)	0.17	(0.05)	6.14	(1.72)	6.14	(1.72)

Figure 5-2 depicts the average of each dependent variable among occupation-provinces that are unlicensed, licensed prior to 1997, and licensed on or after 1997. Regarding wages, it is clear that older licensed occupation-provinces have the highest values and experience a slightly steeper slope. For the newly licensed this is also true, but to a lesser degree. It is noteworthy that both license groups seem to diverge from the unlicensed over time, particularly in the standard deviation measure. The higher wage values among licensed occupations-provinces are reflective of the commonly observed wage premium associated with licensing, and are not surprising. It is interesting however, that the differences between the newly licensed and unlicensed appear to grow over time. Keep in mind that the licensing classification is not time varying, so the occupation-provinces in the new group become licensed over time. The fact that the line representing the average of these values also increases relative to the unlicensed over time suggests that licensing is having an positive effect on these measures, and more so as more become licensed. When we look at the average education measure in Figure 5-2 it is clear that there are significant overall differences between licensed and unlicensed occupation-provinces. However, there is very little difference in the slopes, and the licensed may actually be shallower. This could partially be due to a ceiling effect but it does raise the question of whether licensed occupations experience enough change in education that it would be able to explain changes in wages. The final graph depicting variance of education displays an inverse pattern to that of education level, but with more instability among the licensed. While it is clear that regulated occupations have less variation in education, as expected, it is not clear that any of the three groups experience a substantially different rate of change over time. So, it appears that either the enactment of new licensed has no effect on educational variability or if it does it is not detectable in the available data.

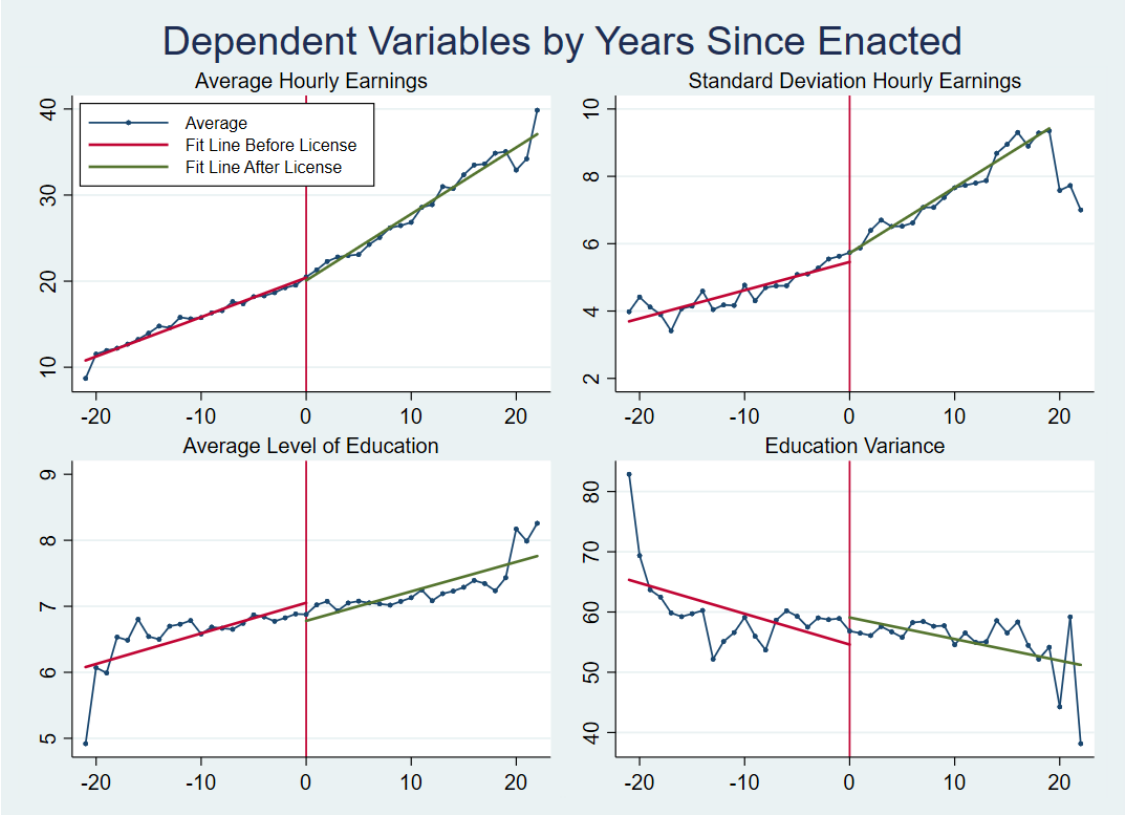
Figure 5-2



Based on the above it is clear that the date of enactment is an important factor in the effects of licensing among those occupation-provinces licensed on or after 1997. Additionally, as indicated by Figure 5-1 we know that at least one license has been enacted in every year since long before 1997 excluding only 2019. Given the fact that enactments of new licenses are spread out across this time period, identifying the effect of enactment may be difficult when looking at annual data. An alternative that addresses this problem is to provide average measures of key variables pooled around the year of enactment. While there is no way to compare these results to old and unlicensed occupations, the graphs in Figure 5-3 provide the average of each variable as well as a line of best fit in the years before and after enactment among the 132 newly licensed occupations. This gives us a nice visual representation of a change in the growth pattern of these averages once a license has been enacted. There are two things to note about these results. First, counter to expectations there is no interruption in the wage levels of newly licensed occupations. Instead the averages as well as the fit lines suggest a clear pattern of acceleration in both average and standard deviations of wages after enactment. Second, when it comes to education level or

variance it appears that there is no detectable post-enactment change in levels of education on average among newly licensed occupations. These graphs clarify the results of the annual figures from Table 5-4, and suggest a pattern of acceleration in average wage measures after enactment. They also confirm the lack of change in education after enactment, at least when level of education is calculated as a simple average and V2s coefficient among all 132 newly licensed occupation-provinces.

Figure 5-3



In order to understand the effects of occupational licensing in the context of modern Canada, it may be helpful to examine the characteristics of occupations that have more recently become licensed, particularly in the last few decades. The section below contains an exploration of the characteristics of newly licensed occupations as well as a comparison to older licensed occupations. This will provide insight regarding the observed differences in the outcomes of old and newly licensed occupations in Figure 5-2 as well as the wage and education effects of newly enacted licenses in Figure 5-3.

Analysis

Growth Curve Analysis Wages-Annual Models

The dependent variables are the average and standard deviation of hourly earnings. The models are two level hierarchical linear models consisting of repeated observations on the outcome variables among occupation-provinces in each year from 1997 to 2019. The null and unconditional growth models in Appendix 5B include variance components and coefficients for time that describe the general pattern of change and variation in wages among occupation-provinces in this time period. The intra-class correlation calculated from these models ranges from .44 for the null model to .48 for the unconditional random effects growth model indicating that a significant portion of wage variability occurs between occupation-provinces. This indicates that almost half of wage variability occurs between occupation-provinces when we control for the effects of time. Additionally, the coefficients of .62 and .01 for time and time squared indicate that wage growth is upward sloping and slightly concave. This pattern remains consistent across the models included in this analysis.

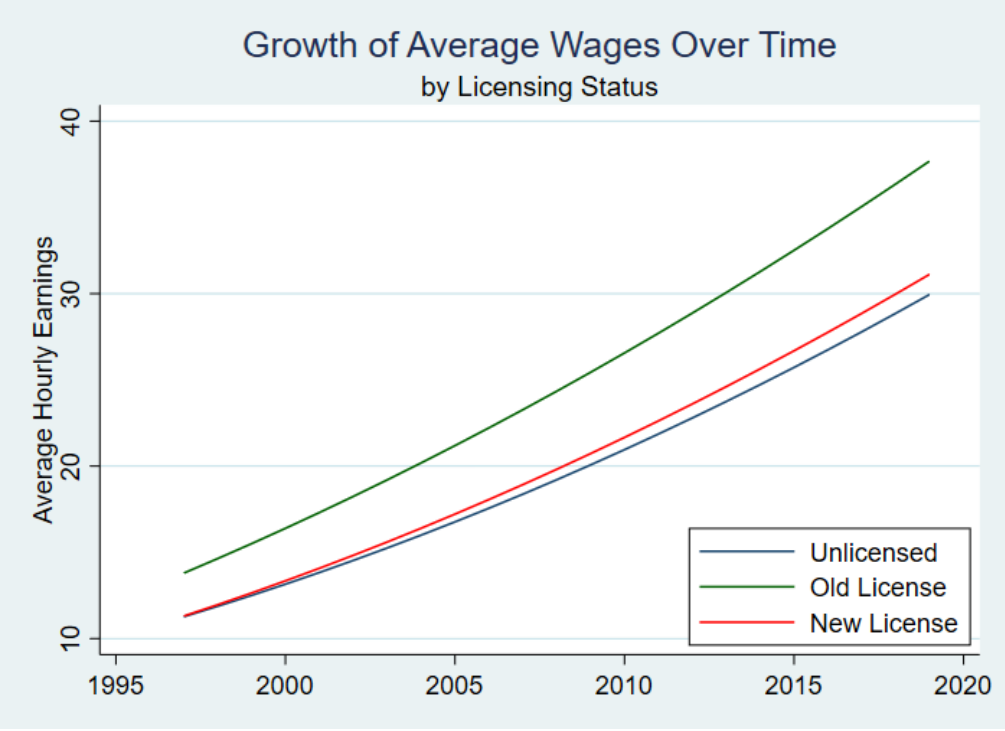
Table 5-5: Average Wage Models with Old and New License Effects

	License		Years Enacted		Interaction	
	B	SE	B	SE	B	SE
Time	0.595	(0.008) ***	0.595	(0.007) ***	0.594	(0.008) ***
Time^2	0.012	(0.000) ***	0.012	(0.000) ***	0.012	(0.000) ***
Old License	2.528	(0.188) ***	1.049	(0.272) ***	1.073	(0.272) ***
New License	0.039	(0.337)	0.193	(0.337)	0.533	(0.409)
Old License#Time	0.237	(0.017) ***	0.202	(0.018) ***	0.203	(0.018) ***
New License#Time	0.051	(0.026) *	0.034	(0.026)	-0.006	(0.038)
Years Enacted			0.035	(0.005) ***		
Old License#Years Enacted					0.035	(0.005) ***
New License#Years Enacted					0.116	(0.055) *
Constant	11.264	(0.059) ***	11.264	(0.059) ***	11.264	(0.059) ***
SD (Time)	0.285	(0.004) ***	0.285	(0.004) ***	0.284	(0.004) ***
SD (Time^2)	0.008	(0.000) ***	0.008	(0.000) ***	0.008	(0.000) ***
SD (Constant)	3.444	(0.041) ***	3.424	(0.041) ***	3.424	(0.041) ***
SD (Residual)	3.443	(0.008) ***	3.443	(0.008) ***	3.443	(0.008) ***
LL	-302261		-302233		-302232	

Table 5-5 includes mean wage growth models with licensing characteristics as occupation-province level covariates. In each of these models the coefficient for Old License functions as a time invariant covariate (TIC). These coefficients describe the pattern of change among a group of occupation-provinces that does not change in the 1997 to 2019 period. The

main effect indicates that occupations with old licenses have higher average wages and the interaction with time indicates that they experience a higher rate of change in wages over time compared to unlicensed occupation-provinces. The coefficient for New License functions as a time varying covariate (TVC), and so those occupation-provinces included in this group can join this group at any time between 1997 and 2019. In this case the coefficient refers to a change in the average wage pattern once an occupation-province becomes licensed. The main effect is non-significant suggesting that newly licensed occupations do not experience an immediate change in wages (the interruption or jump in wages expected based cross-sectional studies of licensing). The time interaction is however significant, suggesting that newly licensed occupations do see a change in the rate of wage growth amounting to .05/hour/year (amounting to 50 cents an hour after ten years) on average after a license is enacted. The wage effects of licensing can be seen in Figure 5-4 which clearly depicts the overall higher average wage among older licensed occupation-provinces, as well as both the lack of a difference at the intercept and the slightly different slope between newly licensed and unlicensed occupation-provinces.

Figure 5-4



The other models in this table introduce years since a license was enacted giving us a measure of wage differences based on how long an occupation-province has been licensed. For new licences this measures something similar to the effect of time but actually represents the effect of time passing after enactment for all those with new licenses. The time interaction however, measures the effect of time passing among newly licensed occupation-provinces that are licensed at that specific point in time only. Note that the New License time interaction is non-significant in the models with years enacted included, suggesting that these two effects, while similar in terms of what they measure, years enacted appears to be statistically stronger. These likely reflect the fact that, years since enactment measures the amount of time since the enactment of a license independent of when it is enacted. The new licensed time interaction on the other hand measures the average slope of occupation-provinces that have been licensed. The implication of this is that the amount of time that has passed since enactment is important to the wage effects of licensing among occupation-provinces licensed in this era.

For old licenses, the main effect is more consistent and significant across each model in Table 5-5, indicating that older licenses do tend to have higher wages by between 1.0 and 2.5$/hour on average. We can also see from the change in the old license main effect and old license time interaction that some of the wage differences in the License model can also be explained by the years enacted. This is indicated by the fact that the old licence effects are reduced to 1.4$/hour and 0.2$/hour/year (amounting to $2 after ten years). Overall this indicates that among older licensed occupations, being licensed for longer is generally associated with higher average wages when compared to unlicensed or more recently licensed occupations. Given the years enacted effects, these wage differences would seem to be the result of licensed occupations experiencing a post-enactment change in the rate of wage growth, indicating that the wage premium generally associated with licensing in cross-sectional analyses arises due to this occurring over a long period of time.

Table 5-6 adds variables for average level of education which functions as a time varying covariate and may explain some of the wage effects of licensing. The first model includes only education at the occupation-province level and indicates that education is generally associated with higher wages (.58/hour/level). In the second model, licensing effects and their interactions with time are added and can be compared to the License model from Table 5-5. The coefficient

for old license is smaller in this model, suggesting that some of the initial wage premium associated with old licences may be explained by differences in education among those occupation-provinces. In the 3rd model, the inclusion of an interaction of licensing and education leads to a notable change in the estimated license effects. The old license effect is rendered non-significant, while the license-education interactions are significant for unlicensed, as well as new and old license ranging from 0.56$/hr to 0.83/hr. Specifically regarding the old licences, the fact that the main effect is now non-significant could indicate that the entire initial wage premium associated with old licenses is due to education. However, it is important to keep in mind the characteristics of these occupation-provinces. Recall from the previous section (Table 5-1) that old licences have consistently high levels of education (likely with very limited change) while also experiencing no change in licensing since 1985 (in this case 1997). So, in these occupation-provinces licensing does not change at all while education is both consistently high among most and likely changes very little, so there is very little variability in education and licensing among older licensed occupations. This means that without more historical data from the time of their enactment it is not possible to determine the causal relationship between licensing, education, and wages among those occupations with old licenses.

Table 5-6: Average Wage Models with Education Effects

	Education: Main			License and Education			Years Enacted		
	B	SE		B	SE		B	SE	
Time	0.598	(0.007)	***	0.576	(0.007)	***	0.576	(0.007)	***
Time^2	0.012	(0.000)	***	0.012	(0.000)	***	0.011	(0.000)	***
Mean Level of Education	0.584	(0.012)	***	0.569	(0.012)	***			
Old License				1.475	(0.169)	***	-0.472	(0.435)	
New License				-0.050	(0.330)		-1.400	(0.827)	
Old License#Time				0.244	(0.017)	***	0.218	(0.018)	***
New License#Time				0.058	(0.026)	*	-0.002	(0.037)	
Unlicensed#Education							0.556	(0.013)	***
Old License#Education							0.687	(0.052)	***
New License#Education							0.827	(0.108)	***
Old License#Years Enacted							0.024	(0.004)	***
New License#Years Enacted							0.109	(0.055)	*
Constant	8.117	(0.088)	0.000	8.074	(0.088)	0.000	8.145	(0.090)	0.000
SD (Time)	0.295	(0.004)	0.000	0.284	(0.004)	0.000	0.283	(0.004)	0.000
SD (Time^2)	0.008	(0.000)	0.000	0.008	(0.000)	0.000	0.009	(0.000)	0.000
SD (Constant)	3.001	(0.038)	0.000	2.980	(0.038)	0.000	2.975	(0.038)	0.000
SD (Residual)	3.431	(0.008)	0.000	3.431	(0.008)	0.000	3.430	(0.008)	0.000
LL	-301463			-301295			-301268		

Among newly licensed occupation-provinces, the effects of education appear to be less pronounced. The introduction of education main effect in the License and Education model does render the time interaction non-significant, but has little effect on years enacted, suggesting that when we control for education the wage slope of occupation-provinces after enactment is still different from unlicensed occupations. The limited effect of education among new licensed occupation-provinces is further indicated in the Education Time Effect model, where the license-education-time interaction is non-significant for new license only. This indicates that among newly licensed occupation-provinces the effect of education on the wage growth rate is nil, while education has a small positive effect on wage growth for unlicensed and especially older licensed occupation-provinces. Overall it is clear that education has an effect on wages, regardless of licensing. Among older licensed occupations it is unclear whether it is licensing or education that explains their higher average wages, while among the new it appears that licensing has effects that are independent of education, though it is possible that the available data do not cover a long enough time period to fully account for the education effects of newly enacted licenses. This will be examined further below (see education models).

The other major occupation-province variable that could shape the wage effects of licensing is coverage; the proportion of the occupation's workforce across Canada that is required to hold a license. Table 5-7 displays models which include licensing coverage as a percentage broken down into ordered categories. The Conditional Coverage model includes only coverage for new and old licenses separately in addition to time and indicates that generally, independent of time, higher coverage is associated with higher wages, ranging from 1.9$ up to 3.5$ among old licensed occupation-provinces that have achieved full coverage. The effects follow the same pattern among new licenses but with smaller effects ranging from near 0 up to 2.4$ among those with less than full coverage and 1.5$ among those with 100%.

Table 5-7: Average Wage Models with Coverage Effects

	License Effects and Coverage		Conditional Coverage		License Effects and Conditional Coverage	
	B	SE	B	SE	B	SE
Time	0.594	(0.008) ***	0.612	(0.007) ***	0.592	(0.008) ***
Time^2	0.012	(0.000) ***	0.012	(0.000) ***	0.012	(0.000) ***
1-<20%	0.134	(0.138)				
20-<40%	0.440	(0.141) **				
40-<60%	0.598	(0.148) ***				
60-<80%	0.967	(0.173) ***				
80-99%	1.199	(0.188) ***				
100%	1.038	(0.201) ***				
Old License	1.658	(0.235) ***			2.911	(0.220) ***
New License	-0.434	(0.345)			0.811	(0.531)
Old License#Time	0.233	(0.018) ***			0.233	(0.018) ***
New License#Time	0.069	(0.026) **			0.075	(0.027) **
Old License1-<20%			1.852	(0.492) ***	-1.116	(0.508) *
Old License20-<40%			2.175	(0.290) ***	-0.887	(0.305) **
Old License40-<60%			2.416	(0.248) ***	-0.706	(0.259) **
Old License60-<80%			2.842	(0.236) ***	-0.479	(0.224) *
Old License80-99%			3.246	(0.215) ***	-0.193	(0.163)
Old License100%			3.480	(0.215) ***	0.000	
New License#1-<20%			0.188	(0.457)	-1.257	(0.624) *
New License#20-<40%			0.996	(0.382) **	-0.446	(0.561)
New License#40-<60%			0.700	(0.346) *	-0.741	(0.524)
New License#60-<80%			0.865	(0.337) *	-0.528	(0.483)
New License#80-99%			2.433	(0.363) ***	1.016	(0.441) *
New License#100%			1.510	(0.449) ***	0.000	
Constant	11.225	(0.060) ***	11.173	(0.060) ***	11.209	(0.060) ***
SD (Time)	0.285	(0.004) ***	0.292	(0.004) ***	0.285	(0.004) ***
SD (Time^2)	0.008	(0.000) ***	0.008	(0.000) ***	0.008	(0.000) ***
SD (Constant)	3.429	(0.041) ***	3.408	(0.041) ***	3.424	(0.041) ***
SD (Residual)	3.443	(0.008) ***	3.443	(0.008) ***	3.442	(0.008) ***
LL	-302238		-302300		-302211	

In the License Effects and Coverage model, the inclusion of main licensing effects and time interactions result in smaller effects for coverage and a smaller effect for old licenses when compared to the 'License' model from Table 5-5. This is similar to the observed effect of including education, and therefore suggests that coverage could explain some of the initial wage premium among older licensed occupation-provinces but has no apparent effect on the rate of wage growth which is very similar to earlier results.

This is further indicated in the final model which includes conditional coverage as well as the main licensing effects and their interactions with time. In this model the coverage effects refer to the effect of coverage at the intercept, relative to the base category of 100% which is why they are mostly negative. The important thing to note about these results is that the effect of

coverage is either much smaller in size or non-significant especially among newly licensed occupation-provinces. This suggests that coverage only explains a small portion of the initial wage premium associated with older licenses, while among the newly licensed there are virtually no initial wage differences (at the intercept) to explain, so the lack of coverage effects here is expected. It is also worth noting that the inclusion of coverage categories has no effect on the new and old license time interaction effects. Coverage interactions with time were tested and found to be almost entirely non-significant. This and the lack of change in the old and new license time interactions suggest that coverage does not explain differences in wage growth among old or new licensed occupation-provinces in the 1997 to 2019 period.

Table 5-8: Standard Deviation Wage Models with Old and New License Effects

	Unconditional Growth			License Effects			Years Enacted Interaction		
	B	SE		B	SE		B	SE	
Time	0.091	(0.010)	***	0.081	(0.010)	***	0.088	(0.010)	***
Time^2	0.017	(0.001)	***	0.017	(0.001)	***	0.017	(0.001)	***
Time^3	-0.001	(0.000)	***	-0.001	(0.000)	***	-0.001	(0.000)	***
Old License				0.730	(0.081)	***	-0.246	(0.115)	*
New License				-0.081	(0.190)		0.221	(0.129)	
Old License#Time				0.107	(0.008)	***			
New License#Time				0.036	(0.013)	**			
Years Enacted									
Old License#Years Enacted							0.028	(0.002)	***
New License#Years Enacted							0.037	(0.018)	*
Constant	3.541	(0.030)	***	3.477	(0.031)	***	3.461	(0.031)	***
SD (Time)	0.146	(0.002)	***	0.142	(0.002)	***	0.142	(0.002)	***
SD (Constant)	1.349	(0.019)	***	1.329	(0.019)	***	1.304	(0.019)	***
SD (Residual)	2.260	(0.005)	***	2.260	(0.005)	***	2.261	(0.005)	***
LL	-252354			-252186			-252175		

An often overlooked potential effect of licensing is its impact on wage variability within licensed occupations. Table 5-8 includes growth models for the standard deviation of wages among occupation provinces in the same period as above. The first two models indicate that the growth pattern in wage variability closely resembles that of average wages. Old occupations have an initial standard deviation that is higher than unlicensed occupation-provinces amounting to 0.73$/hour, while newly licensed occupation-provinces do not. Both old and new however, have small but noticeably higher rates of growth in wage variation (.11$/hour and .04$/hour respectively). This can also be seen in the years enacted interaction model, and this effect suggests that newly licensed occupation-provinces experience an acceleration of growth in wage variability much like they do in mean wages at a rate of .04$/hour/year enacted. One potential

explanation for this is that licensing simultaneously raises wages for some while also creating an unlicensed sector within the occupation where wages would be relatively low, and the combination of these effects would result in higher and increasing within-occupation wage inequality when compared to unlicensed occupation-provinces. It is also possible that wages tend to vary more in occupations with higher average wages simply because there is more room for variability.

Growth Curve Analysis of Education-Annual Models

The analysis of the wage effects of licensing in the previous section suggests that education has some association with the wage premium often seen among older licensed occupations, but education appears to have limited effects on newly licensed occupation-provinces. In order to uncover the relation between the enactment of a new license and education in an occupation, and hopefully its subsequent effect on wages, this section explores the effects of licensing on education itself. This section includes growth models of both average and variation in level of education on licensing characteristics. Table 5-9 includes three models of average level of education on similar licensing characteristics from the wage models above. Across each of these variables three things remain consistent. The first is the coefficient for Time, indicating that unlicensed occupation-provinces experience a slow upward trend in levels of education, equating to almost one full level on average across the '97 to 2019 period.

Secondly, variance components are very similar across each of the models, with the SD(Constant) in particular suggesting that there is significant variation between occupation-provinces in average level of education. The fact that these components remain so similar indicates that none of the models explain significantly different proportions of this variance.

Table 5-9: Education Models with Old and New License Effects

	License			License and Years Enacted Interaction			Interaction and Time		
	B	SE		B	SE		B	SE	
Time	0.035	(0.001)	***	0.034	(0.001)	***	0.035	(0.001)	***
Old License	1.861	(0.074)	***	1.790	(0.095)	***	1.221	(0.107)	***
New License	0.062	(0.072)		0.014	(0.045)		0.008	(0.092)	
Old License#Time	-0.014	(0.002)	***				-0.029	(0.003)	***
New License#Time	-0.006	(0.004)					0.000	(0.008)	
Old License#Years Enacted				0.000	(0.001)		0.015	(0.002)	***
New License#Years Enacted				-0.007	(0.005)		-0.008	(0.008)	
Constant	5.596	(0.022)	***	5.603	(0.022)	***	5.596	(0.022)	***
SD (Time)	0.023	(0.001)	***	0.023	(0.001)	***	0.023	(0.001)	***
SD (Constant)	1.444	(0.015)	***	1.445	(0.015)	***	1.434	(0.015)	***
SD (Residual)	0.807	(0.002)	***	0.807	(0.002)	***	0.807	(0.002)	***
LL	-142811			-142841			-142777		

Finally, the coefficient for Old License is the only large effect observed in these models, indicating that occupation-provinces licensed prior to 1997 have a distinctly higher average level of education compared to the unlicensed amounting to between one and two levels. However, the coefficients for New License are non-significant suggesting that the enactment of a new license has had little effect on education levels among these occupations within this time period. Note also that the time interactions are very small and either not significant or negative, suggesting that the rate of change in licensed occupation-provinces is either not different or is slower when compared to unlicensed occupation-provinces, amounting to around one third of a level across the entire 23 year period. Part of this may simply be due to a ceiling effect imposing limits on change in education among old licensed occupation-provinces in particular. Overall it appears that the relationship between licensing and education is weak enough to raise doubts that there is a causal relationship between the two. It is possible that the impact of licensing on education unfolds over a very long time and the limited timeframe of these data prevent adequate measurement of its effect. So if average level of education is positively affected by a newly enacted license, it may only be apparent when measured over much more than a 23 year period.

Table 5-10 includes three models of variability of education with the V2s coefficient (on a 0 to 100 scale) as the dependent variable. There are a few things to note about these models. First, the coefficients for time suggest a general downward trend in the variability of education across unlicensed occupation-provinces. With a value of approximately -0.17 in the linear model, the effect appears small as a per year effect, but across 10 years this would amount to a drop of 1.7 on the 0 to 100 scale, and across multiple decades this could amount to a substantial

transformation in the pattern of educational attainment in the Canadian labour market. It is also worth noting that while the quadratic time effect is statistically significant, it is small in size, suggesting that the pattern of change in education variance is initially positive but curves downward over time to a small degree.

A second thing to note is that some of the variance components are surprisingly large in size. The SD(Constant) of 14 indicates significant variation in education variability at the intercept (time=0), indicating generally large differences in the variance of education between occupation-provinces. The SD(Time) effect is also substantial. With a value of 0.56 to 0.51 and the average effect of time varies between occupations, with a large portion being in the range of -0.17 plus or minus 0.56 in the linear model, or 0.26 plus or minus 0.51, indicating that some occupation-provinces do not experience significant change in education variability at all, while others experience a modest rate of change.

Table 5-10: Education Variability Models with Old and New License Effects

	Linear Model			Linear Time Interaction			Quadratic Time Interaction		
	B	SE		B	SE		B	SE	
Time	-0.171	(0.011)	***	0.233	(0.026)	***	0.260	(0.027)	***
Time^2				-0.018	(0.001)	***	-0.020	(0.001)	***
Old License	-10.743	(1.093)	***	-10.746	(1.091)	***	-9.744	(1.129)	***
Old License#Time	0.092	(0.036)	*	0.088	(0.036)	*	-0.198	(0.090)	*
Old License#Time^2							0.013	(0.004)	***
New License	-0.556	(1.279)		-2.389	(1.296)		-2.585	(2.164)	
New License#Time	0.093	(0.078)		0.215	(0.081)	**	0.236	(0.316)	
New License#Time^2							0.000	(0.011)	
Constant	60.263	(0.325)	***	58.859	(0.335)	***	58.768	(0.336)	***
SD (Time)	0.561	(0.010)	***	0.510	(0.016)	***	0.511	(0.016)	***
SD (Time^2)				0.012	(0.001)	***	0.012	(0.001)	***
SD (Constant)	14.060	(0.032)	***	14.026	(0.032)	***	14.025	(0.032)	***
SD (Residual)	21.107	(0.226)	***	21.061	(0.225)	***	21.061	(0.225)	***
LL	-452894			-452742			-452736		

The final thing to note of these models is the old and new license effects. It is immediately clear from the main licensing effects that occupation-provinces with old licenses have substantially less variation in education when compared to the unlicensed, amounting to somewhere between 9.7 and 10.7. This is not surprising, as we established in the previous section, these occupation-provinces represent classic licensed professions that have well established and specific educational requirements. Among new licenses however, there appears to be no statistically significant difference in the main effect of education variance when

compared to unlicensed occupation-provinces. When it comes to the time interaction effects, New License remains non-significant except for the simple linear time interaction. However, this is rendered non-significant in the quadratic model indicating that newly licensed occupation-provinces likely do not experience a different rate of change in education variance when compared to the unlicensed. Occupation-provinces with older licenses however, do appear to experience a significantly different linear rate of decline in V2s relative to unlicensed occupation-provinces based on how this effect changes across the three models. The combination of the small positive linear time effect in Models 1 and 2 with the -0.198 in Model 3 suggest a linear rate of change very near zero, but with a small upward curve. So, we can conclude that generally, education variance is in a slow decline, newly licensed occupations barely differ from the unlicensed and old licensed occupations may experience almost no change in education variance at all. This suggests that older licensed occupations likely have well established credential requirements and thus do not experience much change in their already lower education variance. Additionally, there is a slow general trend toward lower education variance in unlicensed occupations, and the enactment of new licenses appears to have almost no effect relative to the unlicensed within the time period covered by these data. So, if licensing does exert influence on education within an occupation-province, it would seem to do so only over a very long period of time.

Growth Curve Models Pooled Around Date of Enactment

The annual models above imply that newly enacted licenses have small effects on wages. It appears that the growth rate of newly licensed occupation-provinces (the New License Time interaction) is mostly non-significant, but the years-enacted effect is more consistently significant and positive, resulting in some uncertainty about the causal wage effects of a newly enacted license. This stems from the fact that in these models what is happening is that those occupation-provinces that become licensed leave the Unlicensed group to join the New License group over the course of the years included in the data. So the main New License effect represents a difference of average wages between all unlicensed occupation-provinces and the seven that are newly licensed as of 1997. Meanwhile, the New License Time interaction could indicate one of two things. First, it may be that those occupation-provinces that become licensed represent those with the highest wage growth rate among the unlicensed. So, the effect of a newly licensed occupation-province joining the licensed group leads to a shift in mean wage of

that group as more occupation-provinces join. Second, it may be that the observed New License Time interaction effect is due to an acceleration of wage growth caused by the social closure effects of a newly enacted license. It is difficult in an annual model to determine which of these is correct. An alternative approach that can address this issue is to model wage growth among newly licensed occupation-provinces pooled around the date of enactment. This will illuminate the true average wage effect of a newly enacted license among these occupation-provinces regardless of when that enactment occurs.

The pooled models included in this section are, like those above, growth curve models with repeated observations of average wages (along with other dependent variables) among occupation provinces, and they include similar occupation-province level covariates. They differ in that they model change in average wages over time leading up to and after the enactment of a new license, independently of when in time that license was enacted. This is accomplished using years enacted (with negative values included to capture the years prior to enactment), which is included in this model as a two part spline. The first segment titled "Before Enactment" is a simple linear effect capturing average wages among occupation-provinces in each year before their license is enacted, and the second segment titled "After Enactment" captures linear growth in averages wages in the years after enactment. There are two things to note about these models. First, the models only include the 134 occupation-provinces that experience a change in licensing between 1997 and 2019, so comparison to other kinds of occupation-provinces is not possible. Second, there are some occupation-provinces that contribute little to no information to the before or after enactment effects. For example, an occupation-province licensed in 1997 will have no years prior to enactment. This means the sample size gets smaller at the highest and lowest values of years enacted. Despite these limitations, these models can address the uncertainty in the annual model and demonstrate the true wage and education effects of newly enacted licenses in this time period.

Table 5-11 displays the results of the average wage models pooled by years enacted. The first thing to note is the variance components which remain consistent across all the models. The SD(Constant) is large, indicating substantial variation in average wages at the time of enactment which is not surprising given that this represents wages at different points in time. The other thing that is interesting is that the SD(After Enactment) is consistently larger than the Before

suggesting a general increase in slope (wage growth rate) variability after enactment, and while it appear small in size, across many years a value of .3 could result in substantial differences in average wages. Looking at the main effect model, we can see that on average there is a change in average growth rate of wages among these occupation-provinces after enactment. We can conclude that on average occupation-provinces licensed in this time period experience an increase in the growth of wages amounting to 0.267 per year, which would result in a large wage premium after many years, assuming a continuation of this pattern. This is graphically represented in Figure 5-5, with the blue line representing average wages before enactment and the red line after. The post enactment change in wage growth is small but visually distinguishable.

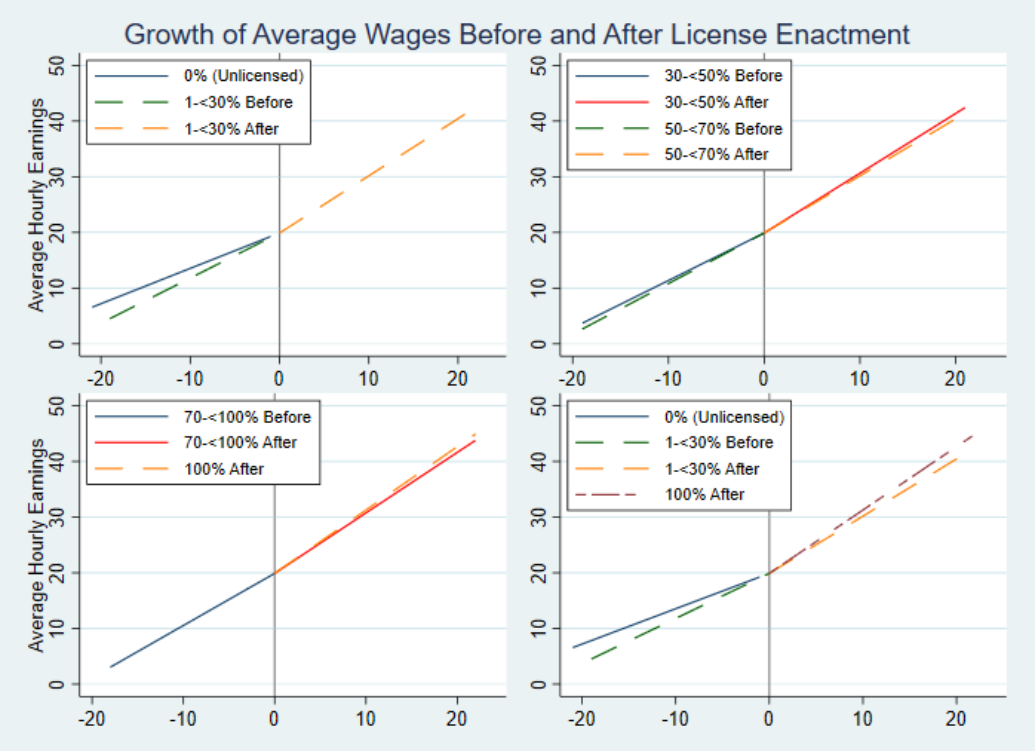
Table 5-11: Average Wage Models Pooled by Years Since Enacted

	Main Effect			By Coverage			Before and After Enactment with Education		
	B	SE		B	SE		B	SE	
Before Enactment	0.817	(0.035)	***	0.633	(0.070)	***	0.804	(0.086)	***
After Enactment	1.084	(0.036)	***				0.466	(0.101)	***
1-<20%#Before Enactment				0.168	(0.077)	*			
20-<40%#Before Enactment				0.207	(0.078)	**			
40-<60%#Before Enactment				0.247	(0.078)	**			
60-<80%#Before Enactment				0.336	(0.089)	***			
80-99%#Before Enactment				0.276	(0.104)	**			
100%#Before Enactment				0.000					
1-<20%#After Enactment				0.964	(0.059)	***			
20-<40%#After Enactment				1.042	(0.052)	***			
40-<60%#After Enactment				0.971	(0.049)	***			
60-<80%#After Enactment				0.996	(0.045)	***			
80-99%#After Enactment				1.159	(0.043)	***			
100%#After Enactment				1.183	(0.046)	***			
Mean Level of Education#Before Enactment							0.003	(0.012)	
Mean Level of Education#After Enactment							0.084	(0.013)	***
Constant	19.840	(0.597)	***	19.925	(0.598)	***	19.901	(0.592)	***
SD (Before Enactment)	0.262	(0.030)	***	0.252	(0.030)	***	0.252	(0.030)	***
SD (After Enactment)	0.341	(0.030)	***	0.334	(0.030)	***	0.333	(0.030)	***
SD (Constant)	6.800	(0.427)	***	6.806	(0.428)	***	6.743	(0.424)	***
SD (Residual)	3.124	(0.043)	***	3.103	(0.042)	***	3.106	(0.042)	***
LL	-8248			-8226			-8226		

The model including measures of coverage elaborates on the Main Effect model by including separate before and after growth rates based on level of coverage. The main before enactment effect now represents the wage growth rate among occupation-provinces in completely unlicensed occupations prior to becoming licensed. The Before Enactment coverage interactions represent the average pre-enactment wage growth rates of occupation-provinces in

occupations with existing licenses in other regions relative to those in occupations with no licenses. So, the predicted pre-enactment wage growth rate of occupation-provinces with 1 to <20% coverage is 0.801 (0.633 + 0.168). Each of the After Enactment interactions simply describes the average post enactment growth rate based on coverage level.

Figure 5-5



There are two important things to note about these results. First, all of the After Enactment effects are positive and much larger than all of the Before Enactment effects. This is not surprising and indicates that newly enacted licenses lead to higher wage growth rates and this effect is stronger if that enactment results in increased licensing coverage. This can be seen in Figure 5-5 where the highest post enactment coverage groups appear to have the steepest slope, particularly noticeable when compares to the unlicensed group. Second, it is surprising that the pre-enactment coverage effects are all positive and significant. This indicates that occupation-provinces have a higher wage growth rate before becoming licensed themselves, if that occupation is licensed in another province. This may reflect the possibility that those occupations that are experiencing the expansion of existing licenses have certain unmeasured characteristics that distinguish them from those that are becoming licensed for the first time (as

suggested by the discussion of Modern Licensing in Canada above). Alternatively, these pre-enactment coverage effects could indicate a within occupation wage spillover effect from licenses in other provinces. Overall, it is clear that coverage has a substantial moderating influence on the wage effects of licenses being enacted in this time period.

The third model in Table 5-11 includes mean level of education and is intended to determine if there is a change in the wage effects of education after a license is enacted. The Before Enactment effect is similar in size to the Main Effect model and the mean level of education Before Enactment interaction is non-significant. This suggests that prior to enactment differences in the level of education between occupation-provinces are not associated with differences in average wage growth rates. However, the After Enactment interaction is statistically significant and the main After Enactment effect is reduced in size. This suggests that a portion of the increased wage growth rate after enactment can be explained by the mean level of education. Put simply, education is associated with higher wage growth after but not before enactment on average, among these 134 occupation-provinces. This could reflect the hypothesized formalization of educational credentials caused or affected by the enactment of a new license which would suggest a social closure effect occurring through education. It is important to keep in mind that the effect size is small, amounting to 0.084 per level of education per year. So, the actual wage effect of education after a license enactment would only amount to a substantive difference in wages over a large number of years, and it is also dependent on the extent to which the mean level of education in an occupation-province changes after enactment. The influence of newly enacted licenses on education is explored in the models below.

Table 5-12: Education Mean and Variance Models Pooled by Years Since Enacted

	Mean Education			Mean Education By Coverage			Education Variance			Education Variance By Coverage		
	B	SE		B	SE		B	SE		B	SE	
Before Enactment	0.032	(0.006)	***				0.049	(0.123)				
After Enactment	0.026	(0.003)	***				-0.046	(0.066)				
1-<20%#Before Enactment				0.025	(0.010)	*				0.118	(0.205)	
20-<40%#Before Enactment				0.042	(0.007)	***				0.048	(0.160)	
40-<60%#Before Enactment				0.037	(0.007)	***				-0.129	(0.159)	
60-<80%#Before Enactment				0.024	(0.011)	*				-0.050	(0.233)	
80-99%#Before Enactment				0.015	(0.014)					0.187	(0.305)	
100%#Before Enactment				0.000						0.000		
1-<20%#After Enactment				0.015	(0.008)					0.174	(0.156)	
20-<40%#After Enactment				0.018	(0.007)	*				-0.007	(0.140)	
40-<60%#After Enactment				0.018	(0.007)	**				-0.010	(0.136)	
60-<80%#After Enactment				0.019	(0.006)	**				0.119	(0.118)	
80-99%#After Enactment				0.031	(0.005)	***				-0.167	(0.099)	
100%#After Enactment				0.034	(0.005)	***				-0.141	(0.100)	
Constant	6.943	(0.114)	***	6.947	(0.113)	***	57.006	(1.391)	***	56.930	(1.389)	***
SD (Before Enactment)	0.037	(0.006)	***	0.035	(0.006)	***	0.855	(0.120)		0.833	(0.121)	
SD (After Enactment)	0.018	(0.004)	***	0.017	(0.004)	***	0.328	(0.082)	***	0.293	(0.091)	***
SD (Constant)	1.296	(0.081)	***	1.281	(0.080)	***	15.266	(0.995)	***	15.231	(0.994)	***
SD (Residual)	0.661	(0.009)	***	0.661	(0.009)	***	13.333	(0.181)	***	13.330	(0.182)	***
LL	-3408			-3402			-12469			-12464		

Table 5-12 includes models that are similar to those in 6-11 but with education mean and variance as dependent variables. The Mean Education models are interesting because they appear to yield statistically significant effects of enactment on mean level of education. However, the difference in the size of the before and after enactment effects is so small that it suggests a lack of change in the average growth rate of wages after enactment. When the model is broken down by coverage the results are very similar but at the highest levels of coverage we do start to see statistically significant differences. These differences are still small in size such that after 10 years after enactment those occupation-provinces that achieve full coverage would experience a change in mean level of education amounting to 0.34 levels. So the overall effect of newly enacted licenses on levels of education appears to be limited to high coverage occupations and even then remains small in magnitude.

The coefficients in the education variance models are also interesting as they are all non-significant, indicating that the growth rate both before and after enactment is not statistically different from zero. This is somewhat surprising as we would expect a reduction in the variability of education if licensing led to the formalization of educational requirements. While there does not appear to be any change before or after enactment, the SD(Constant) is quite high

(15.2), indicating that there are significant differences in the variability of education between occupation-provinces. These results suggest that the licensing of an occupation does not lead to formalized educational requirements, in the time covered by these data. Overall, we can conclude that the enactment of a new license has limited effects on education, raising some questions about the observed wage effects are related to education, and suggesting that they may instead reflect the direct influence of licensing on wages among these occupation-provinces.

Discussion and Conclusions

Over the last three to four decades there has been a significant expansion of occupational licensing in Canada. My analysis has shown that this expansion is part of a modern trend in the Canadian labour market. As seen in Figure 5-2 and Table 5A-1, since 1997 there have been 136 new licenses enacted across Canada, and this number jumps to 301 if we go back as far as 1985. Some of the licensing in this period is the expanding coverage of existing licenses in occupations like, finance, trades, and paramedical, among others. Many are however, newly established licenses in previously unlicensed occupations with many of these being adjuncts to science and medical professions. This is interesting as it hints at both a connection to other related occupations with well established licenses, but also that licensing is for the first time occurring in lower skill and lower status occupations and in larger numbers. This indicates a significant change in the role and perception of licensing as a legitimate part of the regulatory and institutional landscape of the Canadian labour market.

It is also important to keep in mind the macro-economic and political context in which this modern trend and the possible change in the perception of licensing has occurred. In 1984 the Conservative party under the leadership of Brian Mulroney came to power. At this time the Conservative party was highly disposed to the ideas of neoliberalism including free trade, small government, and the retrenchment of social programs (Conway, 1999, p. 13). In 1993 the Chrétien Liberals came to power, but neoliberalism had become firmly established in Canadian politics, and this Liberal government proved to be even more fiscally conservative, significantly reducing transfers to the provinces for welfare, health, and education, as well as cutting funding to employment insurance and the federal public service (Conway, 1999). This political shift occurred alongside a number of notable changes in the global economy having significant effects on Canada. These include the expansion of free trade in the signing of the U.S. Canada Free

Trade Agreement (FTA) in 1989 and North America Free Trade Agreement (NAFTA) in 1994, changes in monetary policy that gave greater weight to inflation reduction than to unemployment, and finally increases in global prices for natural resources, especially energy (Jackson, 1999; Stanford, 2008). This combination of political and economic changes ushered in a number of notable transformations in the structure of the Canadian labour market with significant consequences for workers.

The most notable change in the Canadian labour market in this period can be seen in the loss of manufacturing jobs. According to Jackson (1999) 138,000 of the 290,000 manufacturing jobs lost between 1988 and 1996 can be attributed to the FTA (p.146). This trend continued into the next decade in which more than 400,000 jobs were lost in manufacturing between 2002 and 2008 (Stanford, 2008, p. 21). The conclusion that these job losses were due to a process of de-industrialization is indicated by the fact that many of these jobs were lost as a result of full or partial plant closures rather than temporary reductions to operations, for example, in 1992 61.3% of manufacturing job losses were due to plant closures compared to 24.2% in 1982 (Conway, 1999, p. 174). The structural transformation of the Canadian labour market is indicated by the decline in the share of employment in manufacturing from 16% to less than 12% between 1990 and 2007 (Conway, 1999, p. 21). During this time the combination of things like trade liberalization and increasing global prices for natural resources led to a shift of investment away from manufacturing toward natural resources. Canada's increased reliance on natural resource extraction did not however replace the jobs lost in manufacturing. Instead most jobs gained in the late 1990's were in low paid services, self employment and involuntary part-time (Jackson, 1999; Stanford, 2008). These changes had significant consequences for workers. Unemployment, which had been around 3% historically rose to 7.5% in 1989, peaking at 11% in the early 1990's (Conway, 1999, p. 174; Jackson, 1999, p. 141). Real personal income and unionization rates also stagnated in this period which contributed to increasing poverty and wage inequality. So, in addition to the fact that the occupations being licensed in this period are different from older ones, they have also been enacted in a dramatically different and rapidly changing economic and political context. It is important to keep this context in mind as a contributing factor that may explain why these occupations are being licensing at this time as well as shaping the wage effects of these new licenses.

Researchers and theorists have tended to have critical views of licensing, arguing that it functions as a social closure mechanism, employing exclusionary practices to restrict entry into certain positions within the division of labour in order to monopolize the economic opportunities associated with that position (including Kleiner & Krueger, 2010; Kleiner & Soltas, 2018; Sørensen, 1996; Weeden, 2002). This prominent theoretical perspective and the empirical evidence of a wage premium in many studies, in combination with the timing of this modern trend of licensing in Canada leads to the understandable expectation that licensing causes an artificial increase in wages in licensed occupations and that licensing has been a contributing factor in rising economic inequality observed in many countries during this time period. However, there has recently been some debate about whether or not licensing is responsible for the higher average wages observed in licensed occupations. Both Redbird (2017) and Zhang (2019) argue that with proper controls there is no wage premium associated with licensing. My own research (Chapter 3 and 4) has shown that much of the wage premium associated with licensing has been due to educational attainment, which tends to be high in licensed occupations. Much of the existing literature and my own research have been cross-sectional and Redbird's (2017) longitudinal analysis lacks occupation level controls for education, preventing any existing research from fully analyzing the complex relationship between these variables.

This chapter makes two contributions to the study of occupational licensing and its effect on labour markets. Generally, the debate about licensing and its income effects is presented as a relatively simple question; either licensing functions as social closure or it does not. This chapter is an attempt to move beyond a binary conception in which licensing is or is not social closure, toward one where licensing is understood as an institutional apparatus that, when established, sets in motion a transformation of the institutional character of an occupation. There are two important things that come from this approach. One is the expectation that the effect of a newly enacted license will be partially dependent on the existing institutional characteristics of that occupation, so licensing may initiate a process of institutional development or it may be a component of an already existing process. For example, a newly enacted license may lead to the establishment of specific and formal credential requirements, or it may be unable to in cases where credential requirements are already well established despite being informal. The other relates to the fact that in social closure theory there is no specification of how social closure comes to be established in an occupation. When it comes to licensing in particular, because it

makes practicing without a license illegal, the expectation is that its effects would be immediate. However, from the perspective that licensing either initiates or is part of a process of institutional transformation, it would be more reasonable to expect the effects of licensing unfold over some period of time. The implication is that empirical evidence of licensing effects may only be detectable across many years, hinting that licenses and their wage effects take a significant amount of time to become established in an occupation.

This is where the second contribution of this chapter is important. The use of growth curve models is both unique in this specific field, and addresses some persistent methodological limitations in existing literature. An overarching threat to causal inference in the study of licensing effects using cross-sectional methods is that unmeasured occupation level variables can bias the estimated effect of licensing. Some attempt to address the problem with fixed-effect models can control for the influence of time invariant variables but cannot account for the effects of time varying covariates. This is particularly important if licensing is part of a larger process of institutional transformation, as this implies that other institutional characteristics in a licensed occupation may also change over time and could play a key role in shaping outcomes like wages.

Growth curve models can do three things that address the limitations in much of the existing research. One is that they allow for the analysis of how the enactment of a new license leads to change in wages and other outcomes over time, thus enabling an analysis that can account for the ways in which licensing's effect emerges from processes that occur over time. Second, their estimates are not biased by unmeasured time invariant covariates. Third, they allow for the inclusion of time varying occupation level covariates which, depending on available data, enables this chapter to explore the ways in which other institutional characteristics of an occupation (specifically education) conditions the influence of newly enacted licenses.

The empirical analysis in this chapter has revealed that there are some unexpected changes that occur in an occupation after the enactment of a new license. As mentioned above, the way in which social closure becomes established and has its effect on something like wages is not specified in the theory. Because licensing is a state enforced form of social closure, I had assumed that the social closure effects of newly enacted license would be apparent very shortly after, and that this would appear as a jump or interruption in the wage growth curve of newly licensed occupations. The wage growth curve models in this chapter however, indicate that this

is not how wages change after enactment. Instead occupation-provinces experience an acceleration of their wage growth rate after enactment, and this effect is particularly pronounced among those that achieve high coverage. This indicates that licensed occupations experience a faster rate of wage increase when compared both to unlicensed occupations and, more importantly, when compared to themselves prior to enactment. This means that hypothesis 1 is only partially supported. Wages do change after enactment and the fact that this change is enhanced by higher levels of coverage suggests that the observed change in wages is due to some kind of social closure effect brought on by the enactment of a license. However, the impact of a new license on average wages would occur over many years, hinting that licensing goes beyond simply having a social closure effect, initiating a long term process of transformation in a newly licensed occupation.

This leads to the second significant factor that relates to the social closure effects of licensing: education. It is well established in existing literature and the preceding chapters, that there is a relationship between licensing and education. In cross-sectional models the inclusion of education/human capital controls reduces or erases the licensing wage premium however, it is difficult using cross-sectional methods to rule out the possibility that licensing results in changes in education which then leads to, or contributes to change in wages. The wage models in this chapter demonstrate that among newly licensed occupation-provinces education appears to explain a very small portion of the post enactment wage effect. This is important for two reasons. One, the inclusion of education in these models does not wipe out the wage effects of old or newly established licenses (in both the annual and pooled models). This is not consistent with existing cross-sectional studies (including my own) and suggests that education does not fully account for the wage effects of occupational licensing when it is measured *longitudinally*. This supports the theory that licensing acts a social closure mechanism, at least semi-independently of education. Second, the pooled models (Table 5-11) in particular suggest that education accounts for a small portion of the observed post enactment wage growth rate increase. They also unexpectedly demonstrate that education itself has more significant wage effects after enactment. These results reflect the hypothesized credential formalization effect initiated by the enactment of a new license. It is however, important to keep in mind that the education effects are *small* in size, indicating that it would take many years for this change in growth pattern to have substantive effects on a newly licensed occupation. It is possible that my education

variables simply do not adequately capture specialized credentials. It is also possible that incumbents in a newly licensed occupation do not acquire more education after enactment and it takes many years for them to age out of the occupation and be replaced by a more educated workforce. This would result in a slow transformation of educational attainment in an occupation that is newly licensed.

This is further indicated by the education models (Tables 5-9, 5-10, and 5-12) which indicate very small or non-significant changes in education after enactment. The annual models indicate that older licensed occupations have significantly higher levels of education as well as lower education variability but the rate of change over time is very small while there are no significant effects among the newly licensed. This raises some doubt that there is a causal link between a newly enacted license and education in an occupation. The pooled mean education models that include coverage however, do suggest that education does change after enactment, but only among those that achieve the highest levels of coverage. This does not extend to variability of education which has no significant effects among newly licensed occupation-provinces at all. So, hypothesis 2 has some weak support and hypothesis 3 is not supported. Perhaps credential formalization only begins to occur in occupations where licenses have been enacted in many jurisdictions and it may take many years for variability of education to change after enactment. The combination of the observed wage growth acceleration and the education effects discussed above are consistent with the perspective outlined earlier. Rather than causing a sudden shift in average wages or levels of education, the enactment of a new license appears to produce an increased rate of growth in these things instead. These consist of differences that are small per year, but that could amount to significant change after many years. I argue that this growth rate change is consistent with the theory of a relatively slow process of institutional transformation initiated by the enactment of a new license. This highlights a need to expand our understanding of how social closure functions, at least as it pertains to occupations. Based on this analysis I can conclude first that the effects of newly enacted licenses take years to become established. Second, it appears likely that the effects of licensing go beyond the license itself and its direct social closure effects, to include changes in the other institutional characteristics of an occupation. So, the long term impact of licensing may arise from a broader transformation of various institutions within an occupation, which can combine in different ways to produce highly variable closure effects across occupations.

With this new understanding of social closure and the effects of licensing, we are left with the question of whether or not the expansion of licensing in the last few decades has contributed to the increasing economic inequality observed in the same time period? Mouw and Kalleberg (2010) argue that detailed occupations do structure inequality to some degree, and the extent to which they do has increased over time. The variance components in the wage models of this chapter also indicate that this is the case in Canada. The results of this analysis suggest that the expansion of licensing does have a detectable if small effect on wage differences between occupations, and this effect may grow to become quite large if the observed wage trends continue for many years. It is therefore reasonable to conclude that licensing has been a small contributing factor in income inequality trends in Canada over the last three to four decades.

Ultimately, my argument is that licensing should be understood as a component of a larger pattern of structural changes that have occurred in this period, and that have produced greater inequality and which has also likely contributed to the growth of licensing itself. So, licensing has expanded in this era due to broader structural economic and institutional changes like de-industrialization, trade liberalization, the decline of unions, and the shift toward a service based economy and so on. In this context licensing should be understood as a regulatory and institutional form that is part of these changes. However, it is also a consequence of those changes in that workers may have increasingly turned to licensing to protect their interests as unions have become less prominent and other worker protections have eroded. At the same time licensing has become increasingly accepted or even desired among Canadians due to those same structural changes.

Any future research on this topic could address the weaknesses of this analysis and explore the institutional effects of licensing in more detail mostly by addressing two important limitations in available data. The first is to find North American data including wage or income measures, in addition to other key variables, going back to at least 1985. The other thing that would advance our understanding of licensing is to collect data on the institutional characteristics of occupations which would allow for a more detailed understanding of the process of institutional transformation brought about by licensing.

Appendix 5A – Date of Enactment Full

Table 5A-1: Number of Licenses by Year

Date	Licenses	Date	Licenses
1797	1	1975	3
1834	1	1976	1
1849	1	1977	2
1867	20	1978	4
1876	1	1979	3
1881	1	1980	2
1884	1	1981	3
1889	1	1982	1
1890	1	1983	5
1891	1	1984	2
1892	1	1985	25
1897	1	1986	18
1898	2	1987	12
1899	1	1988	25
1902	1	1989	15
1903	2	1990	17
1906	1	1991	9
1910	2	1992	4
1913	1	1993	2
1920	77	1994	7
1922	13	1995	14
1930	11	1996	17
1931	1	1997	7
1932	1	1998	4
1933	1	1999	7
1935	22	2000	12
1936	3	2001	6
1940	10	2002	7
1941	1	2003	15
1942	1	2004	7
1943	1	2005	1
1952	11	2006	8
1953	3	2007	7
1954	1	2008	12
1955	12	2009	3
1957	3	2010	4
1960	1	2011	3
1961	1	2012	3
1963	1	2013	2
1964	7	2014	4
1965	5	2015	8
1967	2	2016	13
1968	3	2017	2
1969	1	2018	1
1970	9		
1971	2		
1972	2		
1973	15		
1974	12		

Appendix 5B – Null and Unconditional Model

Table 5B-1: Null and Unconditional Growth Model - Average Wages

	Null		Unconditional	
	B	SE	B	SE
Time			0.616	(0.007) ***
Time^2			0.012	(0.000) ***
Constant	20.130	(0.084) ***	11.486	(0.058) ***
SD (Constant)	5.755	(0.062) ***	3.528	(0.042) ***
SD (Residual)	7.178	(0.016) ***	3.443	(0.008) ***
SD (Time)			0.295	(0.004) ***
SD (Time^2)			0.008	(0.000) ***
LL	-374564		-302480	

References Cited

Allaj, E. (2018). Two Simple Measures of Variability for Categorical Data. *Journal of Applied Statistics, 45*(8), 1497-1516.

Arrow, K. J. (1973). Higher education as a filter. *Journal of public economics, 2*(3), 193-216.

Augustine, H. J. (2015). Employment match rates in the regulated professions: trends and policy implications. *Canadian Public Policy, 41*(Supplement 1), S28-S47.

Baron, J. N., Hannan, M. T., Hsu, G., & Koçak, Ö. (2007). In the company of women: Gender inequality and the logic of bureaucracy in start-up firms. *Work and Occupations, 34*(1), 35-66.

Becker, G. S. (1964). *Human capital : a theoretical and empirical analysis, with special reference to education*: National Bureau of Economic Research; distributed by Columbia University Press.

Bielby, W. T., & Kalleberg, A. L. (1981). The structure of occupational inequality. *Quality and Quantity, 15*(2), 125-150.

Blaug, M. (1976). The empirical status of human capital theory: A slightly jaundiced survey. *Journal of economic literature, 14*(3), 827-855.

Blaug, M. (1987). *The economics of education and the education of an economist*: New York University Press.

Blaug, M. (Ed.) (1992). *The Economic value of education : studies in the economics of education*: E. Elgar Pub.

Brown, D. K. (1995). *Degrees of control : a sociology of educational expansion and occupational credentialism*: Teachers College Press.

Brown, S., & Sessions, J. (Eds.). (2004). *2 Signaling and Screening*. Cheltenham and Northampton: Edward Elgar Publishing Ltd.

Brzozowski, M., Gervais, M., Klein, P., & Suzuki, M. (2010). Consumption, income, and wealth inequality in Canada. *Review of economic dynamics, 13*(1), 52.

CICIC, C. I. C. f. I. C. Retrieved from https://www.cicdi.ca/935/perform_an_advanced_search_in_the_directory_of_occupational_profiles.canada

Conway, J. (1999). Dismantling a Nation: The Transition to Corporate Rule in Canada. In: JSTOR.

Dale, A. (1987). Occupational inequality, gender and life-cycle. *Work, Employment and Society, 1*(3), 326-351.

Damelang, A., Haupt, A., & Abraham, M. (2018). Economic consequences of occupational deregulation: Natural experiment in the German crafts. *Acta Sociologica, 61*(1), 34-49.

Doeringer, P. B., & Piore, M. J. (1971). *Internal labor markets and manpower analysis*: Heath.

Dunlop, J. T. (1957). The task of contemporary wage theory. In *The theory of wage determination* (pp. 3-27): Springer.

Ferrer, A., & Riddell, W. C. (2008). Education, credentials, and immigrant earnings. *Canadian Journal of Economics/Revue canadienne d'économique, 41*(1), 186-216.

Fortin, N., Green, D. A., Lemieux, T., Milligan, K., & Riddell, W. C. (2012). Canadian inequality: recent developments and policy options. *Canadian Public Policy, 38*(2), 121-145.

Gittleman, M., & Kleiner, M. M. (2016). Wage effects of unionization and occupational licensing coverage in the United States. *ILR Review, 69*(1), 142-172.

Gomez, R., Gunderson, M., Huang, X., & Zhang, T. (2015). Do immigrants gain or lose by occupational licensing? *Canadian Public Policy, 41*(Supplement 1), S80-S97.

Graddy, E. (1991). Toward a general theory of occupational regulation. *Social science quarterly, 72*(4), 676-695.

Green, D. A., & Sand, B. M. (2015). Has the Canadian labour market polarized? *Canadian Journal of Economics/Revue canadienne d'économique, 48*(2), 612-646.

Grusky, D., & Galescu, G. (2005). Foundations of a neo-Durkheimian class analysis. *Approaches to class analysis*, 51-81.
Grusky, D., & Sorensen, A. B. (1998). Can Class Analysis be Salvaged? *American Journal of Sociology, 103*(5), 1187-1234.
Harvey, D. (2007). A brief history of neoliberalism. In U. Oxford Scholarship Online - York (Ed.): Oxford University Press.
Hauser, R. M., & Warren, J. R. (1997). Socioeconomic indexes for occupations: A review, update, and critique. *Sociological methodology, 27*(1), 177-298.
Jackson, A. (1999). The free trade agreement—a decade later. *Studies in Political Economy, 58*(1), 141-160.
Jackson, A. (2001). Can There Be a "Second Way" in the Third Millennium? *Studies in Political Economy, 65*(1), 39-64.
Kalleberg, A. L., & Sorensen, A. B. (1979). The sociology of labor markets. *Annual review of sociology, 5*(1), 351-379.
Kampelmann, S., & Rycx, F. (2012). Are occupations paid what they are worth? An econometric study of occupational wage inequality and productivity. *De Economist, 160*(3), 257-287.
Kerr, C. (1954). The balkanisation of labour markets. In E. W. H. Bakke, Phillip; Palmer, Gladys;Myers, Charles; Yoder, Dale; Kerr, Clark (Ed.), *Labour Mobility and Economic Opportunity* (pp. 92-110). New York: Technology Pree of MIT and Wiley.
Kim, C., & Sakamoto, A. (2008). The rise of intra-occupational wage inequality in the United States, 1983 to 2002. *American Sociological Review, 73*(1), 129-157.
Kleiner, M. M. (2006). *Licensing occupations: Ensuring quality or restricting competition?* : WE Upjohn Institute.
Kleiner, M. M., & Krueger, A. B. (2010). The prevalence and effects of occupational licensing. *British Journal of Industrial Relations, 48*(4), 676-687.
Kleiner, M. M., & Soltas, E. J. (2018). Occupational Licensing, Labor Supply, and Human Capital. *Labor Supply, and Human Capital (May 1, 2018)*.
Kreckel, R. (1980). Unequal opportunity structure and labour market segmentation. *Sociology, 14*(4), 525-550.
Law, M. T., & Kim, S. (2005). Specialization and regulation: The rise of professionals and the emergence of occupational licensing regulation. *The Journal of Economic History, 65*(3), 723-756.
Leontaridi, M. (1998). Segmented labour markets: theory and evidence. *Journal of economic surveys, 12*(1), 103-109.
Marginson, S. (2017). Limitations of human capital theory. *Studies in Higher Education*, 1-15.
Mill, J. S. (1890, 1848). *Principles of political economy : with some of their applications to social philosophy*: D. Appleton and company.
Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of political economy, 66*(4), 281-302.
Mincer, J. (1970). The distribution of labor incomes: a survey with special reference to the human capital approach. *Journal of economic literature, 8*(1), 1-26.
Mincer, J. (1974). *Schooling, experience, and earnings / Jacob Mincer*: National Bureau of Economic Research :.
Morgan, S. L., & Cha, Y. (2007). Rent and the evolution of inequality in late industrial United States. *American Behavioral Scientist, 50*(5), 677-701.
Mouw, T., & Kalleberg, A. L. (2010). Occupations and the Structure of Wage Inequality in the United States, 1980s to 2000s. *American Sociological Review, 75*(3), 402-431.
Murphy, R. (1988). *Social Closure: The theory of monopolization and exclusion*. Oxford: Clarendon Press.

Navarro, V. (2007). Neoliberalism as a class ideology; or, the political causes of the growth of inequalities. *International Journal of Health Services, 37*(1), 47-62.
Norman, G. R., & Streiner, D. L. (2008). *Biostatistics: the bare essentials*: PMPH USA (BC Decker).
Oi, W. Y. (1962). Labor as a quasi-fixed factor. *Journal of political economy, 70*(6), 538-555.
Piketty, T. (2014). Capital in the twenty-first century. In A. Goldhammer & E. B. Y. U. Ebscohost (Eds.): The Belknap Press of Harvard University Press.
Piore, M. J. (1969). On-the-job training in the dual labour market. In A. R. C. Weber, Frank Hyde; Ginsburg, Woodrow (Ed.), *Public-Private Manpower Policies* (pp. 101-132). Madison: Industrual Relations Reserach Association.
Piore, M. J. (1970). Jobs and Training. In S. B. Beer, Richard (Ed.), *The State and the Poor* (pp. 55-83). Cambridge: Winthrop Publishers.
Raudenbush, S., & Bryk, A. (2002). *Hierarchical linear models : applications and data analysis methods* (2nd ed.). Thousand Oaks, CA: Sage Publications.
Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1): sage.
Redbird, B. (2017). The New Closed Shop? The Economic and Structural Effects of Occupational Licensure. *American Sociological Review, 82*(3), 600-624.
Redbird, B., & Grusky, D. B. (2015). Rent, Rent-Seeking, and Social Inequality. *Emerging Trends in the Social and Behavioral Sciences: An Interdisciplinary, Searchable, and Linkable Resource*, 1-19.
Saez, E., & Veall, M. R. (2005). The evolution of high incomes in Northern America: lessons from Canadian evidence. *American Economic Review, 95*(3), 831-849.
Schirle, T. (2015). The gender wage gap in the Canadian provinces, 1997–2014. *Canadian Public Policy, 41*(4), 309-319.
Schultz, T. W. (1963). *The economic value of education*: Columbia University Press.
Schultz, T. W. (1971). *Investment in human capital : the role of education and of research*: Free Press.
Shapiro, C. (1986). Investment, moral hazard, and occupational licensing. *The Review of Economic Studies, 53*(5), 843-862.
Skrondal, A., & Rabe-Hesketh, S. (2008). Multilevel and Related Models for Longitudinal Data. In J. M. de Leeuw, Erik (Ed.), *Handbook of Multilevel Analysis* (pp. 275-299). New York: SPringer.
Smith, A. (1999, 1910). *The wealth of nations*: Penguin Books.
Snijders, T. A. B., & Bosker, R. J. (1999). *Multilevel analysis : an introduction to basic and advanced multilevel modeling*. London ; Thousand Oaks, Calif.: Sage Publications.
Sørensen, A. B. (1977). The structure of inequality and the process of attainment. *American Sociological Review*, 965-978.
Sørensen, A. B. (1996). The structural basis of social inequality. *American Journal of Sociology, 101*(5), 1333-1365.
Sørensen, A. B. (2000). Toward a sounder basis for class analysis. *American Journal of Sociology, 105*(6), 1523-1558.
Spence, M. (1973). Job Market Signaling. *Quarterly Journal of Economics, 87*, 355-374.
Stanford, J. (2008). Staples, deindustrialization, and foreign investment: Canada's economic journey back to the future. *Studies in Political Economy, 82*(1), 7-34.
Statistics Canada. Guide to the Labour Force Survey. Retrieved from https://www150.statcan.gc.ca/n1/pub/71-543-g/71-543-g2018001-eng.htm
Stigler, G. J. (1971). The theory of economic regulation. *The Bell journal of economics and management science*, 3-21.
Sweetland, S. R. (1996). Human capital theory: Foundations of a field of inquiry. *Review of educational research, 66*(3), 341-359.

Tam, T. (1997). Sex segregation and occupational gender inequality in the United States: Devaluation or specialized training? *American Journal of Sociology, 102*(6), 1652-1692.
Thurow, L. C. (1975). *Generating inequality : mechanisms of distribution in the U.S. economy*: Basic Books.
Treiman, D. J. (1976). A standard occupational prestige scale for use with historical data. *The Journal of Interdisciplinary History, 7*(2), 283-304.
Van de Werfhorst, H. G. (2011). Skills, positional good or social closure? The role of education across structural–institutional labour market settings. *Journal of Education and Work, 24*(5), 521-548.
van der Velden, R. K. W., & Wolbers, M. H. J. (2007). How Much Does Education Matter and Why?: The Effects of Education on Socio-economic Outcomes among School-leavers in the Netherlands. *European Sociological Review, 23*(1), 65-80. doi:10.1093/esr/jcl020
Wang, G. G., & Sun, J. Y. (2009). Clarifying the boundaries of human resource development. *Human Resource Development International, 12*(1), 93-103.
Warman, C., Sweetman, A., & Goldmann, G. (2015). The portability of new immigrants' human capital: language, education, and occupational skills. *Canadian Public Policy, 41*(Supplement 1), S64-S79.
Weber, M. (1978). *Economy and society : an outline of interpretive sociology*: University of California Press.
Weeden, K. (2002). Why do some occupations pay more than others? Social closure and earnings inequality in the United States. *American Journal of Sociology, 108*(1), 55-101.
Weeden, K., & Grusky, D. (2005). The Case for a New Class Map. *American Journal of Sociology, 111*(1).
Weiss, A. (1995). Human capital vs. signalling explanations of wages. *Journal of Economic perspectives, 9*(4), 133-154.
Wilensky, H. L. (1964). The professionalization of everyone? *American Journal of Sociology, 70*(2), 137-158.
Zhang, T. (2019). Effects of occupational licensing and unions on labour market earnings in Canada. *British Journal of Industrial Relations, 57*(4), 791-817.
Zhang, T., & Gunderson, M. (2020). Impact of occupational licensing on wages and wage inequality: Canadian evidence 1998–2018. *Journal of Labor Research, 41*, 338-351.
Zhou, X. (1993). Occupational power, state capacities, and the diffusion of licensing in the American states: 1890 to 1950. *American Sociological Review*, 536-552.