The Short- and Long-Term Career Effects of Graduating in a Recession:

Hysteresis and Heterogeneity in the Market for College Graduates[1]

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Abstract

This paper analyzes the long-term effects of graduating in a recession on earnings, job mobility, and employer characteristics for a large sample of Canadian college graduates using matched university-employer-employee data from 1982 to 1999. The results are used to assess the mechanisms behind persistence and adjustment after temporary shocks in the labor market. We find that young graduates entering the labor market in a recession suffer significant and lasting earnings losses that fade after 8 to 10 years. These losses are substantially larger and more persistent for less advantaged college graduates. The losses we find can be partly explained by an initial reduction in employer quality. Recovery occurs through a time-intensive process of job mobility to better employers. The high degree of persistence and heterogeneity we find can be explained by a model of endogenous search for better employers. Comparative advantage and age-dependent search costs lead young and higher skilled workers to search more intensely and to recover quickly, while less skilled and older workers can be permanently down ranked to less attractive employers.

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1. Introduction

Increasing evidence suggests that even short term conditions in the labor market can have substantial long-term effects on some groups of workers.[2] A high degree of persistence has implications for the nature and importance of frictions in the labor market – a key building block in many micro and macro economic models.[3] However, data limitations often prevent quantifying the full extent of short and long-term effects from aggregate labor market shocks.[4] Similarly, in most applications several sources of frictions and confounding factors operate simultaneously, preventing the empirical assessment of alternative channels of persistence in the labor market. Yet, it is the interaction between alternative mechanisms that may be responsible for the persistent effect of short-term labor market shocks.

In this paper, we analyze the short- and long-term effects of graduating in a depressed labor market on college graduates with different educational backgrounds using an unusual match between administrative university-employee-employer data from Canada. We take advantage of our exceptional data to learn about the mechanisms driving persistence in the labor market and to quantify the long-term effect of initial labor market shocks in workers' careers. To shed light on potential channels of persistence and the interactions between them, we first develop a parsimonious model of endogenous job search with heterogeneous workers and firms that explicitly accounts for search frictions, ability, specific human capital, and age. In a second step, we quantify the long-term effects of initial labor market conditions on the evolution of earnings for low and high skilled college graduates. Lastly, we use the detailed longitudinal information on employment, job mobility, and employer characteristics covering a horizon of ten years to assess the empirical relevance of the channels of persistence predicted by our model.

Young workers are an ideal group to study the importance of 'luck', since they may be particularly affected by temporary labor market conditions (Katz and Autor 1999, Freeman 1979).[5] Moreover, since labor

[2] See, e.g., Baker, Gibbs, and Holmstrom (1994) for workers at a large firm; Jacobson, Lalonde, and Sullivan (1993) for workers displaced by mass layoffs; Beaudry and DiNardo (1992) for workers in stable employment; Oyer (2006) for economics PhDs and investment bankers; Kahn (2006) for college graduates in around the 1982 recession. On the other hand, Bertrand and Mullainathan (2001) show that CEOs can benefit from positive shocks. More generally, Gottschalk and Moffitt (1994) document an important degree of persistence of earnings shocks in the labor market.

[3] The labor literature suggests job search (Topel and Ward 1992, Neal 1999), wage differentials (Dickens and Katz 1987, Krueger and Summers 1988, Abowd, Creecy, and Kramarz 2002), contracting (e.g., Beaudry and DiNardo 1992), or specific skills (e.g., Neal 1995, Altonji and Williams 1997) all play some role. These frictions enter macroeconomic models of search and matching in the labor market (e.g., Pissarides 2000, Hall 2005b, Shimer 2005a, 2006, Krause and Lubik 2006a), of price setting and monetary policy (e.g., Woodford 2003), or of international trade (e.g., Davis and Harrigan 2007).

[4] Important exceptions are Beaudry and DiNardo (1991) and some of the literature on 'scarring,' further discussed below. Although a long literature assesses the current effects of recessions for low-income workers, little is known about the long-term effects (e.g., Hines, Hoynes, and Krueger 2002, Cutler and Katz 1991).

[5] During the first 10 years of work, individuals experience 70% of overall wage growth, change jobs frequently, and find a career occupation and employer (Murphy and Welch 1990, Topel and Ward 1992). In this formative period young workers are particularly at risk of earnings losses (Blanchflower and Oswald 1994), job losses (Farber 2003), and unemployment (Ryan 2001) from a recession. Similarly, a long literature documents how disadvantaged workers are hurt most in recessions and may gain most in expansions (e.g., Hines, Hoynes, and Krueger 2002, Freeman 2001).

market entrants have similar prior labor market experience, they are affected by luck in a comparable moment of their career and can be categorized into more and less advantaged groups based on their university background.[6] In addition, the unique data set at our disposition allows us to address several important empirical challenges inherent in estimating the long-term impact from initial labor market shocks. First, the distinction between temporary and persistent shocks is crucial to isolate the role of luck. The broad range of cohorts in our sample yields sufficient variation to isolate the effect of the very first labor market conditions. Second, typically there are too few recurring labor market shocks affecting large groups of similar workers. Our data cover almost the universe of 20 years of graduating cohorts encompassing two large recessions with differential strength across ten regions.[7] Third, detailed information on longitudinal employment patterns and the timing of college entry and exit allows us minimize the confounding effects from selective participation or graduation.

This is the first paper to use matched university-employer-employee data to systematically analyze the effects of initial luck on the entire process of dynamic adjustment for a large number of cohorts of college graduates with different earnings capacities. Our results suggest three main findings. First, luck matters – graduating in a recession leads to large initial earnings losses that do fade, but slowly and over a period of eight to ten year period after graduation. A typical recession -- a rise in unemployment rates by five percentage points in our context -- implies an initial loss in earnings of about 9 percent that halves within 5 years and finally fades to zero by 10 years. This result is robust to the use of both national and regional unemployment rates, does not appear to arise due to correlation with labor market shocks occurring later in workers' careers, and does not seem to be due to selective employment and graduation decisions.

Second, some workers are more affected by luck than others. In particular, earnings losses from temporarily high unemployment rates are strongest for labor market entrants and small for workers with two or more years of labor market experience. Graduates with the lowest predicted earnings suffer significantly larger and much more persistent earnings losses than those at the top. Thus, we see a temporary increase in inequality from recessions lasting up to ten years, which translates into permanent increases in inequality in the present discounted value of earnings.

Third, initial random shocks affect the entire career profile, including systematic changes in job mobility and firm placement. We find that temporary reductions in the quality of the first employer can explain 30-

[6] For more mature workers, hard-to-observe differences in on-the-job experience, training, and job levels may not be approximated well by potential labor experience. Thus, a labor market shock at a given year of *potential* experience may affect them at different points in their *actual* career development and at different skill levels. Similarly, college background is a worse predictor of potential earnings as workers accumulate experience.

[7] Several previous studies on the persistent effects of aggregate labor market conditions have used the Panel Study of Income Dynamics (Devereux 2003) and the National Longitudinal Studies of Youth (Gardecki and Neumark 1998, Neumark 2002, Kahn 2006). While providing detailed survey information on careers and worker demographics, the small samples of these data sets do not allow controlling for cohort, state, and year effects, controlling for persistent correlated labor market conditions, or studying other career outcomes than wages with sufficient degree of precision. Moreover, often the range of cohorts studied covers a limited range of business cycles.

40% of initial earnings losses. The dynamic adjustment process is characterized by increased mobility across employers and industries and improvements in average firm characteristics, but has little effect on employment status beyond the first year. This pattern differs by worker type. Workers at the top of the wage-distribution catch up quickly by moving to better firms, workers with low predicted earnings are permanently down-ranked to firms paying lower wages, and the median lies in between. We also find an important degree of persistence of unemployment rate shocks within firms, especially for very large and high paying employers.

Viewed in the light of the theory, the data closely replicates the dynamic patterns implied by our model of endogenous job search in the presence increasing costs of mobility and heterogeneous workers and firms. First, an important part of catch-up in the first years after entry is due to increased job mobility and improvements in firm quality. Second, catch-up by movement between firm types slows down significantly and continues within firms as workers' age, settle down, or accumulate firm or sector specific capital. Third, workers with higher predicted earnings (our measure of skill) catch-up faster by moving to higher quality firms; this is consistent with presence of comparative advantage in the context of endogenous job search. Last, the model can rationalize why low skilled workers suffer permanently from initial conditions by lasting reduction in the quality of their employers.

Our paper contributes to several recent strands of literature in labor economics and macroeconomics. By examining the long-term effects of a typical labor market shock for a representative number of cohorts, a wide range of career outcomes, and workers of different experience and ability, we help to establish that persistence is a widespread phenomenon in the labor market and not just relevant for single cohorts, job losers, or the unemployed.[8] We also present one of the first papers showing that temporary labor market conditions have systematic affects on the entire career profile, including firm and industry placement and job mobility. Our results confirm that there is persistent cyclical down grading of labor market entrants.[9]

Although the incidence of temporary labor market shocks is widely studied (e.g., Gottschalk and Moffitt 1994, Farber 2003), we are among the first to provide an explicit model of the process of recovery after a temporary shock, to highlight the importance of age-related frictions and their interaction with workers' skills, and to evaluate the predictions using our empirical results and a simulation exercise.[10] Thereby, this is also one of the few papers to systematically analyze the joint response of job mobility and employer characteristics to an exogenous labor market shock.[11] It thereby extends important empirical studies on the role of job search not based on exogenous variation and without detailed information on workers' skills or on their

[8] This extends the existing literature documenting that luck can matter for single occupations (e.g., Oyer 2006, Bertrand and Mullainathan 2001), for job losers (e.g., Jacobson, Lalonde, and Sullivan 1993, von Wachter and Bender 2006), for young unemployed workers (e.g., Elwood 1982), or for single cohorts of workers (e.g., Freeman 1975, Welch 1979, Beaudry and DiNardo 1992, Baker, Gibbs, and Holmstrom 1994, Kahn 2006).

[9] Albeit a recurring hypothesis in labor economics (Okun 1973, Devereux 2003), few papers had the necessary data to follow the career development of so many cohorts in the detail our data permits us to do.

[10] For an alternative but related approach based on movements across occupations see Moscarini and Vella (2008).

[11] A small empirical literature documents how job characteristics respond after a job loss (e.g., Farber 1994, Stevens 1997, von Wachter and Bender 2006) without explicitly modeling the recovery process.

employers (e.g., Jovanovic and Moffitt 1990, Topel and Ward 1992, Christensen, Lentz, Mortensen, Neumann 2005). It is also one of the first papers demonstrating a systematic role of firms in workers' careers and their recovery after shocks, further highlighting the importance of firm heterogeneity in the labor market.[12]

Our paper also contributes to several strands of literature in macroeconomics. First, our evidence suggests that the speed of adjustment after labor market shocks can be slow, that it involves movements from low- to high-wage sectors and firms, and that it may dependent on worker characteristics such as age and skills. This is relevant for understanding the pattern of cyclical adjustment in the labor market either in models of job search (e.g., Krause and Lubik 2006a,b) or mismatch (e.g., Shimer 2007). It also confirms that the age- and education-structure of the population will matter for the labor market's recovery after cyclical shocks (e.g., Shimer 2001). Our results also imply that positive assortative matching of workers to firms is an important phenomenon (e.g., Shimer 2005b, Gibbons, Katz, Lemieux, Parent 2005, Lentz 2007, Garibaldi and Moen 2007). However, we show that the sorting processes involved can be slow, and that the allocation of workers to firms can be permanently alter by temporary labor market conditions.

Last, while macroeconomists typically measure the cost of recessions for a representative worker (Lucas 1987),[13] an increasing literature suggests that less able workers may be hurt most in recessions (e.g., Hines, Hoynes, and Krueger 2002, Freeman 2001). Our data allows us to provide explicit and comparable estimates of the decline in the present discounted value of earnings due to a recession for more and less advantaged workers.

The rest of the paper is organized as follows. Section 2 gives an overview of relevant models of career determination. Section 3 outlines our model of endogenous job search and derives the implications for the effect of initial labor market conditions. Section 4 outlines the empirical strategy we use to address these questions and our approach to deal with selective labor market entry, selective labor force participation, and the presence of correlated unemployment shocks. The main results on earnings are discussed in Section 5, followed by an analysis of heterogeneity. Section 6 describes our results for employment, job mobility, and firm characteristics in the context of theoretical and simulated predictions from our model of job search. A detailed sensitivity analysis addressing among others the question of selection and omitted variable bias due to recurring aggregate unemployment conditions is summarized in the Appendix. The seventh and eighth sections discuss alternative explanations and offer conclusions and directions for future research.

[12] A long literature suggests industry and firms pay different wages to similar workers (e.g., Dickens and Katz 1987, Krueger and Summers 1988, Abowd, Creecy, and Kramarz 2002). Gibbons, Katz, Lemieux and Parent (2005) and Fox (2004) show that high-skilled workers are sorted among different industries and into larger firms.

[13] Lucas' original measure asked how much additional consumption would make workers indifferent between economies with and without consumption risk. More recent papers distinguish between individuals with and without wealth holdings, or between workers on the job and those laid-off (see, e.g., Barlevy 2005 for an excellent survey).

2. Models of Career Determination

The following section briefly reviews the main models of career determination that have guided our modeling strategy and the interpretation of our results. Although most features of these models are relevant for the full labor market, we focus the discussion on labor market entrants. Economists have long suggested that young workers may suffer most by conditions in the external labor market,[14] and this is confirmed in the existing literature.[15] However, little is known about the degree of persistence of these losses, or the importance of alternative mechanisms through which aggregate shocks are transmitted through the labor market as workers age.

As a common benchmark for the analysis of wage progression, the neo-classical model with human capital accumulation does not predict long-term effects from short term labor market shocks.[16] If human capital accumulation occurs on the job (e.g., Mincer 1974), long spells of non-employment or reduced working hours may initially lower earnings growth for younger workers. However, the standard model has difficulty explaining lasting effects of recessions that involve short spells of unemployment as typically observed for young college graduates. Extensions of the standard model assign a role to the accumulation of firm specific capital (e.g., Becker 1964) or industry specific capital (e.g., Neal 1995). If search frictions lead to persistent job mobility, workers may initially accumulate less specific human capital, and catch up once they find stable employment in a firm or industry.[17]

Search theory yields a second class of models typically used to model career development of young workers (e.g., Topel and Ward 1992, Neal 1999). For workers entering the labor market in a recession, search models predict that a temporary worsening of the wage offer distribution leads to a time intensive catch-up

[14] Katz, Loveman, and Blanchflower (1995) and Katz and Autor (1999) suggest that demand shifts towards high-skilled labor may have hurt younger unskilled workers more than mature unskilled workers due to the presence of contracts and firm specific skills. The same may hold for changes in relative supply (Freeman 1975).

[15] E.g., Clark and Summers (1981), Blanchflower and Oswald (1994), and Farber (2003) document the responsiveness of young workers' employment, wages, and job stability to cyclical shocks. We know that job movers have more pro-cyclical wages than workers on the job (e.g., Devereux 2001, Bils 1985), and that job finding rates are more pro-cyclical than job separation rates (e.g., Shimer 2005a). Since labor market entrants are most likely to be among those searching for jobs (Topel and Ward 1992) and most likely to be unemployed (Clark and Summers 1981), this further underscores their vulnerability to cyclical shocks

[16] Without human capital accumulation, the basic neo-classical model predicts earnings should only depend on current labor market conditions in similar fashion for all age and education groups, and long-term effects of early labor market conditions only arise due to correlated labor market shocks. This could be modeled as temporary adjustment processes, as in a standard neo-classical model with flexible (but possibly slow) wage adjustment. It could also arise within a neo-classical model augmented with an explicit equilibrium relationship between wages and unemployment. A complete model of regional wage and employment adjustment with and without unemployment is outlined in Blanchard and Katz (1992).

[17] If workers pay for training by wage cuts (Mincer 1974) and jobs offer different degrees of learning (Rosen 1972), then earnings trajectories may also be affected by changes in the availability of jobs in the economy. However, if the amount of 'learning' jobs declines, then wage trajectory should be characterized by higher entry wages and lower growth rates. On the other hand, if workers forsake more earnings in recessions to have faster catch-up, we may underestimate initial earnings losses. We show that differences in firm-specific experience profiles across cohorts do not affect our results.

process. This process involves a high degree of job mobility with wage gains concentrated at job changes rather than accruing on the job (e.g., Burdett 1978). Although the job search model is featured in many empirical and theoretical analyses of the labor market, as of yet few papers analyze the causal determinants of job search or the role of search in the adjustment to labor market shocks.[18]

Increasing evidence suggests high-wage jobs are concentrated in particular firms. When this occurs, job search leads workers to switch towards high wage employers, and this pattern may be relevant in the transmission of business cycle shocks. Indeed, a longstanding hypothesis in labor economics suggests some firms and sectors pay rents, that high wage firms have more pro-cyclical job creation, and that young and less able workers are down ranked as employment at high wage firms and sectors contracts in recessions (e.g., Reynolds 1951, Reder 1955, Okun 1973, Cutler and Katz 1991, Hines et al. 2002). The initial loss from graduating in a recession occurs due to a reduction in employer quality, and the catch-up process involves transitions to better employers.[19] Although such a process of cyclical upgrading is supported by several stylized facts,[20] few papers explicitly model and quantify the importance of labor market shocks on job transitions between different types of firms and industries.

Clearly, search intensity may be endogenous and differ across workers, and this has been integrated in standard search models (e.g., Mortensen 1986, Pissarides 2000, Shimer 2004). However, until recently heterogeneity in search intensity was a feature of empirical rather than theoretical work. A small empirical literature suggests that educated workers search more intensely both on and off the job, and that the costs of job search appear to increase with age (e.g., Blau and Robins 1990, Bloemen 2005, Böheim and Taylor 2002) and decline with education (e.g., Christensen et al. 2005).[21] Search effort and mobility between sectors and

[18] Since the seminal characterization of the job mobility process over workers' careers by Topel and Ward (1992), several authors have refined the notion and determinants of search. For example, McCall (1990) and Neal (1999) extend the definition of the search process to include occupations and industries and argue that some job switches have larger effects on future search than others. Yet, few papers analyze the role of firms or worker skills (with exceptions noted in the text). An exception are Topel and Ward (1992) themselves, who note that transitions to larger firms lead to more stable jobs, and a related literature documenting correlation in turnover rates and firm size (e.g., Anderson and Meyer 1994)

[19] A process of cyclical upgrading can be motivated in a multi-sector model with queuing due to search frictions or some form of wage rigidity (McDonald and Solow 1985, Akerlof and Yellen 1985). Krause and Lubik (2006a) formalize this process in a general equilibrium framework with good and bad employers and on the job search. Alternatively, it could arise due to a process of sorting by comparative advantage (Gibbons, Katz, Lemieux, and Parent 2002, McLaughlin and Bils 2001). A process of cyclical up- and down-grading due to the adjustment of hiring and promotion standards was first described by Reynolds (1951) and Reder (1955), and taken up by Okun (1973, 1981), and Hall (1974). Barsky and Solon (1989), Solon, Whatley, and Stevens (1997), and Devereux and Hart (2005), among others, examine the importance of such a process within firms.

[20] First, firms and industries pay wage premiums that cannot be easily rationalized by worker characteristics (e.g., Krueger and Summers 1988, Dickens and Katz 1988, Abowd, Kramarz, and Margolis 1999, Abowd, Creecy, and Kramarz 2003). Second, sectors paying higher wages have more pro-cyclical job creation, partly because of more volatile demand for their products (Okun 1973, McLaughlin and Bils 2001, Aaronson and Christopher 2004). Third, less able workers tend to flow to larger firms and high wage sectors in booms (Vroman 1977, Albaek and Sorensen 1998, Devereux 2002).

[21] Shimer (2001) explores the macro-economic implications of the fact that younger workers are likely to be less well matched and searching for jobs; however, there is no inherent difference between old and young workers in his model.

regions has been the focus of a growing literature on spatial mismatch. Mismatch can arise because of spatial frictions in search models (e.g., Manning 2003, Wasmer and Zenou 2006) or because of the assignment process of workers to markets (Shimer 2007). As in more standard search models, typically worker heterogeneity is not modeled explicitly.[22] However, there is strong evidence that young educated workers are more likely to move between regions, on average and in response to adverse labor market shocks (e.g., Bound and Holzer 2000, Wozniak 2006, Saks and Wozniak 2007). Similarly, job mobility between industries and occupation is highest among young workers, when career concerns are most important and industry or job specific skills are small (e.g., Neal 1999).

A third class of models suggests that careers evolve at least in part within firms (e.g., Prendergast 1999, Gibbons and Waldman 1999). Of the existing models, at least two are relevant for the analysis of initial conditions. First, models of job assignment (e.g., Prendergast 1993) can imply persistent recession effects within firms. For example, Gibbons and Waldman (2004) rationalize persistent conditions found by Baker, Gibbs, and Holmstrom (1994) by the presence of task specific skills. Second, models of long-term contracting (e.g., Harris and Holmstrom 1982, MacLeod and Malcolmson 1993) have been used by Beaudry and DiNardo (1991) to explain persistent effects of labor market conditions when workers enter a firm. Clearly, since workers should move employers to avoid persistent losses, firm-specific effects of recessions require some form of barrier to job mobility. This is more likely to occur in large firms that may provide rents, insurance, career-options, or other non-pecuniary benefits not captured in the wage.

Last, standard career models do not predict differential effects of recessions on less advantaged workers; if wages are equal to workers' marginal product, similar shocks should lead to comparable losses. Yet, we know that young and low-skilled workers, non-whites, or women lose most in recessions in terms of wages (Hoynes 2000, Hines et al. 2002) and are most likely to drop out of the labor market (Bils 1985, Solon, Barsky, and Parker 1994). A high degree of heterogeneity in college quality or parental background suggests that even within the group of male college graduates those least advantaged may bear most of the burden of recessions. Only in the presence of rents or complementarities do firms have incentives to select the most able workers for employment, and to reduce the employment of less able workers.[23] Thus, differences in the response to recession shocks among alternative skill groups may help to understand the mechanisms driving persistence in the labor market. Clearly, differences in the long-term cost of labor market shocks is of interest

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A series of recent papers explore the role of skill in job search and mobility in the context of assortative matching of workers to firms (e.g., Lentz 2007, Garibaldi and Moen 2007).

[22] An exception is Dohmen (2005) who distinguishes between education groups in a model of home-ownership and regional mobility. The role of gender has been studied as well (e.g., Ureta and Light 1995, Keith and McWilliams 1999).

[23] A cyclical process of adjustment in hiring and promotion standards has been often noted (e.g., Reder 1955). Barsky and Solon (1989) develop a numerical example. Generally, any model in which wages contain rents that vary inversely with worker ability predicts that high-wage firms should try to selectively hire more able workers, giving rise to the presence of queues. Such rents can arise due to rigid pay scales as in Hall (1974), or unions, as in Solow and MacDonald (1988). Lemieux (1998) describes the two-sided selection process for the case of unionized firms.

in its own right and, as further discussed below, it would be a further indication that uniform measures may yield an incomplete picture of the cost of business cycles (e.g., Lucas 1987, Barlevy 2005).

3. Endogenous Job Search and Initial Conditions

The following section presents a simple model of job search that allows us to interpret our empirical results. We derive predictions of the model for the short-term and long-term effect of temporary labor market conditions in an environment with multiple frictions. Our model combines several key features of the previous literature. First, search-frictions imply that initial conditions have persistent effect on earnings and job mobility. The novelty in our model is that search is endogenous and interacts with changes in the costs and benefits of search as workers age. Second, we introduce a role for specific human capital accumulation on the job. Third, our model allows for differential effects of initial conditions for high and low skilled workers.

The model delivers five key predictions. First, job search per se can imply persistence of initial labor market. However, in a pure job search model the effect of initial conditions eventually fades. Second, if we allow for endogenous job search and specific capital accumulation, search leads to fast initial catch-up through job mobility that slows as workers' mobility declines with age. Third, this pattern turns out to be more pronounced for high skilled workers; they search more intensely and catch-up before age-related constraints start to bind. Fourth, an increasing fraction of low-skilled workers may stop to search and remain at low productivity firms. Fifth, the model predicts a second phase of catch-up as workers climb the job ladder within firms.

3.1 Endogenous Job Search and Specific Human Capital

Model Setup. We consider the case of an economy of infinitely lived, risk-neutral workers. Workers start their working lives employed at one of two types of firms. High-productivity firms pay higher average wages than low productivity firms. Workers are either of high or low skill, and we assume that high wage firms pay high skill workers more than low skill workers. This is a key assumption that will lead to sorting of high skilled workers to high productivity firms. We assume that wages are deterministic within firms and increase with job tenure. We will discuss alternative assumptions below.[24] Fitting with the low effect of adverse initial conditions on unemployment in our sample, there is no job destruction in this economy and jobs last until the worker quits.[25] The model is set in discrete time.

[24] Adding stochastic increases to wages on the job as function of job tenure would add complexity without fundamental insights (see Topel 1986, Topel and Ward 1992, Mortensen 1988).
[25] There are also no endogenous quits into non-employment. Since it may be relevant for low-skill workers, the introduction of labor supply would be a promising extension of the model.

Workers employed in the less productive firm search for a job in the more productive firm. We allow search effort to affect the probability of getting a job at the good firm in a proportional way.[26] If p is the fraction of high productivity firms in the economy, λ is the constant natural arrival rate of job offers, and s is the chosen search intensity, we assume

$$\pi_t \equiv \Pr\{\text{Obtain Job at Good Firm in t}\} = \lambda \times s \times p$$

Note that p takes the role of the mean of the stationary distribution of wage offers in this model.[27] Workers choose search intensity s optimally given benefits and costs. The cost of job search $\psi(s,a)$ is convex and may depend on age a. For simplicity, we work with $\psi(s,a) = \frac{\gamma(a)}{2}s^2$, where $\gamma'(a) > 0$; none of our results depend on a quadratic specification. The parameter $\gamma(a)$ captures implicit increases in the cost of job search with age as workers buy a house, get married to a working spouse, get children, or more generally begin to settle down. At the end of Section 6, we provide some evidence that these costs increase rapidly after college graduation and are likely to be relevant for a substantial fraction of graduates by the time they reach age thirty.

Value Functions. If a worker is employed at a high productivity firm (firm 1) he stops searching and stays at firm 1 forever. The deterministic value of this event can be expressed as

$$V^1(\tau,\alpha) = \alpha w_1 + \delta_1 g(\tau) + \beta V_t^1(\tau+1,\alpha),$$

where τ indexes job tenure, w_1 is the starting wage at firm 1, g(τ) is a concave function, and δ_1 indexes the returns to tenure at the high wage firm.[28] Since firm 1 pays high skilled workers more, we have that for a low skilled worker $\alpha = 1$, while for a high skilled worker $\alpha > 1$. β is the discount factor.

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[26] This is a frequent assumption in theoretical (e.g., Pissarides 2000, Chapter 5, Mortensen 1986) and empirical (e.g., Christensen et al. 2005) work. Shimer (2004) provides a critique of the implicit complementarity between search intensity and the probability of successfully finding a job. He proposes a specification implying that workers may trade reduce their search intensity when the probability of success is high. This alternative formulation would have no bearing on our mean results, since the overall job finding probability would still be increasing in search intensity. In fact, our comparative static results for $\alpha, \gamma, \tau, \delta_2$ are unaffected, while the derivatives with respect to λ, p now depend on the the level of the product λp.

[27] Several key insights of the model also attain in a context of endogenous search among a continuous distribution of job offers (see, e.g., Mortensen 1986).

[28] Note that we have to impose restrictions on g(τ) such that the value of employment at firm 1 is finite. For simplicity, we assume here that g(τ) is linear until τ^* and constant there after. Given consensus estimates of the returns to tenure, such a piecewise specification with a low value for τ^* appears realistic (e.g., Altonji and Williams 1997).

If the worker is at a low wage firm (firm 2) the worker can decide to search for a job at a firm of type 1. We have that the value of employment at firm 2 is

$$V^2(\tau,\alpha,a) = w_2 + \delta_2 g(\tau) + \beta J_t\,(\tau+1,\alpha,a+1),$$

The value of job search is captured by

$$J(\tau+1,\alpha,a+1) = \max_{s\geq 0}\left\{\pi(s)V^1(0,\alpha) + (1-\pi(s))V^2(\tau+1,\alpha,a+1) - \psi(s,a)\right\}.$$

Note that given our assumptions, both $V^1(\tau,\alpha)$ and $V^2(\tau,\alpha,a)$ are concave in s.

Optimal Search Intensity. If the worker decides to put effort into search, by the envelope theorem and our assumption on the shape of search costs, optimal search intensity is implicitly defined by the first order condition

$$s^* = \frac{\lambda p}{\gamma(a)}\left[V^1(0,\alpha) - V^2(\tau+1,\alpha,a+1)\right]. \tag{1}$$

Search intensity is chosen by trading off the marginal benefits of an increase in search intensity with the marginal cost. We use this relationship to obtain basic comparative static results needed to assess the predicted persistence of initial conditions in this model. Note that optimal search intensity may drop to zero. We will return to this question below.

Comparative Statics. Differentiating equation (1) allows us to obtain key inputs into our main results concerning the persistence of initial conditions. First, search intensity declines with job tenure at the low productivity firm, $\frac{ds^*}{d\tau} = -\lambda p \frac{\delta_2}{\gamma} g'(\tau)$. Similarly, search intensity declines with the cost of search, $\frac{ds^*}{d\gamma} = -\frac{\lambda p}{\gamma^2}\left[V^1(0,\alpha) - V^2(\tau+1,\alpha,a+1)\right]$. These results capture the notion that search frictions interact with the tendency of mobility to decline as workers age into the labor market. While labor market entrants are 'newly minted' and flexible, the cost of job mobility and with it the degree of persistence of initial conditions increases over time.

Second, high skilled workers search more intensely since they benefit more from search, $\frac{ds^*}{d\alpha} = \frac{\lambda p}{\gamma} w_1$. This is a direct implication of our assumption on the wage structure, and leads to sorting of more able workers to high productivity firms over time. The advantage of high skilled workers is decreasing with

mobility costs, which affect high skill workers more than low skilled workers, i.e., $\frac{d^2 s^*}{d\alpha d\gamma} = -\frac{\lambda p}{\gamma^2} w_1$, something we exploit below. The model predicts various other interaction effects. Among others, increases in the wage offer distribution p or the natural arrival rate of offers λ offset the tendency to reduce search with age. Higher frequencies of job offers also increase search intensity more for high skilled workers.

3.2 The Long-Term Effect of Initial Conditions

We next turn to the implication of these results for the persistent effect of initial labor market conditions. This yields the main five implications of our model.

Implication 1: "Constant Search". It is useful to first derive the effect of initial conditions on mean earnings and job mobility for the case of a fixed search effort $s = \bar{s}$ in all periods. Let the probability that the worker is in firm 2 in the initial period be $1 - p_0$. The probability of changing from firm 2 to firm 1 in each period is $\lambda \bar{s} p$. Then by recursion, after T periods in the labor market the conditional probability of still being at firm 2 (the conditional CDF of wages in our model) is

$$\Pr\{\text{Firm } 2 \mid T\} = \Pr\{\text{Firm } 2 \mid 0\} \exp\{-(\lambda \bar{s} p)T\} = (1 - p_0) \exp\{-(\lambda \bar{s} p)T\}.$$

This probability is an important determinant of the evolution over time of the conditional rate of job mobility and conditional mean earnings

$$\Pr\{\text{Job Move} \mid T\} = \lambda p \bar{s} \Pr\{\text{Firm } 2 \mid T\}$$
$$E\{w \mid T\} = \omega_1(T) - [\omega_1(T) - \omega_2(T)] \Pr\{\text{Firm } 2 \mid T\},$$

where $\omega_1(T)$ and $\omega_2(T)$ are conditional mean earnings for workers in firm 1 and 2 at time T, respectively. Since $\omega_1(T) - \omega_2(T) > 0$ under weak conditions for all T, convergence after an initial down ranking of workers to lower quality firms will eventually attain.[29]

To examine the effect of initial conditions, it turns out to be useful to define the rate of decay of initial labor market conditions as

[29] Note that $\omega_j(T) = E\{w \mid \text{Firm j, T}\},\ j = 1,2$ also depends on search intensity and on initial conditions through average job tenure and average ability; $\omega_1(T) - \omega_2(T) > 0$ holds as long as $\delta_1 \geq \delta_2$ and $E\{g(\tau) \mid \text{Firm}1, \text{T}\}$ converges reasonably fast to g(T). This will hold for in particular for smaller values of τ^* (as T> τ^*), the tenure year at which we assume the returns to tenure to become constant. As argued above, a small value of τ^* fits empirical estimates of the causal returns to job tenure.

$$R(T) \equiv \frac{d^2 \Pr\{\text{Firm 2} \mid \text{T}\}}{d(1-p_0)dT} \Big/ \frac{d \Pr\{\text{Firm 2} \mid \text{T}\}}{d(1-p_0)} = -\lambda sp < 0. \quad (2)$$

R(T) captures the change of the marginal effect of initial conditions over time on the probability of being in the low state. This rate determines how fast mean wages converge after an initial shock, and how the rate of job mobility responds. Of interest is how R(T) changes with the parameters of the model.

With a fixed intensity of search, the rate of decay R(T) is constant and depends on the given intensity of search s, the natural offer arrival rate λ, and the probability that a given offer is from a high productivity firm p. Low offer arrival rates can lead to persistent effects of shocks. Although few direct estimates of the 'rate of contact' between workers and firms exist, typical estimates in the literature suggest that convergence takes place within 5 to 10 years after entry into the labor market.[30] Clearly, fixed differences in search intensity (or offer arrival) by high and low skilled workers would imply differential rates of catch-up. In the catch-up process, job mobility is higher initially and then declines.[31]

The model with constant search in itself can already explain an important part of our results. However, the rate of decay may not be constant, and in fact it will not turn out to be in our data. Thus, the implications of time dependent endogenous job search are examined next. Moreover, at reasonable values a constant intensity of search cannot explain both the observed rate of catch-up as well as average turnover rate and experience-earnings profiles observed in the data.

Implication 2: "Time Dependent Search." If search effort is chosen endogenously, deriving the conditional probability of remaining in firm 2 with time T in the labor market is slightly more involved.[32] However, the rate of decay of the marginal effect of initial conditions with time in the labor market again takes on a simple and intuitive expression

$$R(T) = -\lambda p s(T) < 0. \quad (3)$$

Implication 2 then follows directly from our comparative static results above – increases in job tenure reduce the rate of decay $\left(dR(T)/d\tau > 0\right)$. That is, as workers accumulate specific human capital in firm 2, their benefits from search decline and they reduce their search effort. In the process, the rate of catch-up in wages due to job search declines. A long literature argues that it is highly probable that workers accumulate at

[30] E.g., using Danish data Cristensen et al. (2005) obtain estimates of λ around 0.5 to 0.6 from a model of endogenous job search with a continuous wage-offer distribution. In a model with fixed search intensity, this would imply convergence from a shock of the magnitude we observe in our data in about years.

[31] None of these results hinge on our assumptions of two firms and hold with continuous wage-offer distributions.

[32] Following Manning (2000), we have that

$$\Pr\{\text{Firm 2} \mid \text{T}\} = (1-p_0)\left[1 - \frac{\lambda}{\Gamma(T)} \int_o^T \Gamma(x)s(x)dx\right], \text{ where } \Gamma(x) = \exp\left\{\lambda \int_o^x s(z)dz\right\}$$

least some industry, occupation, or firm specific skills. Our model shows that this can lead to increases in the persistence of temporary labor market conditions.

Increases in the cost of search with age as workers settle into family and working lives has a parallel effect – while search intensity is high initially, it drops off with time in the labor market $\left(dR(T)/d\gamma > 0\right)$. For example, we know that marriage rates of male college graduates begin rising quickly after graduation. In so far as their wives work or perhaps get children, their search costs might rise, reducing their ability to shed the effects of initial conditions by moving and taking jobs at better firms.

Implication 3: "Differences by Skill Group." Differentiating the rate of decay by our index of skill α shows that high skill workers catch-up faster from bad initial conditions, i.e., $dR(T)/d\alpha < 0$. This is a direct implication of our result that search intensity increases in skill levels. If search intensity is low enough, low-skilled workers may be trapped in the less productive firm, something discussed further in Implication 4. Another implication from our model is that increases in search costs with age have a larger negative effect on search intensity (and thus on the rate of decay) for high skilled workers, i.e., $\frac{d^2R(T)}{d\gamma d\alpha} = -\lambda \frac{d^2 s^*(T)}{d\gamma d\alpha} = \lambda p \frac{w_1}{\gamma^2} > 0.$ I.e., if aging plays a role, search intensity for high skilled should be high initially but drop off more quickly than for lower skilled workers.

Implication 4: "Catch-Up On-the-Job." Once a worker finds a job at a type 1 firm, given our assumptions on g(τ), her earnings will continuously revert to that of similar workers already in the firm as she deterministically accumulates firm specific skills. Given typical estimates of the non-linearity of the wage-tenure profile, this process is likely to be strongest for the first few years on the job, when returns to tenure are thought to be most relevant. Note that the importance of human capital accumulation on the job may differ by skill groups. Similarly, an alternative interpretation is that the wage-tenure profile reflects moves up the job ladder within the firm. If firms tend to offer jobs with high growth potential when economic conditions are good, these improvements may be a function of external labor market conditions (Gibbons and Waldman 2004), something we discuss as possible extension of our model below.

Implication 5: "Zero Search." In our model job search is only positive if $\Delta J \equiv J\left(\tau+1, \alpha, a+1; s^*(T)>0\right) - J\left(\tau+1, \alpha, a+1; s^*(T)=0\right) > 0.$ Since this difference is monotonously decreasing in job tenure in firm 2 (or in search costs), over time an increasing fraction of workers completely stops searching. If this occurs, there is no further catch-up. Given the assumptions of our

model, if search drops to zero it both occurs earlier and is more prevalent for low skilled workers. Thus, it may be that catch-up is incomplete for workers at the lower end of the skill spectrum.[33]

Summary of Implications. Search frictions in the labor market lead to persistence of initial conditions (Implication 1). We have argued that these frictions interact with increases in the cost of job search – either because of aging or because of specific capital – to lead to a drop off in the decay of initial conditions as workers age (Implication 2). Higher skilled workers are predicted to catch-up faster, since they benefit more from search. The drop off in catch-up is thus predicted to be larger for low skilled workers, since due to their lower search intensity they will have caught up less when tenure- or age-related costs begin to matter. However, since increases in search costs have bigger effects for high skilled workers, the difference in catch-up rates due to search is concentrated in the first years after entry (Implication 3). Over time, an increasing fraction of low skilled workers may stop searching altogether (Implication 4). Once workers arrive at high productivity firms, catch-up continues within firms as they accumulate specific skills or move up the job ladder (Implication 5).

Extensions. We have kept the theory as parsimonious as we could while making our basic points. Clearly, the model's descriptive ability could be improved in a variety of ways. We briefly sketch some possible extensions here. First, there may be many firms of either firm type, and workers may keep searching for a good match even once they settle for a particular class of firms. If the intensity of this additional search is fixed, firms post wages, and offers are drawn from a continuous distribution, this affects the continuation value of staying at either firm without affecting our main results. Although this would help to explain continuing job mobility observed in some cases, it adds complexity without affecting our core insights, so we do not pursue it here.

Second, influential models have argued that external labor market conditions affect workers' wages even on the job because of long-term contracting or job assignment.[34] In this case, workers would be affected by initial labor market conditions even after they found a better employer. This has been shown to be empirically relevant in some cases (e.g., Beaudry and DiNardo 1992). We will show below that a similar phenomenon could be at play in our data as well. However, the introduction of non-stationarity would increase the

[33] To see this, note that $\Delta J = \pi(s)[V^1(\alpha,0) - V^2_{s>0}(\tau+1,\alpha,a+1)] + [V^2_{s>0}(\tau+1,\alpha,a+1) - V^2_{s=0}(\tau+1,\alpha)] - \psi(s,a).$ Only the first two terms depend on job tenure at firm 2, and both are monotonously decreasing in tenure. Similarly, the expression decreases monotonously with age, since an increase in age reduces the benefit from search while increasing the direct costs.

[34] See Harris and Holmstrom (1982) and Beaudry and DiNardo (1992) for models of implicit insurance contracts; see Baker, Gibbs, and Holmstrom (1994) and Gibbons and Waldman (2004) for the role of variable job assignment; similarly, models of job search, wage-contracting, and renegotiation could potentially give rise to persistence of labor market conditions on the job (e.g., Cahuc, Postel-Vinay, and Robin 2006).

complexity of our basic model without core additional insight. We limit ourselves to heuristically discussing this aspect below.

Third, another realistic extension would allow lower skilled workers to benefit more from human capital accumulation at highly productive employers. This could be introduced into our model by, say, allowing for a non-zero chance that low skilled workers skills improve (their α increases) after spending some time at firm 1. This would raise the wage gap for a low-skilled worker from staying at the low productivity firm. It thereby reduces the difference between high and low skilled workers introduced by our assumption of comparative advantage. We do not further pursue this in our partial equilibrium approach, since a full exploration of this aspect would require modeling of employers' decision as training low-skilled workers may be more expensive. We come back to these extensions when discussing the empirical results.[35]

Last, introducing job destruction could explain why some low-skilled workers may suffer persistent down ranking to lower quality employers in a recession, without experiencing a permanent upgrading to better firms in a boom. While the model outlines mechanism why workers may not move upwards from lower-quality firms, an exogenous rate of job destruction may imply that over time low-skilled workers graduating in a tight labor market may be pushed out of high-wage firms.

Further Discussion. Several recent papers explore on-the-job search and heterogeneity among workers and firms in a general equilibrium setting to establish the degree of assortative matching (Lentz 2007, Garibaldi and Moen 2007) and the implications for business cycle dynamics (Krause and Lubik 2006a). The key implication of our partial equilibrium analysis for this literature is that the sorting and adjustment processes involved can take a very long time. We also provide a mechanism through which the allocation of workers to firms can be permanently affected by a temporary shock. It is beyond the scope of this paper to extend our analysis to a general equilibrium setting. However, we conjecture that the key mechanisms identified here are likely to hold in a more general framework. First, since our set up bears resemblance to that of Lentz (2007), we expect our result on the effect of skills on search intensity and assortative matching of high skilled workers to high wage firms to attain in a more general setting. Second, age and tenure related costs can be seen as a particular specification of the cost structure in existing models, and our comparative static results should go through as well.[36] However, the time dependent search costs we emphasize imply that

[35] We could also allow workers to choose the intensity of human capital accumulation in response to their initial placement and initial conditions in the labor market. Since we do not have direct observations on training or time worked in our data, the most straightforward way to introduce this into our model would be to allow workers to choose whether to work or not. While in non-employment, workers receive unemployment benefits, but do not accumulate specific (or general) human capital. For some workers at the low end of the earnings distribution (for whom the non-employment option is typically most attractive) increasing labor supply and with it human capital accumulation may be an alternative channel of catch-up to more intensive job search. We will return to this point in Section 7. Human capital in the context of a search model is addressed in Ljungqvist and Sargent (1998).

[36] Given the results in Lentz (2007), we believe that assortative matching would hold in a general equilibrium setting. In particular, since our search costs do not differ by skill-group, we do not have unemployment, and we work with

some workers are less responsive to firm wage differentials, weakening one channel leading towards assortative matching. Similarly, such costs are likely to dampen the cyclical flows between sectors emphasized in Krause and Lubik (2006a).

Another important question is whether the particular search frictions we assume can lead to an inefficient allocation of workers to firms. An economy without age or tenure related frictions returns to the original steady state after a temporary shock. However, under age-related frictions such a shock can permanently alter the allocation of workers to firms. If the benchmark of constant search costs is efficient, the resulting allocation could indeed be inefficient. If wages are approximately equal to workers' productivity, the resulting total loss in output is approximated by the long-term earnings losses we estimate. For some cohorts, the earnings losses are shown to be quite large and very persistent, implying potentially important efficiency losses. The argument is more complex if the allocation is distorted by tenure-related costs, since a change in job-specific skills also implies a modification of the optimal assignment of workers to firms. A full analysis of these considerations is beyond the scope of this paper and necessitates a modeling of firms' responses, since as in models of mismatch the clearing of markets can occur by movements of workers and firms. Our empirical results suggest that the speed of adjustment implied by either of these mechanisms can be very slow.

4. Empirical Strategy and Matched Data

4.1. Cell-Level Regression Strategy and Sensitivity

Our data allow us to observe almost the universe of male college graduates in Canada graduating from 1976 to 1995 from the end of their first college degree for ten years into their careers. To measure the long-term effects on earnings of starting to work in a recession, our main specification exploits cyclical variation in unemployment rates for young workers at the regional level. Since our main independent variable – the rate of unemployment – varies across province and across cohorts, we collapse the individual level data at the level of graduation cohort, initial region of residence, and calendar year and work only with the cell means $\bar{y}_{crt}$ of the log of annual earnings and other variables (weighted by the corresponding cell sizes).[37] The cell level model on which most of the estimates in the paper are based on is

comparative (not absolute) advantage, the problems raised by Shimer and Smith (2000) would not arise. Our main comparative static results should hold as well, possibly adjusted for a response of job creation.

[37] Note that below, to estimate versions of equation (5), we also work with a version of the data that is collapsed at the level of graduation cohort, initial region of residence, calendar year, and region of *current* residence. The only individual characteristics we could include are the actual duration of college and age. Instead of including years of college in an individual level model, we split the sample between workers who graduated and all workers with some college.

$$\bar{y}_{crt} = \alpha + \beta_e UR_{cr0} + \phi_t + \theta_r + \gamma_e + \chi_c + u_{crt} \quad (4)$$

where θ_r, χ_c, γ_e, and ϕ_t represent unrestricted fixed effects for first region of residence (r), year of graduation (c), year of potential labor market experience (e), and calendar year (t). The unemployment rate is measured at the time of graduation and the region of first residence (UR_{cr0}). Given the presence of experience, region, and cohort effects the main coefficients of interest β_e on the initial unemployment rates measure *changes* in experience profiles in earnings and other outcomes resulting from province-cohort-specific variation in unemployment rates.[38] To account for group specific error-components, we cluster standard errors at the cohort-region level.

We interpret the variation in UR to arise from changes in aggregate labor demand that are uncorrelated with characteristics of different graduation cohorts. Year-to-year variations in cyclical labor market conditions that identify our estimates move at a higher frequency than age-specific population, participation, or enrollment trends.[39] To make sure we pick up mainly effects occurring due to demand conditions and avoid influences from cohort-specific labor supply changes of young workers, in our sensitivity analysis we have also used the unemployment rate for all workers as measure of initial labor market shock.[40] Remaining differences between graduation cohorts at the national level are taken out by cohort fixed effects. Below and in the appendix we address other potential biases due to changes in cohort quality at the regional level from selective graduation and selective employment. We also present a wide range of specification and robustness checks, such as different sample restrictions or different cohort restrictions.

Dynamic Effects. Since the state of regional labor markets continues to influence workers' earnings even after labor market entry (e.g., Oswald and Blanchflower 1994), our basic estimate of the effect of the first unemployment rate exposure captures the average change in earnings from graduating in a recession given the *regular evolution of the regional unemployment rate faced afterwards*. In other words, it estimates the dynamic effect of the first unemployment rate plus the weighted sum of the effect of unemployment rates a worker

[38] As it is well-known, cohort, potential experience, and year effects cannot be identified separately without an additional restriction on cohort effects is needed. Since we are mainly interested in experience effects and in their change over the business cycle, we simply drop one additional cohort effect from the regression. We could have chosen to restrict cohort effects to sum to zero (as suggested by Deaton 1997). This alternative does not alter our estimates of the experience profile. We also have assessed the linearity assumption implicit in Equation (1) by plotting and regressing the residuals of earnings and unemployment rates (from first stage regressions on province, year, and cohort dummies) by experience years. The results (shown in Appendix Figure 2) suggest that the linearity assumption is highly plausible.

[39] Despite increases in college enrollment rates in Canada since the 1980s, the correlation between unemployment rates for young and old workers is high and it has remained stable (Beaudry et al. 2000).

[40] Similarly, to assess the role of participation changes, we also replicated our results using the employment-population-ratio for 15 to 24 year olds.

faces in his career.[41] To isolate the effect of labor market conditions at entry net of subsequent effects on earnings from exposure to a possibly prolonged recession or expansion, we have also estimated a series of models that control for the history of regional unemployment rates that workers experience throughout their career. Among others, this helps to distinguish the role of labor market conditions at entry from the effect of labor market conditions when entering a new firm in mid-career (as stressed for example by Beaudry and DiNardo 1991). This also allows us to assess whether the effects of aggregate unemployment rates at time of entry to the effect of unemployment rates differ from that experience by more mature workers.

We began by including the current unemployment rate interacted with experience as an additional control, and also experimented with a more complete dynamic model. The effect of the early unemployment rate turns out to be remarkably stable in all specifications we try. We allow for dynamic effects of the aggregate unemployment rate a worker was exposed to at each in experience year (e) in the relevant region (r_e), denoted by $UR_{r_e e}$ (this unemployment rate will differ for different graduation cohorts). Denote the effect on earnings in experience year e from the unemployment rate at experience year 0 (1,2,3,4,…) by $\beta_{e,0}$ ($\beta_{e,1}, \beta_{e,2}, \beta_{e,3}, ...$). Dropping other regressors and the region subscripts on the unemployment rates for simplicity, the complete dynamic model can be written succinctly as

$$\bar{y}_{crt} = \phi_t + \theta_r + \chi_c + \gamma_e + \beta_{e,0} UR_{cr0} + \beta_{e,1} UR_{r_1 1} + \beta_{e,2} UR_{r_2 2} + ... + \beta_{e,10} UR_{r_{10} 10} + \varepsilon_{crt} \quad (5)$$

where we impose the restriction $\beta_{e,s} = 0 \; \forall \; s < e$. The full dynamic regression estimates the effect of the transitory component of each aggregate unemployment condition, net of its correlation with other unemployment rates affecting the worker in adjacent experience years. Due to high inter-temporal correlation of aggregate unemployment rates, it is difficult to estimate the fully unrestricted model in Equation (5). However, it turns out that more parsimonious models can yield the desired results.[42] In our final specification,

[41] With the notation of Equation (5
) the omitted variable bias of the coefficients on the first unemployment rates is

$$p\lim \hat{\beta}_{e,0} = \beta_{e,0} + \sum_{d=1}^{e} \beta_{e-d,d} \frac{\text{cov}(UR_{rt0}, UR_{r_d d})}{\text{var}(UR_{rt0})}.$$

[42] For example, the time series process of unemployment is often characterized as an AR(2) with high persistence of the first lag. In this case, the first two leads of unemployment (i.e., unemployment at experience years one and two) should remove omitted variable bias from the dynamic effect of the unemployment rate at experience zero. We estimate the full dynamic model including unemployment rates at all periods fully interacted with experience dummies, as well as a more restricted model with only two additional unemployment rates. As expected, these models give similar results. (Some prefer to model it as ARIMA(1,1,0), but often a prior of stationarity is invoked to distinguish a persistent AR(2) from the similar non-stationary process (e.g., Blanchard and Katz 1992)).

we use a restricted model in which we constrain the effects of unemployment to be the same in groups of experience years. This model is further discussed in the Appendix.[43]

Sensitivity. As suggested above, our identification strategy allows us to obtain an estimate of the effect of early labor market conditions if there are no unobserved characteristics correlated with the initial unemployment rate that vary with experience. This may fail if early labor market conditions affect workers' labor supply decisions (e.g., see Bils 1985, Solon, Barsky, and Parker 1994). The labor force exit of less able workers would lead to an *understatement* of any negative effect of unemployment rates on earnings, and our estimates would represent a lower bound (however, if worse workers reenter the labor market with a time lag, it would lead us to over-estimate persistence). As we show below, initial unemployment rates have small effects on the propensity to temporarily exit our earnings sample due to unemployment or non-employment. To further address the problem of selective labor force participation, the large sample sizes allow us to re-estimate our main models using a sample of workers with positive earnings in each period.[44] In addition, to focus on a sample of men with stable labor force attachment, we drop those who permanently stop filing taxes at any point in time. Since this group may contain workers who emigrate (mainly to the U.S.) for economic reasons, we compare our main results including those who permanently stop filing in the Appendix.

Individual characteristics might also correlate with unemployment rates at college exit if more able students remain in college longer to avoid graduating in a recession. If better students delay graduation, that would lead us to *overestimate* the initial negative effect and underestimate the degree of persistence. This is unlikely to explain an important part of our estimates of persistent effects because the process of reversion of initial losses takes too long to be explained by lagged entry of more able workers. Two additional results lead us to believe the bias from selective entry is small. First, a detailed analysis of college duration in response to unemployment rates at actual and predicted time of graduation indeed suggests there are only small increases in the duration of college in response to unemployment rates for our preferred sample. Second, to also address the problem directly, we use information on the date of *entry* into college and official degree duration to construct predicted graduation dates for all graduates in our sample. We then use the unemployment rate in the *predicted* year of graduation as an alternative source of variation to identify the long-term effect of initial labor market conditions. In the appendix, we discuss two sets of estimates based on this additional measure.

[43] Instead of imposing restriction across experience years, we have also experimented with more parametric models of the decay of the initial effect of unemployment. While an exponential rate of decay is rejected by the data, the dynamic behavior of unemployment rate effects could be capture reasonably well by a fourth order polynomial in the time of the shock. However, this approach doesn't solve the problems inherent in the data – too persistent unemployment shocks and too few cohorts at older ages.

[44] This is generally not possible in the smaller survey data sets used to assess this kind of bias (e.g., Bils 1985). To further check for selective participation decisions, we also analyzed changes in predicted earnings with experience and with early unemployment shocks. While there is a very small but significantly negative gradient in predicted earnings with experience, perhaps suggesting a pattern of migration, there is basically no correlation with early unemployment shocks.

First, we show reduced form estimates using the unemployment at predicted graduation as the relevant labor market shock. The second set of estimates present instrumental variable estimates using the unemployment rate at the predicted date of graduation as an instrument of the unemployment rate at actual graduation. Since the case can be made for either approach, we present both.[45]

Alternative Mechanisms. Since initial labor market conditions will affect earnings through multiple channels, the estimated coefficients in the regression of log earnings represent reduced form effects of the initial unemployment rate on earnings-experience profiles. We provide an assessment of the importance of each channel by analyzing its response to the initial unemployment rate. We also combine information on the most relevant channels to decompose the overall persistent effect of initial labor market conditions. Thereby, we examine the role of three sets of variables: first, outcomes related to employment such as receipt of unemployment insurance, filing income taxes with zero earnings, and not filing taxes. Second, outcomes relating to job mobility, such as changes in workers' main employers, changes in industry of main employer (at the one, two, and three digit level), mobility across provinces, and whether workers left their first employer or their first industry. Third, we analyze the effect of graduating in a recession on the characteristics of young workers' employers. As described in the Appendix, we construct average log median earnings, average total payroll, and average number of employees at the firm level, averaged over the entire period of existence of the firm for all employees (not only workers with college education) controlling for aggregate year and region effects. If more able workers are sorted into better firms, the wage measures do not necessarily capture the fixed firm component in pay rates, but a more inclusive measure of 'firm quality'. Results by Abowd et al. (2003) suggest that this correlation may be weak. We use multiple measures of firm quality in case some measures include workers more selectively than others.

Another potential channel of how workers regain their lost earnings is mobility across provinces (Wozniak 2006). However, the descriptive analysis shows that regional mobility is much lower in Canada than the U.S. To assess directly whether reversion occurs by moves to economically vibrant provinces, we included the history of aggregate unemployment rates and fixed effects for current province of residence interacted with year effects as explained above. To check whether provincial mobility is beneficial for other reasons (for example due to the wider scope for good job matches), we have also analyzed the incidence and returns to provincial mobility directly as an outcome and found them to be small. In addition, variation at the national level represents shocks affecting the entire labor market whose effect is unmitigated by inter-regional mobility. Thus, we also present estimates based on variation of unemployment rates at the national level.[46]

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[45] Note that if the graduation date is endogenous, so are potential labor market experience and initial cohort effects. We have estimated a series of reduced form models with predicted cohort effects and predicted experience with little change in the main results. Earnings are predicted based on college and major as discussed in Section 5.3.

[46] The national model we estimate is

$$\log \overline{w}_{ct} = \alpha + \phi_t + \gamma_e + \beta_e UR_{c0} + \chi_0 c + \chi_1 c^2 + u_{ct},$$

4.2. Canadian Administrative Data and the Evolution of Careers

Our results are based on a unique match between three large administrative data sets collected and compiled within Statistics Canada that is described in detail in the Data Appendix. The data combines administrative information on about 70% of Canadian college students and college graduates from 1976 to 1995 with longitudinal individual income tax records and firms' payroll information covering the years from 1982 to 1999.[47] The data contains detailed information about individual students' course of study (such as type of degree, major, date of graduation), with detailed career information (e.g., annual earnings, province of residence, receipt of unemployment benefits) and information on employers. Exploiting the panel nature of our firm data, we calculate average firm size, average median wage, and total payroll taken at the establishment level, with year fixed effects taken out. All firm characteristics refer to permanent attributes so that they remain unchanged across the worker panel (i.e., an individual's firm characteristics can change only if she moves employers).

To generate a uniform sample with a common definition of labor market entry, we focus on the effect of recessions at the end of the *first* exit from college and exclude workers obtaining higher degrees from our sample.[48] As shown in Appendix Table 1 even within this relatively homogeneous sample there is a high rate of drop out and high variance in college attendance. Despite the use of administrative data there is likely to still be some measurement error in actual graduation in our data. Thus, our main sample excludes college dropouts to focus on a more homogenous group of workers with better measured graduation date. To do so, we calculate the difference (D) between actual and predicted graduation year, and keep only workers with non-negative difference. The right columns of Appendix Table 1 show characteristics for that sample. Among the sample of workers on or above grade 89% graduate, and average duration of college is about 4 years.[49]

To assign the unemployment rate at the time of graduation, we have to choose a relevant province of residence. We settled for the province of first residence as the relevant labor market for young college graduates.[50] We impose some additional basic sample restrictions and limit the degree of missing observations

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where the dependent variable is real earnings, and ϕ_t and γ_e represent calendar year and potential labor market experience effects, respectively. The national model includes either linear or quadratic cohort trends, since unrestricted cohort effects are not identified.

[47] The word 'college' is somewhat a misnomer in Canada because it is used usually to refer to one or two year community-level post-secondary institutions rather than degree-granting universities. In keeping with the terminology most often used, we shall refer to Canadian universities as colleges.

[48] Since we find early recessions do not affect the probability of obtaining a graduate degree, this does not affect our results. We have experimented with other definitions of the relevant date of labor market entry (such as last degree or last degree of continuous education), with little effect on the results. In the sensitivity analysis, we also show results using a sample that includes workers obtaining a post-graduate degree.

[49] By restricting our main discussion to graduates, we are also sure of picking up the effect of early unemployment rather than the drop out decision. Our data suggests undergraduates are unlikely to finish early or drop out because of labor market conditions. Not surprisingly, the most of the results hardly differ when replicated with the full sample.

[50] The alternative, province of college, gives similar results. Appendix Figure 1 compares the effect of the two choices for our main estimates. With choice of province of college as the relevant labor market, the unemployment rate at

on earnings. In particular, we drop workers who permanently stop filing taxes with the purpose of removing individuals who stopped being recorded annually because they left the country, obtained a new personal identification number, entered the underground economy, or their file was simply miscoded along the way. Further sample restrictions are discussed in the Data Appendix.

Figure 1 and Appendix Table 3 describe the general experience profiles and mobility patters in our data, and also document the many similarities between experience profiles in Canada to those in the US. To summarize briefly, the first years of the careers of young male Canadian college graduates are characterized by steep wage growth (also documented for the U.S. by Mincer 1974, and Murphy and Welch 1990), frequent job changes (Topel and Ward 1992, Giuliano and von Wachter 2004), initially unstable labor force attachment (Ryan 2001, Gardecki and Neumark 1998), some interregional mobility (Wozniak 2006), and frequent industry changes (McCall 1990, Neal 1995, Parent 2000). In addition, we document a strong experience gradient in average size and average wages paid by employers – from year one to ten, average firm size and average firm wage increase by 34% and 24%, respectively (Appendix Table 3). Male Canadian graduates tend to move to firms that on average pay more and are larger the longer they progress through the labor market.[51]

The time series of unemployment rates at the provincial level and the provincial average are shown in Panel A of Figure 2. Canada experienced two major recessions in the early 1980s and 1990s that increased young workers' unemployment rates for certain years by more than seven percentage points. We use this variation for our national specification.[52] Figure 2A also displays a high degree of regional heterogeneity. During this period, an increase of unemployment rates of 5 percentage points (or about two standard deviations, see Appendix Table 1) describes a typical large recession.[53]

A potential concern discussed in Section 4 is whether the variation in youth unemployment rates in Figure 2A also represents changes in the supply of male college graduates. Although education-specific unemployment rates are too noisy for most provinces, the unemployment rate for young college educated men for the larger states, such as Ontario or Quebec, are closely correlated with the youth unemployment rate and the average unemployment rate. As noted above, aggregate unemployment rates between older and

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experience year zero fails to pick up some effects of the unemployment rate at experience year one that are absorbed if we choose province of first residence as relevant market. This leads us to believe that province of first college has a stronger measurement error than province of first residence. If we group 0-1 together, the results of the two choices are indistinguishable. An examination of the incidence and gains of province mobility leads us to believe that selective mobility from province of college to province of first residence is small.

[51] Using data from the Current Population Survey Appendix Table 5 shows that a similar pattern is also present in the U.S. (see also Figure 1).

[52] The picture shows unemployment rates for 15 to 24 year olds. Using unemployment rates defined for workers age 20 to 24 or for college graduates only does not substantially alter the pattern of unemployment over time or across regions, nor does it affect our results.

[53] Panel B of Appendix Table 1 shows summary statistics. Appendix Table 1, Panel C also shows the distribution of our sample between provinces and the mean and standard deviation of unemployment across Canadian provinces. The sample of students differs across provinces because of population differences and college representation. We address this by including initial province fixed effects (and sometimes also current province fixed effects).

younger workers in Canada move in parallel at different levels; this appears to hold for college graduates as well.

5. The Persistent Effect of Initial Labor Market Conditions on Earnings

Panel B of Figure 2 shows average earnings-experience profiles of the graduation cohorts in our data at the national level together with their entry wage at experience one (their first full year of work) and the average wage for 'mature' workers (workers with 5 to 10 years of experience).[54] One can clearly see differences in starting wages across graduation cohorts leading to differences in average cohort earnings. Thus, as found by others, if we were to add cohort effects in a simple earnings recession, they significantly improve the fit of the model. However, the figure also shows a clear pattern of convergence. That is, initial differences in starting conditions appear to fade over time. Cohort effects appear to have a time-varying component, or, as noted by Beaudry and Green (2001), experience profiles vary across cohorts.

There exists a strong correlation between starting wages and initial unemployment rate conditions, which persists into higher experience years and slowly fades over time. This is shown in Panel A of Figure 3, which graphs national unemployment rates for young workers with wages at different years of experience by graduation cohort (both expressed as deviations from their means across cohorts). The correlations in Panel A strongly suggest that part of the initial but fading earnings differences in Figure 2B are driven by variation in initial labor market conditions. In addition, Panel B in Figure 3 compares the effect of aggregate unemployment on wages for workers with different labor market experience – the figure clearly shows how college graduates just entering the labor market bear most of the burden of recession adjustment, something we will return to below.

The correlation at the national level shown in Figures 2 and 3 is also exploited in Table 1, which shows the long-term effect of national unemployment rates on log real earnings, controlling for year and experience effects and linear or quadratic cohort trends. Column (1) and (4) show the shift in experience profiles due to an unemployment shock in experience year zero including a linear cohort trend for all workers with some college and those in the graduate sample, respectively. Standard errors are clustered at the level of graduation cohort to allow for group level error terms. The results suggest a strong initial effect that persists but fades after about five years in the labor market.

5.1. Main Regional Models

Our main results are drawn from regional models that include cohort effects as well as effects for initial province of residence as described in Section 2. The shifts in experience profiles due to an initial provincial

[54] Graduation cohorts 1976 and 1994 have lower and higher average earnings then the rest of the sample, respectively, due to variation in college reporting rates (Appendix Table 2A shows the respective decline and increase in sample sizes). In the regression models, this is accounted for by cohort fixed effects; in the figures these two cohorts are dropped.

unemployment shock are shown in Column 3 of Table 1 for all workers with at least some college and Column 6 for the graduate sample. The initial effects are similar in size to those from the national model, but starting at experience year four the regional estimates remain more persistent, and converge to zero only after 10 experience years. Although estimates for the graduates are slightly more precise, there is little difference in the point estimates for graduates and all workers with some college. This is apparent in Figure 4A, that plots the main coefficient estimates against potential experience. It does not appear that those with a college degree fare better than the full sample.

Comparing national results with the regional results, we can exclude a strong correlation of initial unemployment rates at the national level with changing unobserved cohort characteristics. Similarly, as shown below, it does not appear that the regional results are driven by more persistent unemployment shocks. However, national estimates may be more strongly affected by measurement error problems due to mis-assignment of the relevant initial labor market shock. Inter-regional mobility is less common in Canada than in the U.S. Thus, the relevant labor market shock is at the regional level, an effect only partially absorbed by the national unemployment rate. Low regional mobility (and, as shown in Oreopoulos et al (2006), lower gains to mobility) also explains why results from the national model are not larger than the regional model.

Due to the presence of continuing exposure to adverse labor market conditions, these estimates represent a summary of the earnings losses the average worker can expect due to entry in a depressed labor market. With an increase in unemployment of 5 percentage points – roughly a shift from boom to recession in our sample – annual wages are about 9 percent lower in the first year after college, still 4 percent lower after 5 years out, and about 2 percent lower 9 years out. Overall, we view the regional and national results as telling a consistent story. Graduating during a recession leads to significantly lower earnings at the beginning of an individual's labor market, but the gap converges to zero within six to eight years after graduation. These results are consistent with estimates from the literature on the "wage curve" in the US.[55] They are also consistent with estimates by Bloom and Freeman (1988) who find that initial effects due to differences in cohort sizes fade after ten years. Similarly, Devereux (2003) finds among a sample of workers from all ages that half of a wage-shock, instrumented by local unemployment conditions, is still present after about five years. Kahn (2006) finds somewhat more persistent losses in earnings than ours, perhaps due to her focus on graduates entering the strong recession of the early 1980s.[56]

[55] The results are also consistent with previous evidence on the impact of unemployment on wages in Canada. Blanchflower and Oswald (1994) obtain a coefficient for log annual earnings on province unemployment controlling for region and year fixed effects for a representative sample of Canadian workers of -.013 (Table 8.3). This is very similar to what we find for male college graduates, despite the fact that their regression models include a range of individual characteristics. They also report an elasticity of -.065 for workers with university degrees and -.169 for workers less than age 25 (Table 8.4). If we divide our estimated coefficients by the average unemployment rate (14%), we obtain an elasticity of -.11 to -.13 for our younger sample of graduates. The corresponding results for the U.S. are an elasticity of -.102 for all workers, -.064 for workers with at least 13 years of schooling, and -.192 for workers age 25 or less.

[56] When we focus on workers graduating in the early 1980s, we find larger losses as well (Figure 5, Panel D). Since by to the cyclical nature of unemployment, life-time unemployment exposure is partially determined by the timing of entry, the

Dynamic Effects. The entry into a depressed labor market appears to leave persistent but temporary scars. To isolate to what extent our results are driven by only a short-term initial exposure to adverse labor market conditions, the large samples and ample cohort variation at our disposition allow us to control for the confounding effects of regional unemployment persistence. This is done in the first column of Table 2, which adds an interaction between unemployment rate in current state of residence and experience, as well as fixed effects for current state of residence.[57] As predicted, the initial effect is reduced by persistence of labor market conditions, but the difference is small. Results by Beaudry and DiNardo (1991) suggest that ensuing labor market conditions may have persistent effects themselves for workers not changing employers. Similarly, job search predicts that unemployment conditions at the beginning of employment spells persist for job changers. As shown in the remaining columns of Table 2, and discussed in more detail in the sensitivity analysis in the appendix, the basic results are not affected if we allow for persistent effects of other labor market conditions as well. The results of the grouped model discussed in Section 4 and the Appendix are displayed graphically in Figure 5 (Panel A). A part of the effect of initial unemployment rates is due to persistent effects of continuing labor market conditions, but the bulk is driven by the very first shock alone.

Sensitivity Analysis. Figure 5 (Panel B) also summarizes another important step of the sensitivity analysis, the question of selective college graduation, which is discussed Section 3.1 and in more detail in the Appendix. Summarizing, since most of our measures indicate insignificant effects of unemployment rates on college duration, selective timing of graduation does not appear to be an important phenomenon in our data. Not surprisingly, when we use the unemployment rate at predicted graduation as instrument our estimates confirm the main ordinary least squares results. Although all our results go through with the instrumental variable estimate, in what follows we report the more efficient ordinary least squares estimates.

The remaining panels of Figure 5 show two further sensitivity checks. First, as we alluded to in Section 3.1, Panel C shows that there are only small (and not significant) differences in the effects when we only include workers always present with positive earnings. Second, Panel D shows that although there are some expected differences in the effects of initial labor market conditions across cohorts (e.g., graduates entering in the strong recession of the early 1980s suffer larger and more persistent effects), our results are not driven by any particular cohort.

These results (Figure 4A, Table 1) are also robust to a variety of additional sensitivity checks. First, our results do not seem to be driven by any particular measure of labor market conditions. To counter the

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fortunes of cohorts may differ. Below we try to control for some of these differences directly. To assess whether the average profiles are driven by single 'unlucky' cohorts, Panel D of Figure 5 shows the same estimate for several cohort groups. While some differences across cohorts are apparent in the size of the initial shock and the speed of reversion and a subset of cohorts graduating in the early 1980s appears to experience more persistent effects, overall the patterns of initial loss and reversion are very similar across cohorts.

[57] Note that since we only observe full history of province of residence for cohorts graduating 1982 onward, Table 2 uses only these cohorts. As further discussed in the sensitivity analysis, the effects for all cohorts are comparable.

concern that the unemployment rate for young workers may be affected by cohort characteristics, we replicated our results with the unemployment rate for all workers (Appendix Figure 1, Panel A). We also find similar results from using the employment population rates for workers age 15 to 25 (or men only). Second, we compare the effect of average unemployment rates in experience year zero, 0 to 1, 0 to 2, and 0 to 3 (Appendix Figure 1, Panel B).[58] While high average unemployment in the early years tends to make the effects more persistent, it does not appear that the effects captured in the main models are driven by periods of extended unemployment. As confirmed by the results in Section 4.3., the driving force behind our main results is the shock in the very first years after entry into the labor market.

We have tried various other sample and specification choices, none of which substantially affected our results. Including college students who enter the labor market after a graduate degree has no effects on our results (Appendix Figure 3) suggesting workers do not selectively enter advanced degree programs due to unemployment. We also tried various ways of excluding workers with repeatedly missing wages, and find little effect on our results.[59] We have re-estimated all of our results using the province of college as the region for the relevant initial shock with no basic change in our results. [60] Part of the reason why regional results show more persistent effects of initial labor market conditions on wages might be that workers are 'stuck' in persistently slack regional labor markets. To address this possibility, we also included current province by current year fixed effects (shown in Appendix Figure 1, Panel C), which barely show any differences in the results. This is also an additional indicator that mobility towards provinces with higher wages is not a strong source of catch-up in our sample.

5.2. Larger Effects for Labor Market Entrants

To put the magnitude of the effect of initial labor market conditions we find into further perspective, Figure 5 (Panel A) shows the dynamic effect of a shock occurring at experience years two to three from the grouped model with full history controls (Table 2, Column 7). To make the dynamic pattern comparable with that of the first group, the table shows coefficients relative to the time of the shock (i.e., experience zero now

[58] Note that since unemployment history is available only for cohorts entering after 1981, these show more persistent effects than the full set of cohorts used in Table 1. We also used the unemployment rate for young men instead of that for all young workers, again with no difference in results.

[59] Appendix Figure 3 shows the results with those who permanently stop filing included. We also used the sample of workers with a valid match to their father's income to assess the degree of selective exclusion due to non-filing. Although having a valid match to father's earnings is affected by initial unemployment, perhaps through an effect on regional mobility, if we replicate Table 1 using only those with a valid match the results are very similar as for all workers. We conclude that workers with a valid father's income match are similar to the entire sample. We then regressed average father's lifetime income and "stopped filing", with insignificant and small slopes.

[60] As shown in Appendix Figure 1, Panel C the results for earnings are marginally weaker initially but as persistent. This is likely due to measurement error, since in this case the shock in the province of residence at experience year one has very strong effects. If we group experience years zero and one together, the effects are very similar. While there may be a concern about selective mobility based on the unemployment shock in the province of college, we feel the effect of measurement error due to the mis-assignment of initial province is larger. This is supported by relatively low incidence and gains from regional mobility.

relates to the moment of the shock). The effect of a shock experienced at experience years 2-3 is much smaller than the effect of a shock at entry (0-1) for all experience years. Our period is too short to observe complete reversion but the point estimates are insignificant after 4-6 years. Inspection of the data leads us to believe that the dynamic effects for shocks at later experience years are small.[61]

To explore the difference between labor market entrants and more mature workers further we also analyzed the profile in the effect of unemployment rates on earnings and all of the other outcomes we consider by five experience groups (see Oreopoulos, von Wachter, and Heisz 2006, Table 5). The results strongly confirm the exceptional role of labor market entrants vis-à-vis mature workers. First, in all outcomes there is an important experience gradient of the effect of current unemployment rates. Thus, pooling different experience levels would obscure important effects present in the data. Second, unemployment conditions in the local labor market matter three to four times as much for labor market entrants than for workers who already progressed into their career by a few years. Third, the estimated gradient is as expected from results of the previous literature. For example, job to job mobility of mature workers declines in recessions (Shimer 2005a); effects on non-employment are small; and average firm size increases for mature workers (since smaller plants are more likely to close). Note that since later experience years pick up some of the persistent effect of the initial shock, the difference between the effect of unemployment at experience years 0-1 and 2-3 or later years is understated. A replication of the table with full dynamic controls yields qualitatively similar results but larger initial differences.

5.3. Larger Effects for Entrants at the Bottom of the Skill and Earnings Distribution

Although differences in the effect of labor market conditions by initial background is a recurring question in economics, very little is known about the degree of heterogeneity in the persistence of initial effects, or how different groups of workers catch-up after an initial shock. Yet, these differences are of special interest for our purposes, because they provide an additional source of variation to assess the economic mechanisms underlying the adjustment process. We use our data to examine whether college graduates with lower predicted wages, based on college background, are more adversely affected by higher unemployment rate conditions. We first use a linear regression model to predict log earnings based on college attended, program of graduation, and years of study, conditional on province of study and cohort year.[62] Since individuals are

[61] Our sample of cohorts is small at later experience years, such that the cohort variation shown in Appendix Figure 1 does not allow us to estimate the average dynamic effects of shocks at later experience years.

[62] A similar approach to assess college quality is followed by Betts, Ferrall, and Finnie (forthcoming), who use the same college data and information on wages after graduation as we do. After analyzing majors and colleges separately, in our final specification we interact major and college dummies. The results by major are shown in Appendix Figure 4 for earnings, the analysis for colleges and other outcomes is in the Web Appendix. Differences by major or college in itself are as expected (e.g., humanities graduates do worst, then come social sciences, economists and engineers are in the middle range), but too broad to yield a prediction of individual earnings capacity. This exercise is done for the graduate sample only, since it is conceptually harder to assign college quality for drop-outs.

likely to be sorted into colleges, these estimates will capture both differences in innate ability as well as differences in college quality.[63] We then group individuals into quintiles based on these predicted wages.

Figure 6 shows the same coefficients for the effects of the initial unemployment rate on log earnings, job mobility, individual's firm's log median earnings, and employment as in the baseline model, but for regression models estimated separately for the first, third, and fifth predicted wage quintiles (this figure corresponds to Figure 4, Panel A for the full sample). Table 5 summarizes the key structure of losses by quintile and compares them to results for the full sample. For the sake of exposition, the table displaces three parameter estimates for the initial dip, first recovery, and final fade of earnings losses in an approach mirroring that of Jacobson, Lalonde, and Sullivan (1993, Table 2). As apparent from the table and figure, those with the lowest predicted annual earnings are most affected by higher initial unemployment conditions and experience permanent earnings losses. Earnings one year into the labor market are about 15 percent lower from a 5 percentage point increase in the initial unemployment rate, and, in this case, remain about 7.5 percent lower even after 10 years. The top quintile's earnings are on average about 7.5 percent lower in the first year after a five point increase in unemployment rates, but the gap falls to less than 2 percent after only 4 years.

Costs of Recessions. The longitudinal data allows us to obtain a direct measure of the cost of recessions that is a useful complement to measures in the literature based on the standard deviations of earnings. Figure 7 (Panel A) graphs two summary measures of the present discounted loss due to entry into the labor market in a recession by deciles of the predicted earnings distribution. First, it plots the percentage decline in the present discounted value of annual earnings; second, it shows the fraction increase in annual earnings a worker would require to be indifferent between the noisy earnings path and an alternative, stable path. The latter corresponds conceptually to the original Lucas measure where we have replaced consumption by annual earnings and is comparable to several estimates of costs of recessions in the literature.[64]

Figure 7, Panel A has two key messages. First, there is an important gradient in the cost of recessions in predicted earnings – those individuals with lower earnings capacity have four to five times costs of recessions than the most advantaged workers. The least advantaged appear to bear most of the costs of recessions. Second, the losses from starting to work in a recession as measured by actual changes in the present discounted values of earnings or utility losses are high even for the more able workers. In particular, for the

[63] This is discussed extensively in Black and Smith (2003), Black, Kermit, and Smith (2005), or Dale and Krueger (2002). An advantage of our data relative to the literature on college quality in the U.S. is that we have access to earnings histories. Using the same data as ours, Betts et al. (2000) find that the effects of observable measures of college quality on earnings are small.

[64] This approximation has clearly important flaws, since social insurance programs smooth temporary earnings shocks and may lead consumption to be less volatile than earnings. On the other hand, this might be less of a concern for highly educated workers whose take up of social programs is low. Here we follow the literature on the costs of recessions by approximating the risk faced by individuals with earnings risk. Cutler and Katz (1991) discuss the usefulness of earnings as a measure of inequality and the effects cyclical shocks.

median worker in our sample they are much higher than what is typically found in the literature.[65] Since these estimates are based on actual changes in earnings in response to a recession shock, they complement existing estimates of the costs of recessions based on Lucas (1987) that use a measure of the standard deviation of consumption or earnings process.[66]

5.4. Effects on Employment and Participation

If unemployment rates affect participation, we might be concerned that our wage-estimates of the previous sections are estimated from a selected sample. Moreover, under a human capital model, individuals not working lose time during which they acquire skills and knowledge that make them more productive. Table 3 replicates the same results as in Table 1 using the fraction of workers claiming unemployment insurance benefits, the fraction of workers filing taxes with zero earnings, and the fraction of workers not filing taxes in a given year. The table shows an initially significant increase in fraction zero earnings and the fraction of unemployment insurance (UI) claimants that fades within three experience years.[67] The effects are numerically small and can be completely explained by short-term persistence of local unemployment rates (not shown). A temporary unemployment rate shock has no persistent effects on employment or participation of male college graduates.[68]

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[65] We find that an uncertain stream of earnings had to be increased by about 7% for the median worker in our sample to be of equal utility as a comparable certain path. The typical estimate in the literature is below 1%. Some studies, such as Storesletten, Telmer, and Yaron (2001) or Krusel and Smith (1999) find effects comparable to ours for households with no wealth.

[66] Specifically, Lucas compares the present discounted value (PDV) of utility from two consumption streams; one certain, $\{C_1^*, C_2^*, \ldots\}$, and one uncertain $\{C_1, C_2, \ldots\}$, where $C_t = (1+\varepsilon_t)C_t^*$, and epsilon is a white noise shock with constant variance. He then asks by proportion μ the uncertain stream has to be higher in each period than the certain stream to be of equal PDV utility. Using a constant relative risk aversion (CRRA) utility function with coefficient of relative risk aversion equal to one and estimates of the standard deviation of aggregate consumption, he derives that for the average worker μ is extremely small. More generally, Lucas' calculations suggest that costs of recessions are very small unless risk aversion is extremely high. Lucas' original study has been extended to take into account different form of risk aversion, absence of savings, or unevenly distributed income shocks. To our knowledge, no one has used the effects of actual recessions shocks or considered heterogeneity in workers' underlying earnings capacity (e.g., Barlevy 2005).

[67] To gauge the magnitude of these numbers, add the fraction workers reporting zero earnings and the fraction UI claimants for the group on or above grade. In the first year in the labor market, a five percentage point increase in unemployment would induce an increase in this measure of 'time not spent working' of about 1 percentage point. If the typical length of a spell of non-employment were 6 months, then the expected amount of time lost would be about 2 days or 0.06 months (0.01 times 6). These back of the envelope calculations suggest that the loss of experience due to labor market entry in recessions is not very large for the average college graduate. These results are echoed by Kahn (2006), who finds small initial effects on hours, employment, and weeks worked for male college graduates in the U.S. after the 1982 recession.

[68] The effects are very similar for the sample of all workers. Table 3 also displays a pattern of 'overshooting' after experience year 7 for some measures; this would imply that workers who had initially higher instability become more stable later relative to their more lucky counterparts. One could think of various hypothetical explanations of such a phenomenon. However, the estimates are numerically very small and never above 0.2 percentage points. Note that the fraction of missing earnings (those not filing) rises only in the year of college exit, during which most graduates only work part of the time.

Since our sample does not contain information on time worked, we also replicated our results with the Canadian Census (available in the Web Appendix).[69] Decomposing the effect of early unemployment rates on annual earnings into the effect on weeks worked and on weekly wages we find that the effect on weeks worked is short lived. The majority of the persistent effects we find is driven by a reduction in weekly earnings. Consistent with the small effects on employment we find our results change little if we restrict our sample to workers with positive earnings in each year (see Figure 5, Panel C). Thus, neither changes in labor market experience nor selective entry or exit from the earnings sample of workers of different abilities affect the main pattern of reversion we see.[70]

6. Predicted and Actual Mechanisms of Recovery

Temporary labor market conditions have long lasting effects on earnings, particularly for middle and lower skilled labor market entrants. The model outlined in Section 3 makes several predictions about the sources through which workers recover from such adverse initial labor market conditions. In our stylized model, an initial shock consists of a temporary shift in the distribution of firm quality. Besides being a convenient modeling decision, this also turns out to capture important features of our data. A long literature shows that high wage sectors have more pro-cyclical employment (e.g., Bils and McLaughlin 2001). We find the same holds for employment at high wage firms.[71] Therefore, we can take the model's implications of a shift in the initial firm distribution directly to the data. We will first address each of the five main implications, and then discuss additional predictions of the model.

Implication 1: "Constant Search". If workers' search intensity is fixed, we saw that reversion of initial conditions occurs through temporary increases in job mobility and a gradual adjustment of firm quality. Thereby, a key prediction was that the exponential rate of decay is constant. Figure 4 and Table 4 show the effect of initial unemployment rates on job mobility and alternative measures of firm quality (discussed in Section 4). Graduates entering the labor market during times of high unemployment start to work at lower quality employers, consistent with the basic assumption of the model.[72] Firm quality then improves quickly in

[69] We use four years from the Census (1981, 1986, 1991, and 1996). Due to the different nature of the data we have to make some assumptions on the timing and province of college graduation. The main effects are very similar to our results.

[70] This is corroborated by the fact that those who permanently stop filing do not appear to be any different from those who remain active (Panel A of Appendix Figure 3). The estimates based on the balanced panel in Figure 5 (Panel C) are by 0.002 smaller in absolute value than our main estimates, a difference that is not statistically significant. Note that, if at all, the figure suggests negative initial selection, possibly consistent with a certain degree of out-migration to the U.S. of high earners. This is consistent with small decline in average predicted earnings with experience in our sample.

[71] Typical high wage and pro-cyclical industries are durable goods manufacturing and construction. Typical low wage, less pro-cyclical sectors are retail trade or personal services. At the firm level, the patterns may arise due to changes in demand for products of different quality, differences in the costs of job creation, or because of changes in product market competition.

[72] It has long been speculated that firms raise their hiring standards in recessions (e.g., Hall 1974, Solon et al. 1997). Note that similar results are also obtained for average one, two, and three-digit industry wage premiums, consistent with the

the first 3-5 years in the labor market when job mobility is higher than average.[73] [74] As the effect of initial unemployment on job mobility declines, improvements in firm quality visibly slow down. Reversion in firm quality continues, but at a reduced rate.[75]

A pure search model could explain important features of our data. However, we do not observe a constant rate of reversion in earnings losses, job mobility, or firm quality. Moreover, simulations suggest that although a low (fixed) arrival rate of job offers can lead to persistence in the simple model, they also imply implausibly low rates of initial job mobility. Thus, a single parameter is unlikely to be able to explain the complex pattern in our data. Also, as we will see, there are important differences in the role of job mobility and firm quality among graduates with different skills. Moreover, catch-up is not always achieved only through job shopping. These aspects are addressed in the remaining predictions of the model.

Implication 2: "Time Dependent Search." In Section 3 we have shown that if search intensity is determined endogenously within the model, increases in the cost of job mobility lead to a rate of decay of initial shocks that declines over time. This may occur either because workers settle into jobs, e.g., they accumulate specific skills, or because of age-related reductions in flexibility as workers get married, buy homes, and settle down. In this case, job changes and improvement in firm quality are very frequent as workers enter the labor market, but drop off as workers age. These patterns are borne out in the data. Job mobility is high initially, and catch-up occurs through mobility to better employers. In a second phase, mobility to high-wage firms slows and reversion continues partly on the job as workers' mobility declines. By

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fact that high wage industries have more pro-cyclical employment creation. However, changes in average industries wage premiums for labor market entrants can only partially explain decline in average firm wages (see the Web Appendix for direct estimates of changes of average industry wages by cohort of labor market entrants).

[73] The potential magnitude of these effects is discussed below in the section "Putting Things Together," when we allow cell-level differences in firm quality to directly explain earnings losses due to adverse initial conditions. Another way to gauge the potential effect of beneficial job mobility, is to compare the improvements in job mobility and firm quality with the average effect of job change on earnings and improvements in employer types by labor market experience. As found in the U.S. by Topel and Ward (1992), we find that job mobility is on average very productive in the first ten years of workers' careers. The positive association job changes and wage changes strengthens for workers graduating in a recession; if we calibrate the magnitude of the effects of job change or improvements in firm quality, we find that 40-50% percent of earnings losses could be explained by productive job mobility. This is discussed in detail in an earlier working paper version (Oreopoulos et al. 2006, Sections 4.3 and 4.4, Table 5).

[74] The results for all workers with some college are very similar. The increase in mobility is significantly larger but shorter lived at the national level. Both results are available in the Web Appendix. Including current unemployment rates interacted with experience to control for persistent local labor market conditions leads to a slight *increase* in the effect on job mobility (since for all but labor market entrants higher unemployment depresses voluntary mobility). This is another sign that the effects on mobility we obtain are stemming for voluntary mobility – in case of involuntary mobility, we would have expected inclusion of additional unemployment controls to *lower* the estimates.

[75] Table 4 also reports effects on the cumulative fraction of workers who left the initial employer, as well as the propensity of change among 2-digit industry classes. While the effects on the rate of job change in columns (1) and (5) decline, the cumulated rate of departure from the 1st employer in columns (2) and (6) increases permanently by about .3 to .5 percentage points. Interestingly, the effect of an early unemployment rate on the frequency of 2-digit industry changes is almost as high as the frequency of changes in employers. This may either mean that the distinction among industries is meaningless in our sample, or that in addition to job shopping workers also actively search for a match with the 'right' industry. Several models of job search of younger workers would predict such a pattern (e.g., Neal 1995 or McCall 1990).

a straightforward and intuitive extension of the pure on-the-job search theory, the more flexible model is better at matching our empirical findings. This extension also allows us to explain prolonged persistence of labor market conditions without having to revert to possibly implausible or arbitrary assumptions on the speed of offer arrival rate or other parameters.

Implication 3: "Differences by Skill Group." If there is comparative advantage for high skilled workers at high productivity firms, these workers benefit more from job mobility and therefore search faster. They are thus predicted to revert faster after a bad initial start by transiting quickly to better firms. Thereby, they are able to catch-up before age related search costs become important. However, as these costs increase, the model implies that high skilled workers reduce their search effort faster than low skilled workers. Figure 6 and Table 5 show the effect of initial unemployment rates on job mobility and firm quality for graduates with high, medium, and low predicted earnings, our measure of skill. Our results imply important differences in catch-up for workers with different skill levels. First, high skilled workers experience large temporary increases in rates of job mobility and completely close the gap in employer quality within four years (Figure 6, Panel B and C). For higher skilled workers, almost the entire reversion of the initial effect of labor market conditions on earnings appears to occur through job changes to better employers.

Second, medium skilled workers also experience above-average job mobility and increases in firm quality within the first four years (Figure 6, Panel B and C). However, recovery of firm quality slows down as workers age, leaving a significant gap vis-à-vis workers entering the labor market in better times (Panel C). The remaining recovery in earnings apparent in Panel A occurs partly on the job, partly through job mobility within firm class. Third, low skilled workers experience low job mobility, and at best temporary improvements in employer quality. Most of the (partial) catch-up appears to occur on the job. These features are consistent with a lower benefit from search coupled with a possibly important role for firm or industry specific capital and increasing costs of job mobility with age. Overall, the differences in initial patterns of catch-up between more and less advantaged workers match the predictions of the model quite closely. Note that as predicted by the model, the difference in mobility is highest at the beginning, and then drops off quickly as high skilled workers catch-up and age related forces play an increasing role.

Implication 4: "Catch-Up On-the-Job." An important feature of the data is that catch-up appears to occur in two phases. In the first phase, workers experience rapid improvements in the type of employer through job search. Improvement in employer quality is absent in the second phase, where reversion appears to occur within firm type. Especially middle skilled workers who find a job at high productivity firms have low tenure initially. The model predicts that their earnings grow faster than that of incumbent workers as they accumulate sector or firm specific skills. This catch-up process appears to be completed in the course of a few years, consistent with returns to tenure mainly playing a role in the first few years on a job. Low skilled workers experience hardly any form of job mobility, and most of their recovery appears to take place as they

stay at their same employer. Thus, for these workers forces of catch-up within the firm are particularly important.

A few qualifications of this interpretation are in order. First, it appears that catch-up 'on-the-job' is important for middle and low skilled but not for high skilled workers. As discussed in the extensions of our model, it may be that middle and low skilled workers benefit more in terms of training from being at a top firm. However, this could also be explained by the fact that high-skilled workers find job at a top firm relatively quickly, and start with a smaller tenure gap vis-à-vis more lucky workers. Second, it appears that for middle-skilled workers catch-up occurs partly through further job changes within given firm types. As discussed in the section 3, it is straightforward to add such continuing job mobility within 'sectors' to our model but leave this to future research. Third, we will see below that catch-up in the second phase could be partly driven by the persistent effect of external labor market conditions. As discussed, allowing for such an effect would be a useful extension of our model that is left for future research.

Implication 5: "Zero Search." Our model predicts that even without further frictions, some workers may be permanently stuck at low quality firms because they end their search effort early. Given comparative advantage, this is most likely to occur for low skilled workers. This feature of our simple model with endogenous job search could rationalize the permanent down grading of low-skilled workers to low quality firms observed in our data. However, as we show in the next paragraph, the decline in firm quality can only explain part of the persistence of reduced earnings for low skilled workers. One way to explain the remaining loss would be to augment our model with differential degrees of human capital accumulation at top firms for high and low skilled workers in the spirit of Gibbons and Waldman (2004). An important insight of our model is that such effects only lead to persistent earnings differences if coupled with search frictions that intensify with age. Without a distinction between 'newly minted,' flexible workers and workers settling down, nothing would prevent low skilled workers to keep seeking better jobs once they have entered the labor market. By introducing such frictions implicitly, our model rationalizes Okun (1973)'s notion of permanent cyclical downgrading of low-skilled workers.

Putting Things Together. The previous paragraphs have argued that our parsimonious model can explain important features of the observed pattern of reversion of earnings losses after entry into the labor market into a recession. The question remains as to the magnitude of the alternative channels we identified. To assess these magnitudes, we included measures of the various channels as additional explanatory variables in a regression of earnings on initial unemployment rates at the group level. Since we have shown that the decomposition of the sample does not vary at the group level in systematic ways, this approach circumvents the problem that at the individual level unobserved heterogeneity may affect choices of job mobility or search intensity. We thus obtain a valid decomposition of the persistent effect of initial unemployment rates on earnings into parts explained by alternative channels.

Figure 7, Panel B shows the effect of initial unemployment rates in years 0-1 on the job market on earnings for workers entering the labor market in 1982 or later, since only for these cohorts we can match workers to firms (this model is taken from Column 5, Table 2). The second line from below shows the remaining effect of initial unemployment rates once we condition for average employer quality in a given cell. The figure suggests that an important part of the earnings difference (about 40-50%) is explained by reductions in firm quality. As predicted by the model, differences in firm quality matter especially in the first years after entry. We then add the *current* unemployment rate to the model, interacted with labor market experience to allow for persistent effects (as in Column 6, Table 2). Once we add persistent effects of further labor market conditions, the long-term effect of initial unemployment fades completely after four years in the labor market. Thus, continuing exposure to adverse labor market conditions correlated with the effect at entry *plus* firm quality explains a large fraction of the earnings losses we find.

Conditional on mean firm quality, the persistent effect of ongoing labor market conditions matters mostly in the latter part of reversion in earnings losses. In the context of our model, this suggests that catch-up within firm type may be affected by external labor market conditions. As suggested in the extensions of our model, this could be because firms offer more high quality jobs when economic conditions are favorable. It could also be that entry wages depend on the state of the labor market, as predicted by models of long-term contracting. Improvement of external economic conditions increase the rate of additional external job offers, and allows the worker to renegotiate the wage upward.

In the appendix (Appendix Figure 5), we also show the same group-level regressions for high, medium, and low skilled workers. Not surprisingly, for high skilled workers we find that differences in firm quality can explain most of the difference in earnings.[76] Medium skilled workers behave very similar to the average. Improvements in firm quality explain an important part of reversion initially, while correlation of initial shocks with continuing persistent labor market conditions explains the second part of catch-up. For low skilled workers, losses in firm quality matters as well, but their overall effect is smaller, especially at the beginning. Ongoing persistent labor market shocks matters little, suggesting that the channel of catch-up is not strongly related to continued external labor market conditions.

The differential role of job mobility and changes in firm quality for the reversion of initial losses for workers of different skill is also summarized in Figure 7, Panel C. By deciles of predicted earnings, the figure shows the fraction of earnings losses that have faded after five years in the labor market, as well as the improvements in firm quality and the fraction of workers that left their first employer. The rate of job mobility and improvement of firm characteristics are monotonously related to catch-up in annual earnings across deciles. This confirms our main result that workers with largest improvement in firm quality also have the fastest improvement in wages.

[76] If we include both additional unemployment rate history as well as firm quality at the cell level, the latter remains strongly significant, while the former becomes largely insignificant.

Additional Implications. An advantage of our theory and the simple extensions discussed is that it can rationalize some additional salient features of the data.[77] First, the model predicts that a higher 'natural' rate of arrival of job offers λ increase the speed of decay of initial conditions (Equation 3). To assess this prediction, we have constructed mean turnover rates in 2-digit industries (calculated over a period of more than 15 years) as imperfect proxy of the mean rate of offer arrival at the industry level. We then compared the dynamics of earnings losses in industries with differences in average turnover rates (Figure 8C). As predicted by the model, the results clearly show that the decay of earnings losses is significantly faster in sectors that have higher average turnover rates.

Second, if an important source of reversion of earnings losses is driven by differences in firm quality, workers that immediately find a job at a high wage firm should experience no loss in earnings. Unfortunately, this prediction is hard to assess directly because different types of workers will start at high wage firms in recessions and in booms. If we nevertheless include a fixed effect for a worker's first employer in our model, about half of the earnings loss can be explained (Figure 8A). As predicted by our stylized model, this is about as much as implied by the results in Figure 7, Panel B.[78] This confirms that search effort and initial luck are important sources of reversion of adverse conditions at labor market entry.

Third, once workers have obtained a job at a high quality employer, we observe that the rate of catch-up slows significantly compared to workers whose first employer pays high average wages (Figure 8B). This is consistent with the structure of the model by which the nature of catch-up changes once workers enter high productivity firms. If the worker starts at a low paying employer, job search is more intense, leading to a high rate of catch-up. Catch-up slows once the worker enters the firm, and is driven (in the model) by faster accumulation of specific skills, or (in an extension) by additional job offers by firms of the same type. Given the large differences in average employer quality on the one hand and rather small consensus estimates of the returns to tenure on the other hand, it is not surprising that this second phase is slower.[79]

Fourth, the model is also consistent with positive concave experience profiles in firm-size and average firm-wages observed in our data (Figure 1). Possibly due to a lack of information on firms, few papers have

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[77] A more in depth discussion of some of these results can be found in an earlier version of this paper (Oreoupolos, von Wachter, and Heisz 2006).

[78] Comparative advantage and sorting implies that average ability of workers starting to work at high wage firms in a recession should be higher than that of workers starting in the same firm in booms. Thus, Figure 8A overstates the importance of the first employer. To allow for firm specific experience profiles, we also include an interaction of initial firm fixed effects and experience effects, effectively allowing for firm specific experience profiles (Figure 8A). We do not find firm-experience profiles can explain an important part of earnings losses in addition to firm fixed effects.

[79] Even if workers continued to search, once at a large firm they are less likely to obtain a better job match. Again, the probability of starting to work at a 'high quality' employer may be correlated with workers' ability, and the degree of selectivity might be affected by early unemployment rates. To address this problem, we have included control functions in the fraction of workers starting to work at 'high quality' firms. Similarly, we have included average fathers' income as control function. Neither affects our results, and is available upon request. Since young workers' earnings may not be entirely a function of their ability (due for example to the presence of employer learning), including worker fixed effects or working with changes in earnings is not an ideal strategy to deal with this problem.

attempted to explain this pattern. Our descriptive analysis shows that improvements in firm quality can explain an important part of earnings growth in Canada, and similar trends appear in US data. These pattern are highly consistent with the basic assumptions and implications of our search model.

Fifth, the model also provides a mechanism by which labor market entrants suffer larger earnings losses than workers that are already employed with a couple of years of experience (Figure 5, Panel A). For most sharing rules of the productive value of specific capitals between workers and firms, an incumbent worker is more valuable to the firm than a labor market entrant. Thus, workers without a job and labor market entrants are expected to bear the brunt of adverse labor market conditions.[80] Clearly, a full answer to this question requires an explicit modeling of the hiring behavior of firms not addressed in our partial equilibrium approach.

Last, we provide some evidence in favor of age-dependent mobility costs. Using the Canadian Census, we have tabulated the fraction of college graduates that were married, had children, moved homes within and between provinces, or owned a house. Albeit each is a crude proxy of mobility costs, all of our indices point to a strong role of age in determining workers' flexibility in the labor market. For example, after graduation the fraction married rises more than six-fold until age 30 to reach 68.7%, after which it rises to 86.3% by age 40. The rate of home owner ship nearly doubles between age 25 and 35. Mobility between provinces peaks at age 26 and then declines. Mobility within province peaks at age 27, and then declines steadily after age 30. Overall, these numbers confirm results from the existing literature that mobility of college graduates is high when workers are young and declines with age.

Overall, we interpret the empirical results discussed in Section 5 and 6 to lend strong support to mechanisms identified in our model of endogenous time-dependent job search. As predicted by job search, we observe important initial increases in job mobility and improvements in firm quality. As implied by endogenous, time-dependent search effort, the rate of catch-up in earnings slows with age, and job mobility subsides. We also see clear differences between high, medium, and low skilled workers as implied by the core predictions of the model. Similarly, the model can also rationalize the lasting declines in employer quality for our lowest skill group. At the end of Section 3, we discussed plausible extensions that can explain some features not immediately implied by the baseline model, such as the fact that catch-up continues within firms and sectors. Given the wealth of evidence we discuss, we view our results as a confirmation that the main mechanisms emphasized by the theory provide part of the explanation of the empirical patterns.

A Simulation Exercise. While our model can reconcile important facts in the data, there are several potential channels in the theory to which the data does not speak directly. To assess the potential role of additional mechanisms implied by the model and to see whether they could be reconciled with the data as

[80] This would be exacerbated if there was an additional role for wage contracts as discussed in the extensions of the model.

well, we simulated the model for different values of the basic parameters. We first simulated the model for the case of a stationary environment (i.e., without returns to tenure or age-related costs); second, we introduced different degrees of age-related costs of search. To keep the analysis simple, we work with two groups of workers (high and low skilled). The parameter values are chosen to replicate basic features of our data. The main outcome of interest is the effect of a one-period initial reduction of the hiring rate at good firms (a reduction in p_0).[81]

The simulation exercise highlights some important insights from the model. First, given that high skilled workers lose more from down grading to the low-wage firm, the fact they appear to do better initially suggests that their hiring rate at good firms falls less in recessions. Second, the large observed discrepancy in the rate of catch-up between high and low skilled workers is unlikely due to differences in search intensity alone; steady state hiring rates at good firms (p) appear to be higher for high skilled workers. Thus, we allow for differential steady state and initial hiring rates by skill-group in our simulations. Third, given differential steady state and initial hiring rates, age-related search costs have a larger effect on low-skilled workers (Figure 9, Panel B); the effect averages out in part at the mean (Figure 9, Panel A), but is still present. Fourth, the effect of age-related costs is particularly strong for very low skilled workers; it also increases with the dispersion of firm quality. Thus, the higher the pre-existing inequality in the labor market, the bigger is the persistent rise in inequality due to initial shocks predicted by the model. Fifth, the model implies that the degree of persistence increases with the size of the shock, especially for older and lower-skilled college graduates. This arises because for large initial shocks it is more likely that the slow down in search occurs before the initial effect has dissipated.

These simulations are robust to alternative choices of parameter values. They further underline the ability of the model to make rich predictions regarding the long-term effects of early short-term labor market

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[81] The basic parameter values are $\beta = 0.9,\ \lambda = 0.5,\ \alpha = 1.4,\ w_2 = 1,$ and $w_1 = 1.4$, where we think of wages as log-wages for this purpose (so high-skilled workers earn 40% than low-skilled workers at firm 1, and firm 1 pays 40% higher wages than firm 2). In addition, we set the fraction of high skilled workers in the economy to 0.4. We let returns to job tenure be 5% in the first four years, 1% in the five following years, and zero thereafter, which is in the middle to high range of what has been estimated in the literature. Age-dependent search costs γ are benchmarked at 1 initially, and are allowed to increase 20% in the first five years after graduation, and 10% for the five following years (30% and 20%, respectively, in the scenario for "steep" rise in costs). These increments loosely follow the observed increase in marriage and home ownership rates among Canadian college graduates observed in the Canadian Census. Note that to avoid needing to model further job mobility, we have set age equal to job tenure at low firm equal to time since exit from college. We then chose alternative values for the initial hiring rate (p_0) and the steady state hiring rate (p). We allow for separate values for high and low skilled workers as described in the text. The values were $p^{High} = 0.8,\ p^{Low} = 0.5$ in scenario with a higher steady state hiring rate for low skilled workers ("more offers", and $p^{Low} = 0.4$ for the scenario with a lower hiring rate; the values for the initial hiring rate were $p_0^{High} = 0.65,\ p_0^{Low} = 0.1$ for the "severe" shock and $p_0^{High} = 0.7,\ p_0^{Low} = 0.25$ for the less severe shock, respectively. Note that given the size of the earnings premium and the speed of observed recovery, the baseline and initial hiring rate have to be higher for high skilled workers to match the patter of the data.

shocks. In particular, the simulations underscore the importance of interactions of age-related costs with other factors determining search intensity (such as skills), the hiring rate, and the size of the initial shock. Yet, another result apparent from the figure is that the predicted slowdown in the recovery due to age-related costs, although significant, is not as large as in the data. This suggests that other factors may matter as well, such as long-term contracting or on-the-job human capital accumulation. This is discussed next.

7. Additional Mechanisms and Explanations

We begin by sketching an alternative model that could explain some of our main facts, and show how we may be able to distinguish it empirically from our model of job search. Then, we discuss other popular models of career development and labor market dynamics that may capture some features of the data.

Consider a model of symmetric employer learning with comparative advantage of low and high skilled workers among firms or sectors (e.g., Gibbons, Katz, Lemieux, and Parent 2005). To fit our main patterns, further assume that the speed of learning is higher for high skilled workers, and that workers accumulate firm or sector specific capital on the job. In a model of employer learning, initial conditions in the labor market can have persistent but fading effects only if they affect workers' expected marginal product. That is, we have to assume that after being down-ranked to worse employers because of cyclical conditions, the market initially underestimates the ability of affected workers. For example, this could occur if the signals of workers' productivity that the market receives while they are at low productivity firms are less informative.[82]

Given these extensions, the model predicts that after beginning to work at worse employers, more able workers are sorted to better firms faster than less able workers. If learning is slow enough, the latter may accumulate firm or sector specific capital while at less productive firms, and may thus be better matched at these employers and stop moving. However, since in equilibrium workers always receive their expected marginal product and work where they are most productive, this model does not predict lasting losses in earnings unless experience-earnings profiles differ between sectors (something we do not find in the data).

One of the key distinctions between the augmented employer learning model and our model with endogenous search intensity is that, in the search model, single draws from the wage offer distribution matter (i.e., there is a role for luck). In the employer learning model, single wage draws should not matter since wages evolve according to expected marginal product. In *Additional Implications* in Section 6, we discussed results indicating that the quality of initial employers had indeed an important role in explaining the extent of

[82] In a learning model, due to Bayesian updating expected productivity after T periods can be written as $E\{p \mid T, d_1,...,d_T\} = \theta_T m_0 + (1-\theta_T)\bar{d}_T$, where p denotes unobserved actual productivity of a worker (with initial mean m_0 and variance σ_p^2) and $d_t = p + e_t$ are signals of a worker's productivity (and e_t is iid with variance σ_e^2). Since we have that $\theta_T = \sigma_e/(\sigma_e + \sigma_p T) \to 0$ as $T \to \infty$, any initial 'mistake' in predicting a cohort's average ability will fade over time.

long-term losses and the speed of catch-up. Other stylized facts (such as positive firm-quality gradients in labor market experience or the role of average sector-level turnover rates) also point towards a search-based explanation. Nevertheless, we do not claim that employer learning is unimportant, only that job search with comparative advantage and time-varying search costs may be part of the explanation of the observed data.

Three additional models used to explain career progression and labor market dynamics are accumulation of general human capital on-the-job, within-firm career progression, and models of asymmetric information. First, we believe the persistence of a short-term initial labor market shock appears too high to be explained by the accumulation of general experience on-the-job, especially once we control for persistence of unemployment shocks. This conclusion is corroborated by the fact that the initial losses in employment we find appear too small to cause significant losses in general human capital accumulation.[83] Similarly, the standard model of general human capital accumulation cannot explain the systematic responses of job mobility and firm quality, the fact that less advantaged college graduates are hurt more, and that labor market entrants fare significantly worse compared with young workers with two or three years of labor market experience. While each of these phenomena could probably be explained by an extension of the standard model, the balance of the evidence suggests important short- to medium run departures from a frictionless view of wage setting.

As stressed in the discussion of our model, this does not mean that investment into human capital on the job does not matter. There appears to be a potentially important role for sector or firm specific skill accumulation on the job. Future work should address to what extent workers actively choose the intensity of skill accumulation as a function of initial labor market conditions. This may be relevant especially for workers in the lower part of the skill distribution. Figure 6 suggested that for these workers productive job changes played less of a role in the recovery process, but that they appeared to increase labor supply (Panel D). The increase in labor supply could be a sign of increased investment into human capital.

Second, our results indicate that an important channel through which workers recover after entry into the labor market in a recession is mobility to better employers. Thus, consistent with the existing literature on voluntary job mobility, we observe a numerically important evolution of careers *between* firms. We have also argued that once workers find a good firm, initial unemployment conditions may affect the evolution *within* firms. We have discussed alternative channels through which this could occur, such as long-term contracting (e.g., Beaudry and DiNardo 1992) or job assignment (Gibbons and Waldman 2004). However, our results indicate that systematic mobility between firms should be an integral part of any model analyzing career transitions and labor market dynamics.

[83] Analyzing survey information on weeks and hours worked, Kahn (2006) comes to a similar conclusion. Labor force attachment of male college graduates is high even in recessions. We also find that a substantial fraction of improvements in wages occur at job changes, and that this correlation strengthens for workers graduating in a recession (Oreopoulos et al. 2006).

Third, the important degree of initial job mobility we find probably also speaks against an important role of asymmetric information in explaining persistence of initial labor market shocks. In general, typically an exogenous shock such as a plant closing or a downturn is viewed to convey less negative information about workers than individual events (e.g., Gibbons and Katz 1991, Kahn 2007). Thus, it is unclear how a recession should lead to a persistent underestimation of workers' marginal product. However, even if this were the case, it is likely that we would observe that workers initially catch-up within firms, and then begin to switch employers once their ability is revealed. Since there currently is no model predicting how such information revelation would occur in the presence of asymmetric information, we leave a more explicit examination of this channel to future work.

8. Conclusion

We have estimated the long term effects of entering the labor market in a recession for a large sample of Canadian men leaving college whose earnings, employers, and career outcomes are tracked for ten years. Our main results suggest that the average worker graduating college in a recession faces earnings losses that are very persistent but not permanent. On average, a two standard deviation increase in the unemployment rate (roughly comparing the difference between those exiting college in a bust versus boom) leads to an initial wage gap of about 10 percent. This gap declines relatively slowly, and fades to zero after about the eighth year. Controlling for unemployment rate conditions after the first year of labor market entry, we also conclude that virtually all of the wage deficit can be attributed to the unemployment rate variation in the very first year after leaving school. The results are robust to selective graduation or selective labor force participation, and to the many alternative specifications we tried.

We also find that college graduates at the bottom of the wage and ability distribution have larger and more persistent losses, while the effects at the top are small and short lived. Our estimates of how the path of earnings declines suggests that the present discounted value of losses in annual earning or utility could be three to four times larger for the least advantaged to the most advantaged workers, indicating that even within the group of college graduates there is a large degree of heterogeneity in the costs of recessions. We also find that the effects of recession shocks are strongest for young workers, while workers with a couple of years of labor market experience are less affected.

To assess potential mechanisms behind the persistent losses and catch-up process we developed a model in which high and low skill workers chose optimal strategies to search for jobs at better employers in presences of age-dependent search costs and comparative advantage. We derive the predictions of our models for the long-term effects of recessions and compare them to the process of recovery we observe in the data. First, we find that recessions initially lead workers to start at less attractive employers. As predicted by our model, an important part of catch-up occurs by workers moving to higher-paying establishments, especially in

the first years after the shock. Second, differences in the importance of mobility towards better firms between more and less advantaged workers support an important role for comparative advantage and evolving search frictions. Last, lack of job mobility could explain why the least advantaged are permanently down-ranked to lower wage firms.

Overall, our empirical results closely support an environment in which heterogeneous workers gradually search for jobs at better firms, but recovery is slowed due to accumulation of specific capital and increases in the cost of mobility as workers age. These results have important implications for our understanding of the role of job search in workers' careers and in the adjustment of the labor market to cyclical shocks. In particular, it appears that while no single mechanism can explain the pattern in our data, multiple frictions are likely to interact with each other and with heterogeneity of both workers and firms to generate the degree of persistence and the pattern of catch-up we find.

While we have argued that our parsimonious model can explain many of the facts we observe, we have made important simplifying assumptions and have only begun contrasting our model to alternative explanations. There are at least three important areas for future research. First, it would be highly desirable to extend our model to include contracting, and develop explicit tests of competing explanations based on search, contracting, and learning frictions. Second, to further examine the implications of our results for economic efficiency, it will be important to embed our model in a general equilibrium framework that explicitly models the hiring decisions and wage setting of firms and the ensuing sorting process. Third, by focusing on male college graduates we have left out important groups of workers – such as high school graduates and women –that will be important in determining the overall response of the labor market to cyclical shocks.

Data Appendix

Our data combines three administrative datasets from Statistics Canada. The first is the University Student Information System (USIS), which includes enrollment and graduate information of post-secondary students in Canada from 1974 to 1997. We augment the USIS data by linking it to income data from the T1 Family File (T1FF) between 1982 and 1999, and to an employer-employee matched dataset called the Longitudinal Employment Analysis Program database (LEAP). Each is described below, followed by how we defined the variables used in our analysis.

USIS is a national database containing pertinent up-to-date information on student participation in and graduation from Canadian degree granting institutions obtained from administrative records provided at the individual level. USIS has two main components. The *enrolment* survey collects information on student counts, and requests information on a broad array of student and program characteristics including institution, province, gender, age, mother tongue, immigration status, country of citizenship and country of origin, full- or part-time status, type of qualification sought (e.g., bachelor, masters, etc., or none), field of study, year of study in program and an individual identifier. The *degrees* survey collects information on all students who have received a degree, diploma or certificate during the calendar year. The degrees survey has a more limited number of data elements than the enrolment survey. These datasets have been merged by the Education, Culture and Tourism Division of Statistics Canada, creating a third file commonly referred to as the *linkage* file. We use the linkage file in this analysis.

The information is obtained from the administrative records of Canadian degree-granting institutions, generally in an individual record format. Approximately 70 percent of post-secondary institutions provided regular annual individual information, including student identifiers that allow matching to the other two administrative datasets. We therefore focus on students from these institutions.[84] All information in the USIS is checked for validity edited by the universities and, in some cases, by the province and by Statistics Canada.

The enrolment survey collects information on student counts as of December 1st in all provinces except Ontario, where the reference date is November 1st. This means that each student who attends university in the fall session is counted only once annually, even though the student may be enrolled in more than one program. This student count is used as a proxy for the total number of students enrolled during a complete academic year.

The degrees survey collects information on all students who have received a degree, diploma or certificate during the calendar year ending in December. It is a count of the number of degrees, diplomas and certificates awarded, not the number of individual students who receive them.

From the enrolment data, we keep all males that began a full-time undergraduate program at a post-secondary school institution between the ages of 17 and 20. We note students' graduation date, or last year enrolled full time (plus one since enrolment was recorded as of December 1). Experience is defined as number of years since graduation or number of years since ending full-time post-secondary education. We examine earnings starting when experience equals zero, since students are likely to have worked for 7 months since graduation. We remove any student taking longer than 8 years to complete an undergraduate degree (dropping less than 1 percent of the sample). We also calculate predicted graduation year based on entry year plus four.

The enrolment data includes information on home province. If missing, home province was assumed to be the province of the institution the student began their program. After finding that national and regional unemployment rates at time of graduation were not correlated with obtaining a subsequent degree, we focus on students that obtain no more than one degree.

The post-secondary students we examine from the USIS are matched to the T1FF using the student identifier. The T1FF is a data set of individual tax records from 1982 to 1999. The T1FF includes information on earnings, defined as the sum of taxable earnings from employment and self-employment. The dataset also contains information on transfers, as well as age, gender, residential address and an identification number for the firm at which the individual is employed. Some students (fewer than 15 percent of the sample) were not matched, mostly due to missing identifiers. Missing ID may be because (1) the

[84] For more on the USIS and the match to the T1FF, see Heisz (2001) and Heisz (2003).

student did not have an ID code (perhaps because he or she was a foreign student), (2) the student had an ID code, but either did not give it to the institution or the institution did not request it, or (3) the institution collected the ID code but did not report it on the USIS survey. To remove individuals that have left the country, we drop any student that does not file in the last two years of the T1FF data.

The cross-section outcome variables we examine include whether a student receives a degree, and years in post-secondary school. The annual outcome variables we focus on are log earnings, dummy variables for not filing taxes, zero earnings, and living in different province than initial province.

Individuals working in the USIS-T1FF are also matched annually to information about their firms from Statistics Canada's Longitudinal Employment Analysis Program database (LEAP), beginning in 1983. The match rate was 96 percent.[85] LEAP is a company-level database that includes all employers in Canada, both corporate and unincorporated. The database tracks the employment and payroll characteristics of individual firms from their year of entry to their year of exit.[86] Employers in Canada are required to register a payroll deduction account and issue a T4 slip to each employee that summarizes earnings received in a given fiscal year. The LEAP database includes every business that issues a T4 taxation slip.

The LEAP includes a 3-digit industry code and information on annual firm size and total payroll amounts. We recorded average firm size, and total firm size between 1982 and 1999, and also subtracted the mean amounts for each year before averaging. Both methods produced similar results.[87] We also recorded when individuals switched firms and industries.

The data are collapsed into cell means by home province, year left post-secondary education, predicted year left post-secondary education, and experience. The cell means are matched to national and provincial unemployment rates both at time of school exit and predicted school exit. We use Statistics Canada's youth unemployment rate (ages 16 to 25). Results with the full unemployment rate were similar.

We work with two samples – the two-way student-earnings match, and the three-way match that also includes firm variables. The main results are obtained on the former, but estimates differ little between the two samples. To maximize the range of cohorts with as much as possible experience history we focus on the full range of graduation cohorts that we can match to unemployment rates at time of labor market entry (1976-1995). In the empirical analysis, we also report alternative results with subsets of cohorts. Appendix Tables 2A and 2B show sample sizes of the two-way match by graduation and experience year for graduation cohorts from 1977 to 1995 (including and excluding observations with missing earnings).

Sensitivity Appendix A: Accounting for Selective College Graduation

The decision to leave college may be a function of the business cycle.[88] If workers postpone college exit in recessions, we would expect that the unemployment rate in the year of *predicted graduation* is positively related to college duration. Similarly, since workers with shorter durations are more likely to be able to further postpone graduation labor market entrants in a recession are more likely to have longer durations. Appendix

[85] In the case of multiple employers, the main employer is the one from which a worker has the most earnings. In defining our mobility measures, we have taken particular care with missing values for firm identifiers and industry codes. To address the problem of missing values, we first fill in single missing values with the adjacent past firm identifier or industry code. We then estimate a conservative and a more inclusive measure of mobility. The first only considers changes between two valid firm identifiers or industry codes. The second treats remaining missing values as a job or industry change. The two measures approximate upper and lower bounds of job mobility.

[86] The self-employed that do not draw a salary are not included on the LEAP database. In addition, businesses comprised solely of individuals or partnerships who do not draw a salary are also excluded from the LEAP.

[87] The USIS industry code is documented in Statistics Canada's USIS user guide, 1995.

[88] College enrollment decisions also depend on the state of the local labor market. However, the effects appear to be small in the U.S. since the 1960s (e.g., the fraction of men age 19 to 21 in college is not affected by the unemployment rate for mature workers, see Card and Lemieux (2000) Table 4, nor is the proportion of workers who finish 12th grade and start college (Table 5). The unemployment rate at age 17 does not affect the probability of having a college degree, but raises the fraction of workers with some college (Table6)). Note that if unemployment triggers entry into college of workers with particular unobserved characteristics, this could affect our instrumental variable strategy even if workers are not forward looking due to correlation of the unemployment rate at entry and at exit. However, as shown in the next section, most of the correlation of unemployment rates fades after three years.

Table 6 shows the effects on various basic measures of college duration of the national and regional unemployment rates, as well as of predicted regional rates, separately for all workers and for those at least on grade. We see no significant correlations at the national level or for regional unemployment at the time when workers should have graduated were they on grade. However, we see some significant effect of early unemployment rates at actual graduation with duration. For a five percent change in unemployment rates, this would imply an increase of 2.5 percentage points (10% relative to the 0.26 average shown in Appendix Table 1).

Panels D to F of Appendix Table 7 show the same specifications for those workers on or above grade (see also the appendix available on our website for more detail). The effects are somewhat smaller. A five point shock to unemployment implies a 0.05 increase in average years of college (corresponding to three weeks or 1.4% relative to a mean of 4.11 years). These results suggest that a very small fraction of workers who are barely on or above grade tend to extend their stay in college by one or two years.[89] The fact that unemployment at predicted graduation matters less suggests this is driven primarily by workers who are already beyond grade. Consistently, the fact that the results are even weaker for the full sample and the fact that being on or above grade is not affected indicates that students overall do not make significant attempts to avoid leaving school in a recession by delaying graduation or enrolling in a new program.[90]

To directly address endogenous college exit we instrument unemployment in the actual year of exit with unemployment in the predicted year of exit based on official degree duration. Predicted year of exit is a valid instrument for actual year if college entry is uncorrelated with unemployment rates in the year of predicted exit, if it has no direct effect beyond the actual unemployment rate, and if it correlates with unemployment at actual exit. We believe the exclusion restrictions are valid, since even if students wanted, given the covariance structure of unemployment rates it would be hard for them to forecast future unemployment rates. The case could be made that the unemployment rate at predicted graduation could in itself be viewed as the relevant 'shock' to workers' careers. Thus, we present and discuss both reduced form and instrumental variable (IV) estimates.

The first two columns of Appendix Table 8 present the reduced form estimates of the interactions of potential labor market experience for the same specifications as in Table 1 (OLS). Columns 3 and 4 show the IV results and the coefficients on the instrument from the corresponding first stage. The reduced form estimates are either equal (all workers) or slightly smaller (graduates) than the corresponding OLS estimates. The numbers in Appendix Table 7 imply that delayed entry is unlikely to affect the estimates of the catch-up pattern in the reduced form. The first stage coefficient is highly significantly different from zero and different from one. The ensuing IV results are either the same as OLS (for those on/above grade), or slightly more negative and more persistent (for all workers). All IV coefficient estimates are well within the confidence intervals for OLS results.[91] Since the general effects of unemployment rates on labor market entry are quite small, it would have been surprising to find much of a difference. We conclude that OLS is appropriate to

[89] Additional results in an appendix available on our website suggests that for this sample the probability of being above grade 1-3 years is raised marginally. Taking the results from Panel F, if 0.85% of workers stay longer and raise average college duration by 0.0056 years, the average additional time spent in college must be more than one year.

[90] Note that as pointed out in Section 2, the propensity of obtaining a graduate degree is also not affected by the unemployment rate in the year of the first exit from college (a 5 point unemployment shock leads to an increase in the probability to obtaining a post graduate degree of 0.008, relative to a mean of 0.2, with the lowest p-value of 0.157 in the regional sample for all workers). Post-graduate degrees are specially concentrated in the health professions, social sciences, and other majors (25-30% of all graduates obtain a graduate degree) and less concentrated in business, engineering, and teaching (8-12% obtain a graduate degree). Our sample restriction tends to more heavily exclude health profession and the social sciences than economics and engineering. To assess whether for some of these subjects the propensity to obtain a higher degree responds more strongly to unemployment at time of graduation, we ran the regressions by major. Social sciences is the only major experiencing consistent increases in the fraction of post-grad degrees during recessions, while health professions experiences consistent declines. All other majors show no clear patterns.

[91] Note that Hausman tests cannot be read off the tables since standard are clustered at either graduation cohort or graduation cohort-initial province level. Although we could implement a test based on Davidson and McKinnon's (1989) approach, we believe that the differences so small that it would not reverse our conclusions.

analyze the effects of early labor market conditions on the long-term career outcomes of Canadian college graduates.

Sensitivity Appendix B: Accounting for Labor Market History

All estimates presented so far represent summary effects of the dynamic impact of the initial unemployment rate plus the dynamic effects of ensuing unemployment rates that correlate with the first. They characterize the expected earnings loss of a worker graduating in a recession and help to assess the implications of different models of career determination. Another estimate of interest is the long-term impact of an isolated temporary shock of labor market conditions for individuals entering the full-time labor market for the first time, holding all else constant. This effect can also be compared to similar shocks at later experience years to benchmark whether initial shocks, when virtually all labor market entrants must search for employment, generate different permanent and transitory effects than subsequent shocks.

Since the current province of residence is available from income tax records, we can use our data to construct unemployment rate histories for each individual starting in 1982. We interact these histories with unrestricted experience dummies and include them into the basic model as additional control variables to isolate the effect of the unemployment rate at time of college exit. Since we only have complete data for 'market history' of individuals graduated starting in 1982, we focus on this restricted group of cohorts.[92] Although shocks are highly persistent initially, the auto-covariance structure dips to zero after three to four years.[93] Thus, the inclusion of two to three lags should suffice to absorb most of omitted variable bias.

Table 2 shows a series of models with augmented controls for unemployment history, each interacted with experience. The table shows the basic regional model with the graduate sample for two models with outcomes recorded between 1982 and 1995. To compare similarly defined unemployment shocks, all models include current province fixed effects.[94] The first model includes the unemployment rate at the current experience year interacted with experience dummies, without additional labor market history. As expected, this has some small initial effects for experience years one to three, but little thereafter. Given that each of these unemployment rates has itself a potentially dynamic effect, the next models include interactions of these unemployment rates with experience dummies.

The first model, shown in Column 3 of Table 2 only includes dynamic effects of unemployment rates occurring in experience years one to three. The result shows an increasing spread in the two estimates that flattens out after experience year 5, exactly as predicted by the omitted variable bias calculations in Section 2. At each experience year the worker is exposed to additional shocks correlated with the initial shock that in itself have dynamic effects, leading to an increasing bias; as the effects of shocks decline for mature workers (as shown in Table 5) and the correlation with unemployment fades or becomes slightly negative, the size of the gap stabilizes. Towards experience year eight the estimates become imprecise as the number of cohorts decline. The next model in Column 4 includes the entire interacted history for each experience year from one to ten. As predicted, the model is extremely similar to the one in Column 3 (however, the joint hypothesis that all additional coefficients or that all dynamic effects at higher experience years are jointly equal to zero is rejected by an F-test). Overall, the effect of the unemployment rate a worker faces in the year of college entry has a long term effect even when controlling for unrestricted dynamic effects of each single unemployment shock experience afterwards.

Since the estimates at later experience become imprecise, we now turn to a grouped model. We restrict the dynamic effects to be equal in two-year intervals (i.e., the effects of the unemployment rate at experience years 0-1, 2-3, 4-5, etc., is constrained to be equal). To keep the size of the coefficients comparable to that of

[92] As shown in Appendix Figure 1, this group of cohorts has slightly more persistent effects of initial labor market conditions. We have also experimented with including cohorts with incomplete unemployment histories. The results, available in an Appendix on our website, are qualitatively the same. We also included unemployment histories based on unemployment rates for all workers, with no differences in the results.

[93] If as commonly done we specify the time series process of the unemployment rate as an AR(2), the coefficients are 0.87 and -.158 for the first and second lag, respectively, in a sample pooling all states and including year and state fixed effects (a procedure followed by Blanchard and Katz 1992). Figures of the auto-covariance structure and further discussion are available in an Appendix accessible on our website.

[94] As shown in Appendix Figure 1 and discussed in Section 3, this has little bearing on our original results.

the main model, we take the averages of unemployment rates within groups (the results are the same if we were to compare coefficients at two standard deviations of the respective regressors). The fully interacted model with grouped unemployment rates then is

$$\log \overline{w}_{crt} = \phi_t + \theta_r + \chi_c + \gamma_e + \beta_{e,0}(UR_{cr0} + UR_{r_1 1})/2 + \beta_{e,1}(UR_{r_2 2} + UR_{r_3 3})/2 + ... + u_{crt}\,.$$

Our data does not allow us to estimate the dynamic effects of unemployment shocks at experience years greater than three with a sufficient degree of precision due to a declining number of cohorts.[95] Thus, we present dynamic estimates for groups 0-1 and 2-3, and include additional dynamic interactions as controls for omitted variable bias. The dynamic effect at experience year 2-3 will help us to give a benchmark for the size of the impact of initial labor market conditions.

The effect of a single shock at experience zero and the effect of the average unemployment in experience years zero and one are very similar. The last columns of Table 2 then show the model with fully interacted controls for grouped unemployment history. The coefficient estimates are graphed in Figure 4 (Panel A). The effect of omitted variable bias is again as predicted. Moreover, now the estimated effects are smooth and show a similar convergence pattern as before.[96]

Sensitivity Appendix C: The Role of Regional Mobility

In columns 6 and 7 of Table 6, we compare the effect of initial unemployment rates on the gains from regional mobility by experience. Interestingly, while regional movers gain more if affected by an early recession initially, these gains fade after experience year three. It is those who stay in the region or residence who have consistently higher earnings growth. Thus, while regional mobility may still be as beneficial in booms as in recessions, it appears regional movers do not have permanently higher rates of catch up than regional stayers. That gains at regional mobility are not as exceptional as gains at job or industry moves also results from the fact that average earnings growth for region movers and stayers is quite similar, as shown in the last columns of Panel A.

It appears that regional mobility is not as important in Canada as in the U.S. (Wozniak 2006). To further explore whether the higher job mobility for workers entering the job market in recessions is associated with higher mobility across provinces, the last columns of Table 3 shows the effects of the unemployment rate at college exit on subsequent provincial mobility. The national unemployment rate is uncorrelated with moving to other provinces for both the full sample and graduate sample in Columns 5 to 6 respectively. The results here suggest no inter-provincial mobility response from worsening in overall economic conditions. For the regression models identifying regional economic shocks, however, we do observe initially increased provincial mobility for cohorts exposed to higher unemployment conditions at time of college exit. For the graduate sample, a 5 percentage point difference in the unemployment rate at entry is associated with about a .75 percentage point difference in the provincial mobility rate in the first two years. This rate is about half that for firm mobility, and drops quickly after the third year.[97] The small effect of unemployment at college exit on provincial mobility suggests that most of the pattern of catch-up in wages over time for individuals that began the labor market in a recession occurs within provinces.

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[95] Thus, dynamic estimates for unemployment shocks at higher experience years pick up the behavior of a limited number of cohorts. While interesting in its own right, the analysis of single cohorts is left to a separate study.

[96] If we repeat the exercise with the full set of cohorts (for which we do not have complete history controls) the results are very similar for the grouped model, with complete convergence occurring after six years in the labor market (shown in an Appendix Figure available on our website).

[97] After the fifth year out of college, the unemployment rate at time of exit is negatively correlated with provincial mobility. Those induced to move to another province from entering the local labor market during high unemployment appear to be less likely to move thereafter. We also replicated our estimates separately for workers who never switch region and for movers. Those never moving, about three quarters of our sample, behave very similar as the full sample (see Web Appendix).

References

Aaronson, Daniel and Sara Christopher (2004). "Employment Growth in Higher-Paying Sectors." *Chicago Fed Letter* (206): Federal Reserve Bank of Chicago.

Abowd, John, Francis Kramarz, and David Margolis (1999). 'High Wage Workers and High Wage Firms.' *Econometrica* 67(2): 411-45.

Abowd, John, Robert Creecy, and Francis Kramarz (2002). 'Computing Person and Firm Effects Using Linked Longitudinal Employer-Employee Data.' Census Bureau LEHD Technical Paper TP-2002-06.

Abraham, Katherine and John Haltiwanger (1995). 'Real Wages and the Business Cycle.' *Journal of Economic Literature* 33(3): 1215-1264.

Acemoglu, Daron (2001). 'Good Jobs vs. Bad Jobs.' *Journal of Labor Economics* 19(1): 1-21.

Akerlof, George A. and Janet L. Yellen (1985). 'A Near-Rational Model of the Business Cycle, with Wage and Price Intertia.' *The Quarterly Journal of Economics* 100(5): 823-838.

Akerlof, George A., Andrew Rose, and Janet L. Yellen (1989). 'Job Switching and Job Satisfaction in the U.S. Labor Market.' *Brookings Papers on Economic Activity* 1988 (2): 495-594.

Albaek, Karsten and Bent E. Sorensen (1998). 'Worker Flows and Job Flows in Danish Manufacturing.' *The Economic Journal* 108(November): 1750-1771.

Altonji, Joseph and Nicolas Williams (forthcoming). 'Do Wages Rise with Job Seniority? A Reassessment.' , *Industrial Labor Relations Review*.

Anderson, Patricia M. and Bruce D. Meyer (1994). 'The Extent and Consequences of Job Turnover.' *Brookings Papers on Economic Activity. Microeconomics*: 177-236.

Baker, George, Michael Gibbs, and Bengt Holmstrom (1994). 'The Wage Policy of a Firm.' *Quarterly Journal of Economics* 109: 881-919.

Barlevy, Gady (2005). 'The cost of business cycles and the benefits of stabilization.' *Economic Perspectives Chicago Federal Reserve* 1st Quarter.

Barsky, Robert and Gary Solon (1989). 'Real Wages Over the Business Cycle.' NBER Working Paper 2888.

Beaudry, Paul and John DiNardo (1991). 'The Effect of Implicit Contracts on the Movements of Wages over the Business Cycle' *Journal of Political Economy:* 99(4).

Beaudry, Paul and David Green (2000). 'Cohort patterns in Canadian earnings: assessing the role of skill premia and inequality trends.' *Canadian Journal of Economics* 33 (4): 907-936.

Beaudry, Paul, Thomas Lemieux, and Daniel Parent (2000). 'What is Happening in the Youth Labor Market in Canada?' *Canadian Public Policy*, XXVI Supplement 1.

Becker, G. (1964). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. New York: Columbia University Press.

Betts, Julian, Christopher Ferrall, and Ross Finnie (forthcoming). 'The Role of University Quality in Determining Post-Graduation Outcomes: Panel Evidence from Three Recent Canadian Cohorts.' Canadian Journal of Economics.

Bils, Marc. J. (1985) 'Real Wages over the business cycle: Evidence From Panel Data.' *Journal of Political Economy,* 666-689.

Black, Dan, Kermit Daniel and Jeffrey Smith (2005). "College Quality and Wages in the United States." *German Economic Review* 6(3): 417-445.

Black, Dan and Jeffrey Smith (2004). "How Robust is the Evidence on the Effects of College Quality? Evidence from Matching." *Journal of Econometrics*. 121(1): 99-124.

Blanchflower, David G. and Andrew J. Oswald (1994). *The Wage Curve*. Cambridge, MA: MIT Press.

Blanchard, Olivier and Lawrence Katz (1992). 'Regional Evolutions.' *Brookings Papers on Economic Activity*, 1: 1992, pp. 1-75.

Blau, D.M. and P.K. Robins (1990), "Job search outcomes for the employed and unemployed", *Journal of Political Economy*, 98, pp. 637-655.

Bloemen, Hans (2005). 'Job Search, Search Intensity, and Labor Market Transitions: An Empirical Analysis.' The *Journal of Human Resources* 40(1): 231-269.

Bloom, David E. and Richard B. Freeman (1986). 'The 'Youth Problem': Age or Generational Crowding.' NBER Working Paper No. 1829.

Böheim, René and Marl P. Taylor (2001). 'Job search methods, intensity, and success in Britain in the 1990s.' ISER working papers, Number 2001–07, Institute for Social and Economic Research, University of Essex, UK.

Bound, John and Holzer, Harry J (2000). "Demand Shifts, Population Adjustments, and Labor Market Outcomes during the 1980s," *Journal of Labor Economics*, Vol. 18(1): 20-54.
Burdett, Kenneth (1978). 'A Theory of Employee Job Search and Quit Rates.' *American Economic Review* 68(1): 212-20.
Cahuc, Pierre, Fabien Postel-Vinay, and Jean-Marc Robin (2006). 'Wage Bargaining with On-the-Job Search : Theory and Evidence.' *Econometrica* 74(2): 323-364.
Card, David (1995). 'The Wage Curve: A Review.' *Journal of Economic Literature* 33 (June): 785-799.
Card, David, and Thomas Lemieux (1997). 'Adapting to Circumstances: The Evolution of Work, School, and Living Arrangements Among North Amercian Youth.' NBER Working Paper No. 6142.
Card, David, and Thomas Lemieux (2000). 'Drop Out and Enrollment Trends in the Post-War Period: What Went Wrong in the 1970s?' NBER Working Paper No. 7658.
Card, David, and Thomas Lemieux (2001). 'Can Falling Supply Explain The Rising Return To College for Younger Men? A Cohort Analysis.' *Quarterly Journal of Economics*, May.
Christensen, Bent Jesper, Rasmus Lentz, Dale T. Mortensen, George Neumann, and Axel Werwatz (2005). 'On the job search and the wage distribution.' *Journal of Labor Economics* 23(1): 31-58.
Cutler, David and Lawrence Katz (1991). 'Macroeconomic Performance and the Disadvantaged.' *Brookings Papers on Economic Activity* 1991(2): 1-74.
Dale, S. B. and A. Krueger (2002). 'Estimating the payoff to attending a more selective college: an application of selection on observables and unobservables.' *Quarterly Journal of Economics* 117, 1491-1528.
Davidson, R., and J.G. Mackinnon (1989). 'Testing for consistency using artificial regressions.' *Econometric Theory* 4: 363-84.
Davis, Donald and James Harrigan (2007). 'Good Jobs, Bad Jobs, and Trade Liberalization.' Mimeo, Columbia University.
Deaton, Angus (1997). *The Analysis of Household Surveys*. Johns Hopkins University Press.
Devereux, Paul (2001). 'The Cyclicality of Real Wages within Employer-Employee Matches.' *Industrial and Labor Relations Review* (54)4: 835-850.
Devereux, Paul (2002). 'Occupational Upgrading over the Business Cycle.' *Labour* 16(3) 423-452.
Devereux, Paul (2003). 'The Importance of Obtaining a High-Paying Job.' Mimeo, University of California, Los Angeles.
Dickens, William T. and Lawrence F. Katz. 'Inter-Industry Wage Differencesand Industry Charachteristics.' *Unemployment and the Structure of Labor Markets*, edited by K. Lang and J. Leonard, pp. 48-89. New York: Basil Blackwell, 1987
Doeringer, Peter and Michael Piore (1971). *Internal Labor Markets and Manpower Analysis*. Lexington, MA: D. C. Heath and Company.
Dohmen, Thomas (2005). "Housing, Mobility, and Unemployment," *Regional Science and Urban Economics* 35(3): 305-325.
Ellwood, David (1982). "Teenage Unemployment: Permanent Scars or Temporary Blemishes?" In: Richard B. Freeman and David A. Wise (Eds). *The Youth Labor Market Problem: Its Nature, Causes and Consequences*,, pp. 349-390. Chicago: University of Chicago Press.
Farber, Henry (1994). 'The Analysis of Interfirm Worker Mobility.' *Journal of Labor Economics* 12(4): 554-93.
Farber, Henry (2003). 'Job Loss in the United States, 1981-2001.' IRS Working Paper No. 471 Princeton University.
Freeman, Richard B. (1975). 'Overinvestment in College Training.' *The Journal of Human Resources* 18(2): 287-311.
Freeman, Richard B. (1979). 'The Effect of Demographic Factors on Age-Earnings Profiles.' *The Journal of Human Resources* 14 (3): 289-318.
Freeman, Richard B. (1981). 'Career Patterns of College Graduates in a Declining Job Market.' NBER Working Paper 750.
Friedman, Richard (1953). 'Choice, Chance, and the Personal Distribution of Income.' *Journal of Political Economy* 61(4): 277-290.
Fox, Jeremy (2004). 'Employer-Size Wage Gaps, Testing Worker Preferences and Talents Explanations.' Chicago, mimeo.
Gardecki, Rosella and David Neumark (1998). 'Order from Chaos? Effects of Early Labor Market Experiences on Adult Labor Market Outcomes.' *Industrial and Labor Relations Review* 51(2): 299-322.

Garibaldi, Pietro and Espen R. Moen (2007). 'Industry Dynamics and Search in the Labor Market.' Mimeo, University of Turin.
Gibbons, Robert and Lawrence Katz (1992). 'Does Unmeasured Ability Explain Inter-Industry Wage Differentials.' *Review of Economic Studies* 59 (3): 515-535.
Gibbons, Robert, Lawrence F. Katz, Thomas Lemieux, and Daniel Parent (2005). 'Comparative Advantage, Learning, and Sectoral Wage Determination.' *Journal of Labor Economics* October 1-54.
Gibbons, Robert and Michael Waldman (1999). 'Incentives in Organizations.' In: Ashenfelter, Orley and David Card (eds), *Handbook of Labor Economics*. Elsevier Science Publishing Company Amsterdam, New York, and Oxford.
Gibbons, Robert and Michael Waldman (2004). 'Task-Specific Human Capital.' *AEA Papers and Proceedings* May, 94 May, pp. 203-207.
Giuliano, Paola and Till von Wachter (2004). 'Does a Four Fold Does a Four-Fold Higher Unemployment Rate Make a Difference? Wage Growth and Job Mobility of Young Workers in France and Germany.' Columbia University, mimeo.
Hall, Robert E. (1974). 'The Process of Inflation and the Labor Market.' *Brookings Papers on Economic Activity* 1974 (2): 343-393.
Hall, Robert E. (2005a). 'Employment Efficiency and Sticky Wages: Evidence from Flows in the Labor Market.' *Review of Economics and Statistics* 87(3): 397-407.
Hall, Robert E. (2005b). 'Employment Fluctuations with Equilibrium Wage Stickiness.' *American Economic Review* 95(1): 50-65.
Harris, Milton and Bengt Holmstrom (1982). 'A Theory of Wage Dynamics.' *Review of Economic Studies* 49: 315—333.
Hines, James, Hilary Hoynes, and Alan Krueger (2002). 'Another Look at Whether a Rising Tide Lifts All Boats.' in Alan Krueger and Robert Solow. (Eds.), *The Roaring Nineties: Can Full Employment Be Sustained?* Russell Sage Foundation: New York.
Hildreth, Andrew, Till von Wachter, and Elizabeth Weber (2005). 'Estimating the 'True' Cost of Job Loss: Evidence Using Matched Data from California 1991-2000.' Mimeo, Columbia University.
Hoynes, Hilary (2000). 'The Employment and Earnings of Less Skilled Workers Over the Business Cycle.' Rebecca Blank and David Card (Eds.), *Finding Jobs: Work and Welfare Reform*. Russell Sage Foundation: New York.
Jacobson, Louis, Robert LaLonde and Daniel Sullivan (1993). 'Earnings Losses of Displaced Workers.' *American Economic Review* 83(4): 685-709.
Jovanovic, Boyan and Robert Moffitt (1990). 'An Estimate of a Sectoral Model of Labor Mobility.' *The Journal of Political Economy* 98(4): 827-852.
Kahn, Lisa (2006). 'The Long-Term Labor Market Consequences of Graduating College in a Bad Economy.' Mimeo, Harvard University.
Kahn, Lisa (2007). 'Asymmetric Information Between Employers.' Mimeo, Harvard University.
Katz, Lawrence F. and David H. Autor (1999). 'Changes in the Wage Structure and Earnings Inequality.' In: Ashenfelter, Orley and David Card (eds), *Handbook of Labor Economics*. Elsevier Science Publishing Company Amsterdam, New York, and Oxford.
Katz, Lawrence F., Gary W. Loveman and David G. Blanchflower (1995). 'A Comparison of Changes in the Structure of Wages in Four OECD Countries.' In: Freeman, R. and L. Katz (eds), *Differences and Changes in the Wage Structure*.
Keith, Kristen and Abigail McWilliams (1999). 'The Returns to Job Mobility and Search by Gender.' *Industrial and Labor Relations Review* 52(3): 460-477.
Kletzer, Lori G. and Robert W. Fairlie (2003). 'The Long-Term Costs of Job Displacement Among Young Workers.' *Industrial Labor Relations Review* 56(4): 682-698.
Koenker, R. and K. Hallock (2001). 'Quantile Regression.' *Journal of Economic Perspectives* 51 (4): 143-156.
Krashinsky, Harry (2002). 'Evidence on Adverse Selection and Establishment Size In the Labor Market.' *Industrial and Labor Relations* Review 56(1): 84-96.
Krueger, Alan and Lawrence Summers (1988). 'Efficiency Wages and the Inter-Industry Wage Structure.' *Econometrica* 56(2): 259-293.
Krause, Michael U. and Thomas A. Lubik (2006a). 'The Cyclical Upgrading of Labor and On-the-Job Search.' Labour Economics 13: 459-477.
Krause, Michael U. and Thomas A. Lubik (2006b). 'On-the-Job Search and the Cyclical Dynamics of the

Labor Market.' Mimeo, Federal Reserve Bank of Richmond.
Krusell, Per and Anthony Smith (1999). 'On the welfare effects of eliminating business cycles.' *Review of Economic Dynamics* 2(1): 245–272.
Lentz, Rasmus (2007). 'Sorting in a General Equilibrium On-the-Job Search Model.' Mimeo, University of Wisconsin.
Lemieux, Thomas (1998). 'Estimating the Effects of Unions on Wage Inequality in a Panel Data Model with Comparative Advantage and Non-Random Selection.' *Journal of Labor Economics* 16 (April) 261-291.
Ljungqvist, Lars, and Thomas Sargent (1998). 'The European Unemployment Dilemma'. *Journal of Political Economy* 106(3): 514-550.
Lucas, Robert (1987). *Models of Business Cycles*. Oxford: Basil Blackwell.
Macleod, Bentley and James M. Malcomson (1993). 'Investments, Holdup, and the Form of Market Contracts.' *American Economic Review* 83(4): 811-37.
Malcomson, James M. (1999). 'Individual Employment Contracts.' In: Ashenfelter, Orley and David Card (eds), *Handbook of Labor Economics, Volume 3*. Elsevier Science Publishing Company Amsterdam, New York, and Oxford.
Manning, Alan (2000). 'Movin' On Up: Interpreting the Earnings-Experience Profile.' *Bulletin of Economic Research* 52(4): 261-294.
Manning, Alan (2002). *Monopsony in Motion: Imperfect Competition in Labor Markets*. Princeton: Princeton University Press.
Manning, A. (2003), "The real thin theory: Monopsony in modern labour markets," *Labour Economics* 10: 105-131.
McCall, Brian (1990). 'Occupational Matching: A Test of Sorts.' *Journal of Political Economy* 98(1): 45-69.
McDonald, Ian M. and Robort M. Solow (1985). 'Wages and Employment in a Segmented Labor Market.' *The Quarterly Journal of Economics* 100(4): 1115-1141.
McDonald, James Ted and Christopher Worswick (1999). 'Wages, Implicit Contracts, and the Business Cycle: Evidence from Canadian Micro Data.' *The Journal of Policital Economy* 107(4): 884-892.
McLaughlin, Kenneth J. and Mark J. Bils (2001). 'Inter-Industry Mobility and the Cyclical Upgrading of Labor' *Journal of Labor Economics* 19(1): 94-135.
Mincer, J., (1974). *Schooling, Experience, and Earnings*. Cambridge, MA: National Bureau of Economic Research.
Mortensen, Dale T. (1986). 'Job Search and Labor Market Analysis.' In: Orley Ashenfelter and Richard Layard (Eds.), *Handbook of Labor Economics,* Volume 2. Amsterdam, New York, and Oxford: Elsevier Science.
Mortensen, Dale T. (1988). 'Wages, Separations, and Job Tenure: On-the-Job Specific Training or Matching?' *Journal of Labor Economics* 6(4): 445-471.
Moscarini, Giuseppe (2001). "Excess Worker Reallocation." *Review of Economic Studies* 68(3): 593-612.
Moscarini, Giuseppe, and Frank Vella (2008). 'Occupational Mobility and the Business Cycle.' NBER Working Paper No. 13819.
Murphy, Kevin M. and Finis Welch (1990). 'Empirical Age-Earnings Profiles.' *Journal of Labor Economics* 8(2): 202-229.
Neal, Derek (1995). 'Industry-Specific Human Capital: Evidence From Displaced Workers,' *Journal of Labor Economics*, October, vol. 13: 653-77.
Neal, Derek (1998). 'The Link between Ability and Specialization: An Explanation for Observed Correlations between Wages and Mobility Rates.' *The Journal of Human Resources* 33(1): 173-200.
Neal, Derek (1999). 'The Complexity of Job Mobility Among Young Men.' *Journal of Labor Economics* 17(2): 237-261.
Neumark, David (2002). 'Youth Labor Markets in the U.S.: Shopping Around vs. Staying Put.' *Review of Economics and Statistics* (August) 462-48.
Oi, Walter Y. and Todd L. Idson (1999). 'Firm Size and Wages.' In: O. Ashenfelter and D. Card (eds.) *Handbook of labor economics*. Volume 3B. Amsterdam, New York, and Oxford: Elsevier Science.
Okun, Arthur M. (1973). 'Upward Mobility in a High-Pressure Economy.' *Brookings Papers of Economic Activity* 1: 207-52.
Oreopoulos, Philip, Till von Wachter, and Andrew Heisz (2006). 'The Short- and Long-Term Career Effects of Graduating in a Recession: Hysteresis and Heterogeneity in the Market for College Graduates.' NBER Working Paper No. 12159.
Oyer, Paul (2006). 'The Macro-Foundations of Microeconomics: Initial Labor Market Conditions and Long Term Outcomes for Economists.' NBER Working Paper No. 12157.

Parent, Daniel (2000). 'Industry-Specific Capital and the Wage Profile: Evidence from the National Longitudinal Survey of Youth and the Panel Study of Income Dynamics.' *Journal of Labor Economics* 18(2): 306-323.
Pissarides, Christopher (2000). *Equilibrium Unemployment Theory*. 2nd Edition. Cambridge, MA: MIT Press.
Prendergast, Canice (1993). 'The Role of Promotion in Human Capital Acquisition.' *Quarterly Journal of Economics* 108(2): 523-534.
Prendergast, Canice (1999). 'The Provision of Incentives in Firms.' *Journal of Economic Literature* 37(1): 7-63.
Reder, M. W. (1955). 'The Theory of Occupational Wage Differentials.' *American Economic Review* 45(5): 833-852.
Reynolds, Lloyd (1951). *The Structure of Labor Markets*. Westport, CN: Greenwood Press.
Rosen, Sherwin (1972). 'Learning and Experience in the Labor Market.' *Journal of Human Resources* 7(3): 326-342.
Ryan, Paul (2001). 'The School-To-Work Transition: A Cross-National Perspective.' *Journal of Economic Literature* 39 (March): 34-92.
Saks, Raven E. and Abigail Wozniak (2007). "Labor Reallocation over the Business Cycle: New Evidence from Internal Migration." IZA Discussion Paper Series 2766.
Shimer, Robert (2001). "The Impact of Young Workers on the Aggregate Labor Market." *Quarterly Journal of Economics*. 969-1007.
Shimer, Robert (2004). 'Search Intensity.' Mimeo, University of Chicago.
Shimer, Robert (2005a). 'The Cyclical Behavior of Equilibrium Unemployment and Vacancies.' *The American Economic Review* 95(1): 25-49.
Shimer, Robert (2005b). 'The Assignment of Workers to Jobs in an Economy with Coordination Frictions.' *Journal of Political Economy* 113(5): 996-1025.
Shimer, Robert (2007). 'Mismatch.' *American Economic Review*, 97(4): 1074-1101.
Shimer, Robert and Lones Smith (2000). Assortative matching and search. *Econometrica* 68(2): 343-369.
Solon, Gary, Robert Barsky, and Jonathan A. Parker (1994). 'Measuring the Cyclicality of Real Wages: How Important is Composition Bias?' *The Quarterly Journal of Economics* 109(1): 1-25.
Storesletten, Kjetil, Chris Telmer, and Amir Yaron (2001). 'The welfare cost of business cycles revisited: Finite lives and cyclical variation in idiosyncratic risk.' *European Economic Review* 45(7): 1311–1339.
Topel, Robert (1986). 'Job Mobility, Search, and Earnings Growth: A Reinterpretation of Human Capital Earnings Functions.' *Research in Labor Economics*, Vol. 8, Part A, pages 199-233.
Topel, Robert and Michael Ward (1992). 'Job Mobility and the Careers of Young Men.' *Quarterly Journal of Economics* 107(2): 439-479.
von Wachter, Till and Stefan Bender (2006) 'At the Right Place at the Wrong Time: The Role of Firms and Luck in Young Workers' Careers.' *American Economic Review* 96(5): 1679-1705.
Vroman, Wayne (1977). 'Worker Upgrading and the Business Cycle.' *Brookings Papers on Economic Activity* (1): 229-252.
Wasmer, E. and Y. Zenou (2006), "Equilibrium search unemployment with explicit spatial frictions," *Labour Economics* 13: 143-165.
Woodford, Michael (2003). I*nterest and Prices: Foundations of a Theory of Monetary Policy*. Princeton University Press.
Welch, Finis (1979). 'The Effect of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust.' *Journal of Political Economy* 87 (5), Part 2: Education and Income Distribution, S65-S97.
Wozniak, Abigail (2006). 'Why Are College Graduates More Responsive to Distant Labor Market Opportunities?' University of Notre Dame, mimeo.

Figure 1: Experience-Profiles in Earnings, Mobility, and Firm Charachteristics Canada and U.S.

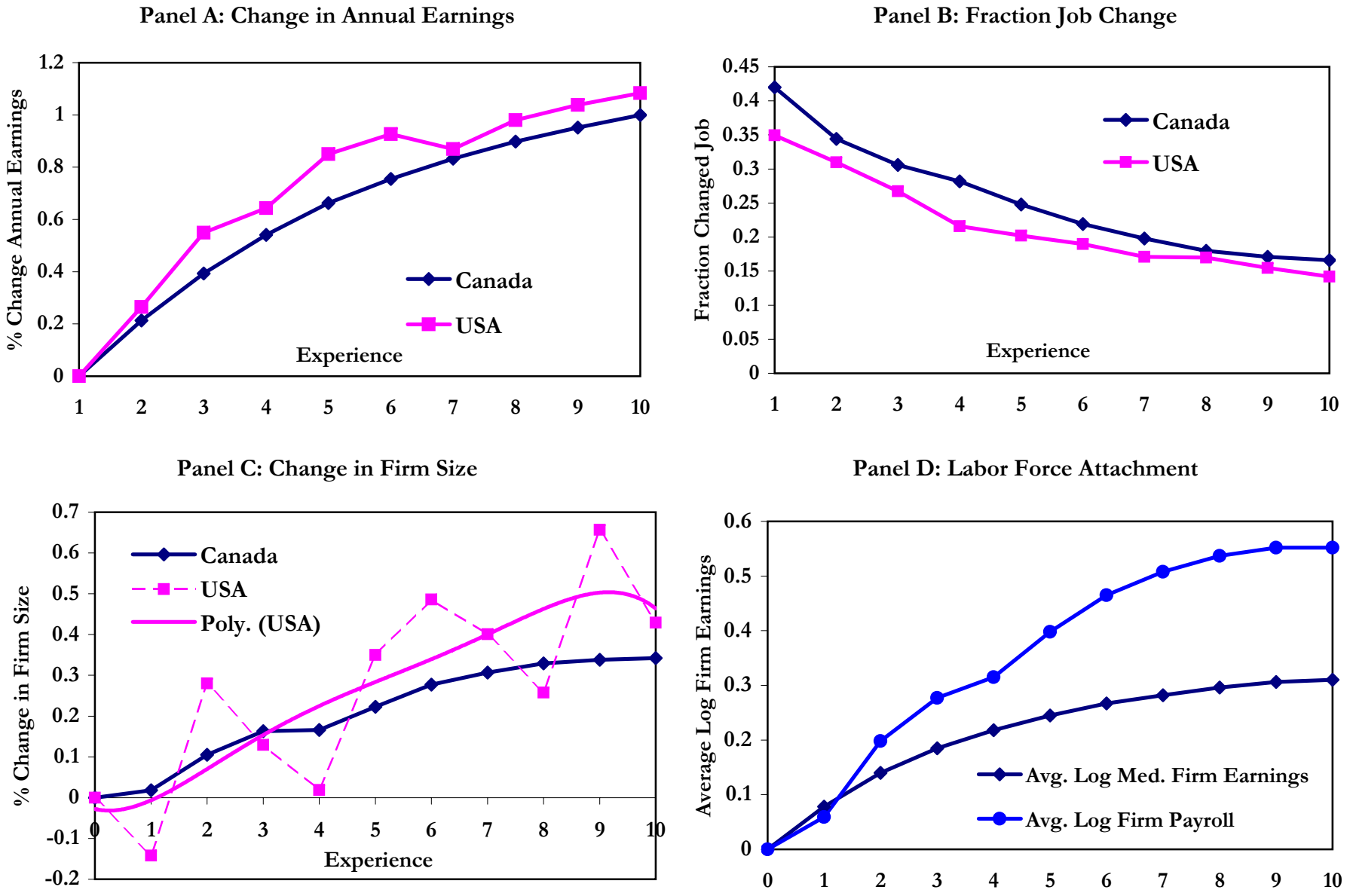


Figure 2A: Unemployment Rates Ages 14-24 for Canada and Provinces 1976-2000

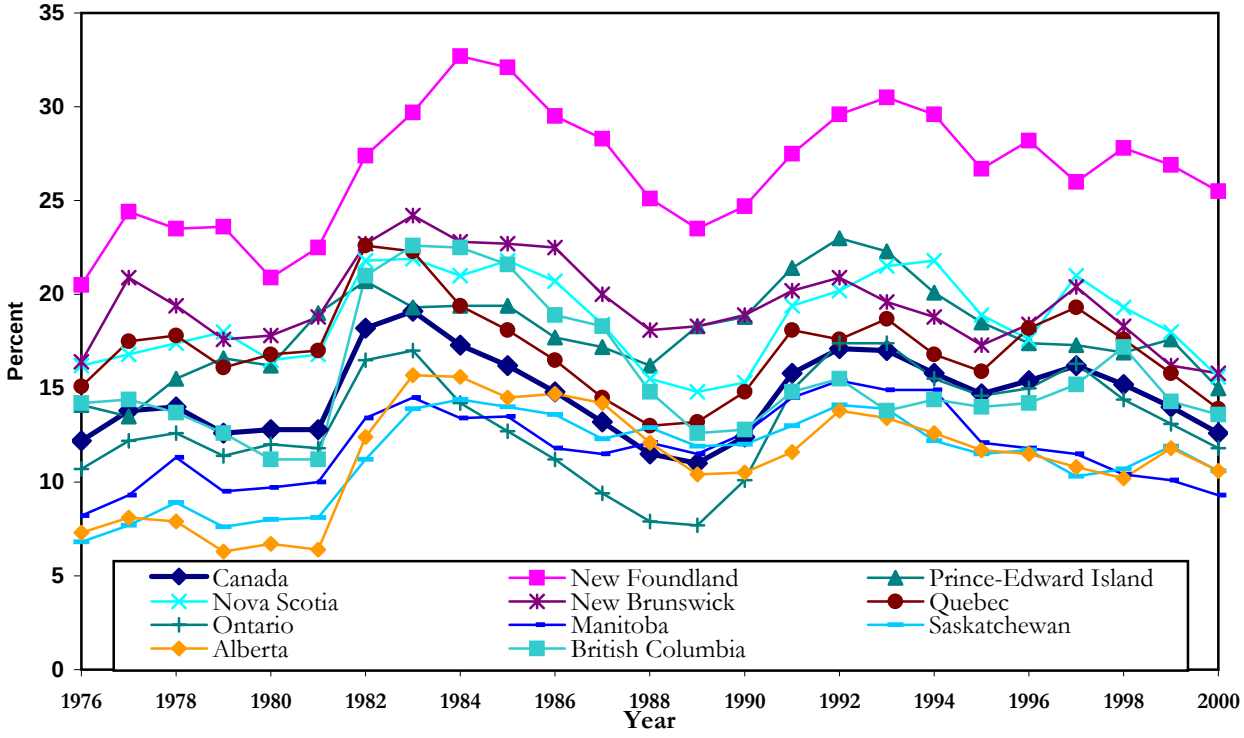


Figure 2B: Mature and Entry Level Earnings and Experience Profiles by Graduation Year

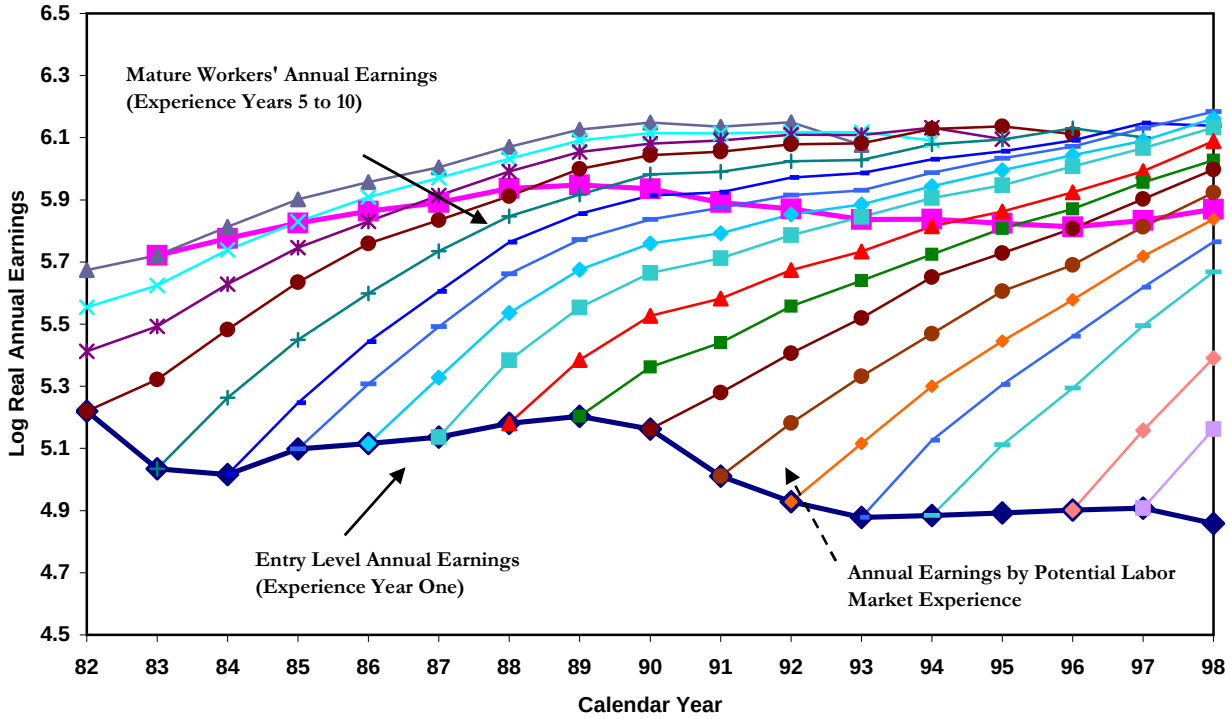


Figure 3A: Earnings By Experience Year For Cohorts Entering Labor Market 1978 to 1993

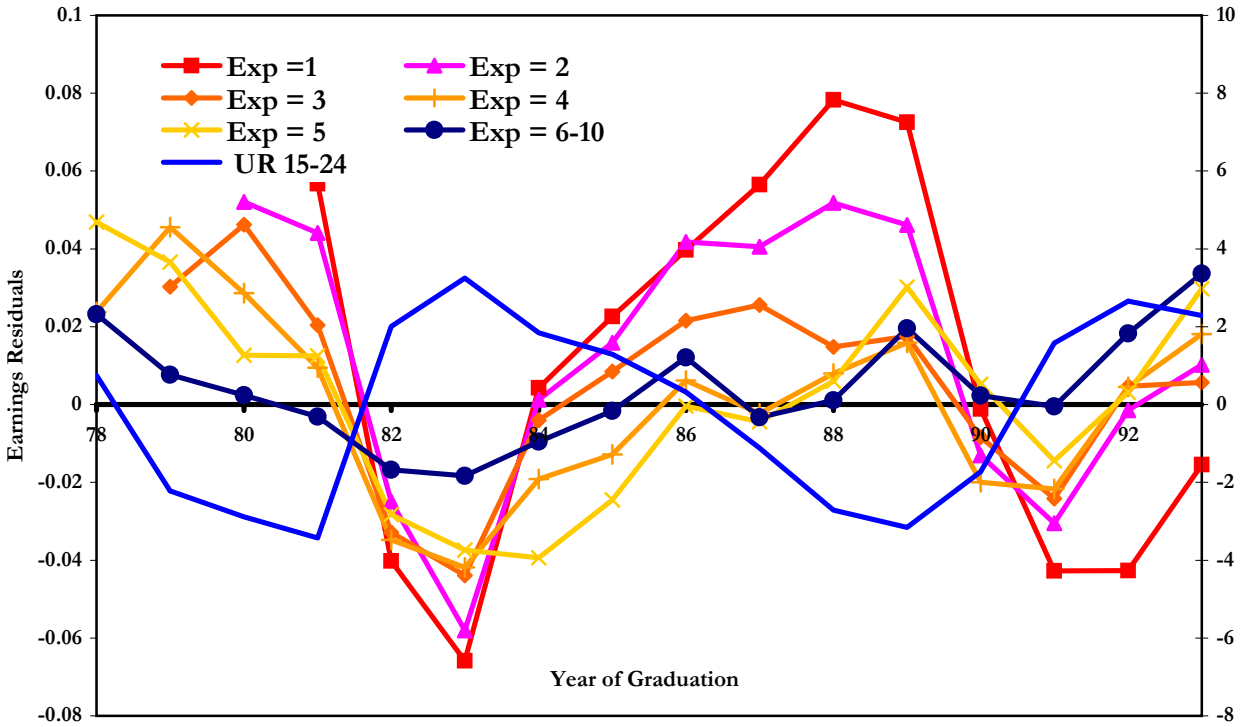


Figure 3B: Aggregate Unemployment and Wage Fluctuations by Experience-Level

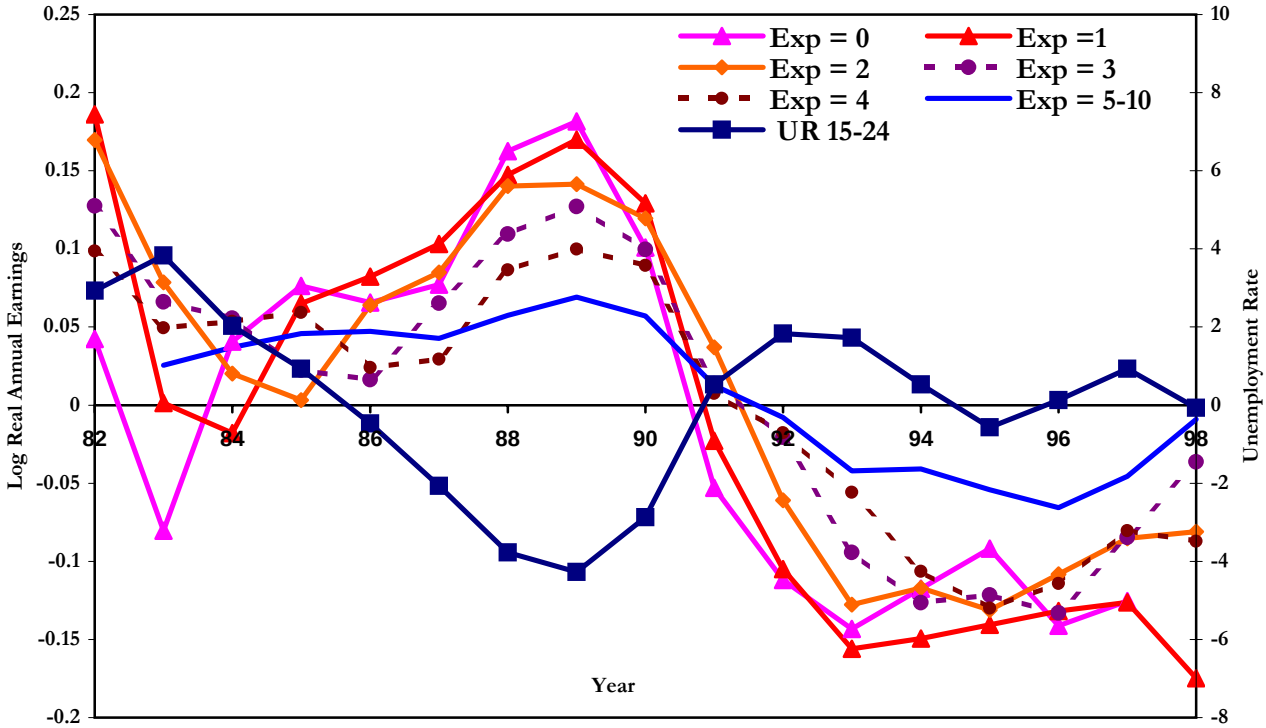


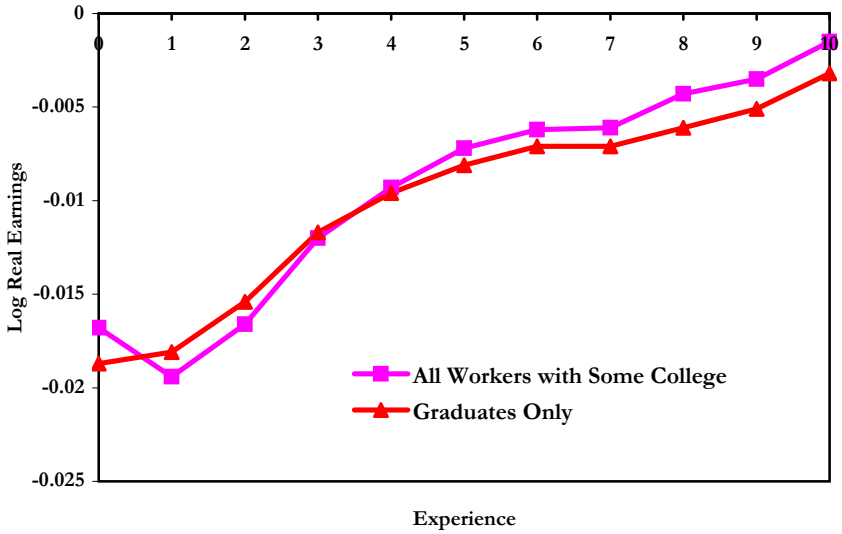
Table 1: Effect of Unemployment Rate at time of Graduation on Log Real Earnings by Potential Experience

	Specification					
National/Regional	**National**	**National**	**Regional**	**National**	**National**	**Regional**
Trend	**Linear**	**Quadratic**	**NA**	**Linear**	**Quadratic**	**NA**
D>=0?	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Experience Year						
0	-0.021	-0.0224	-0.0168	-0.0231	-0.0232	-0.0187
	[0.0047]***	[0.0039]***	[0.0026]***	[0.0037]***	[0.0036]***	[0.0024]***
1	-0.0177	-0.0187	-0.0194	-0.0168	-0.0169	-0.0181
	[0.0052]***	[0.0028]***	[0.0024]***	[0.0049]***	[0.0026]***	[0.0021]***
2	-0.0128	-0.0137	-0.0166	-0.0116	-0.012	-0.0154
	[0.0033]***	[0.0026]***	[0.0022]***	[0.0030]***	[0.0021]***	[0.0019]***
3	-0.0084	-0.0089	-0.012	-0.006	-0.0066	-0.0117
	[0.0022]***	[0.0022]***	[0.0021]***	[0.0022]**	[0.0015]***	[0.0017]***
4	-0.0061	-0.006	-0.0093	-0.0036	-0.004	-0.0096
	[0.0025]**	[0.0027]**	[0.0020]***	[0.0028]	[0.0021]*	[0.0016]***
5	-0.0065	-0.0055	-0.0072	-0.0035	-0.0032	-0.0081
	[0.0029]**	[0.0020]**	[0.0019]***	[0.0024]	[0.0015]**	[0.0016]***
6	-0.0027	-0.0023	-0.0062	-0.0018	-0.0012	-0.0071
	[0.0032]	[0.0020]	[0.0020]***	[0.0027]	[0.0018]	[0.0017]***
7	-0.003	-0.0027	-0.0061	-0.0019	-0.001	-0.0071
	[0.0043]	[0.0023]	[0.0020]***	[0.0034]	[0.0018]	[0.0017]***
8	-0.0001	0.0002	-0.0043	-0.0008	0.0006	-0.0061
	[0.0049]	[0.0028]	[0.0019]**	[0.0034]	[0.0016]	[0.0017]***
9	0.0035	0.0038	-0.0035	0.0021	0.0038	-0.0051
	[0.0047]	[0.0027]	[0.0019]*	[0.0033]	[0.0017]**	[0.0017]***
10	0.0066	0.0051	-0.0015	0.0047	0.0049	-0.0032
	[0.0048]	[0.0028]*	[0.0020]	[0.0034]	[0.0022]**	[0.0017]*
Constant	7.3951	-3.6341	8.8017	7.673	-2.0294	9.0456
	[0.2571]***	[2.3916]	[0.1012]***	[0.2095]***	[0.8040]**	[0.0668]***
N	14407	14407	14407	8679	8679	8679
R-squared	0.76	0.77	0.8	0.93	0.93	0.95

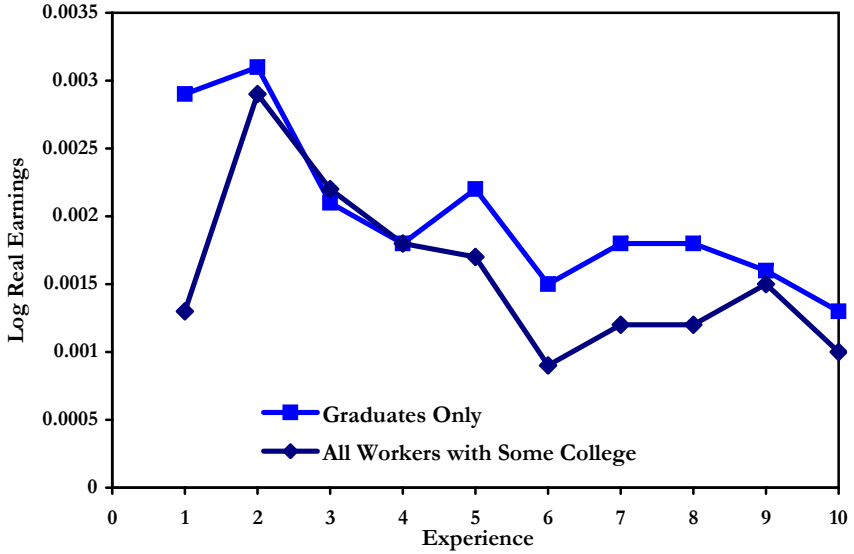
Note: The sample includes males in Canada leaving university between 1976 and 1995. 'D' indicates the difference between the actual year left and the predicted year of graduation based on year of entry and program. Sample sizes reflect cell sample sizes after collapsing the micro data by graduation cohort, province of residence in each year of graduation, and experience year. The national model regresses log annual earnings on the youth unemployment rate in the country at the year of college exit, interacted with experience years 0 to 10, plus province of residence fixed effects, experience fixed effects, and a linear or quadratic graduation cohort trend. The regional model regresses log annual earnings on the youth unemployment rate in the province of first residence, interacted with experience years 0 to 10, plus province of residence fixed effects, experience fixed effects, and year of graduation fixed effects. The coefficients shown are the unemployment rate at college exit and experience interactions. One, two, and three asterix indicates statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively. See text for more details.

Figure 4: The Persistent Effects of Unemployment in the Year of Graduation on Earnings, Job Mobility, and Firm Outcomes (Graduation Cohorts 1976-1995)

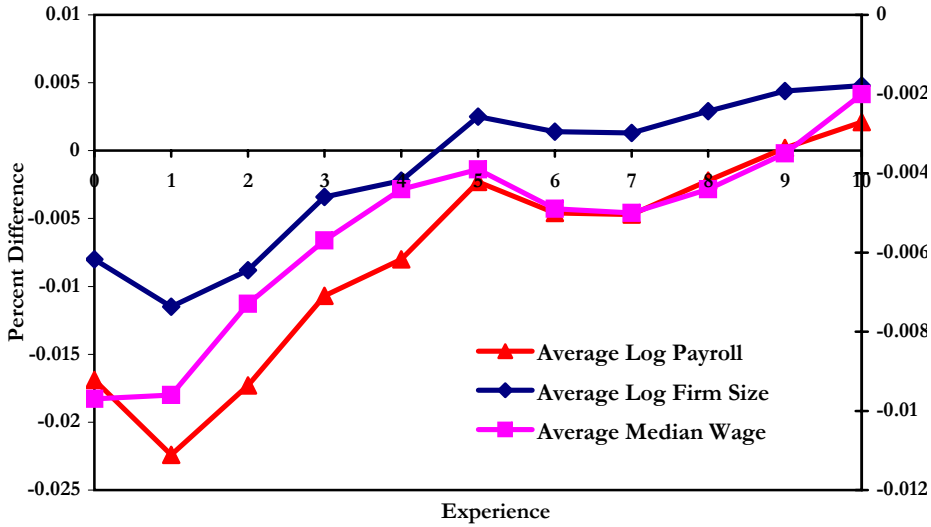
Panel A: Log Real Annual Earnings



Panel B: Probability of Annual Change in Employers



Panel C: Average Firm 'Quality', Graduates Only



Panel D: Fraction not Working, Different Measures

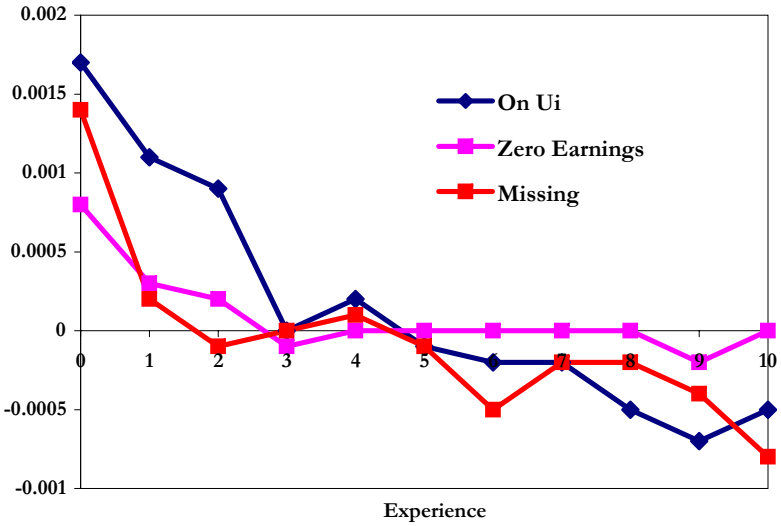


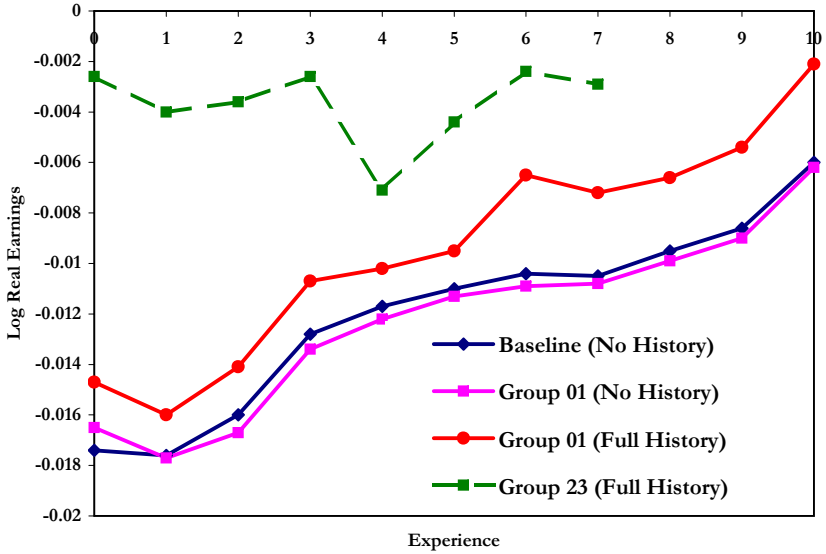
Table 2: Effect of Unemployment Rate at time of Graduation With Controls for UR History, Basic and Grouped Model - Graduate Sample, Regional Model, Cohorts 1982-1995

Model	Specification						
	Baseline (No UR History)	With Current UR*Exp	With History in Exp=1,2,3	With Full UR History	Baseline Group 0-1 (No Hist.)	Group 01 With Full History	Group 23 With Full History
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Experience Year							
0	-0.0174	-0.0184	-0.0173	-0.0159	-0.0165	-0.0147	---
	[0.0028]***	[0.0028]***	[0.0027]***	[0.0028]***	[0.0030]***	[0.0031]***	---
1	-0.0176	-0.0178	-0.017	-0.0172	-0.0177	-0.016	---
	[0.0024]***	[0.0047]***	[0.0044]***	[0.0048]***	[0.0025]***	[0.0026]***	---
2	-0.016	-0.0142	-0.014	-0.0121	-0.0167	-0.0141	-0.0026
	[0.0021]***	[0.0025]***	[0.0041]***	[0.0041]***	[0.0020]***	[0.0025]***	[0.0025]
3	-0.0128	-0.0117	-0.0087	-0.0094	-0.0134	-0.0107	-0.004
	[0.0019]***	[0.0020]***	[0.0037]**	[0.0035]***	[0.0018]***	[0.0024]***	[0.0024]*
4	-0.0117	-0.0113	-0.0063	-0.008	-0.0122	-0.0102	-0.0036
	[0.0018]***	[0.0019]***	[0.0039]	[0.0038]**	[0.0018]***	[0.0024]***	[0.0030]
5	-0.011	-0.0108	-0.0076	-0.0082	-0.0113	-0.0095	-0.0026
	[0.0018]***	[0.0018]***	[0.0046]	[0.0043]*	[0.0016]***	[0.0026]***	[0.0041]
6	-0.0104	-0.0102	-0.008	-0.0076	-0.0109	-0.0065	-0.0071
	[0.0019]***	[0.0019]***	[0.0055]	[0.0048]	[0.0018]***	[0.0030]**	[0.0043]
7	-0.0105	-0.0105	-0.0104	-0.0099	-0.0108	-0.0072	-0.0044
	[0.0019]***	[0.0019]***	[0.0049]**	[0.0046]**	[0.0019]***	[0.0032]**	[0.0041]
8	-0.0095	-0.0095	-0.0067	-0.0049	-0.0099	-0.0066	-0.0024
	[0.0019]***	[0.0019]***	[0.0050]	[0.0043]	[0.0020]***	[0.0029]**	[0.0040]
9	-0.0086	-0.0085	-0.0103	-0.0091	-0.009	-0.0054	-0.0029
	[0.0019]***	[0.0019]***	[0.0051]**	[0.0038]**	[0.0020]***	[0.0032]*	[0.0045]
10	-0.006	-0.0054	-0.0125	-0.0115	-0.0062	-0.0021	-0.0032
	[0.0021]***	[0.0021]***	[0.0055]**	[0.0050]**	[0.0023]***	[0.0039]	[0.0051]
Constant	9.2257	9.2636	9.2633	9.2379	9.2195	9.2031	---
	[0.0982]***	[0.1023]***	[0.0969]***	[0.1034]***	[0.1040]***	[0.1102]***	---
N	7536	7536	7536	6994	7536	7299	---
R^2	0.96	0.96	0.96	0.97	0.96	0.96	---

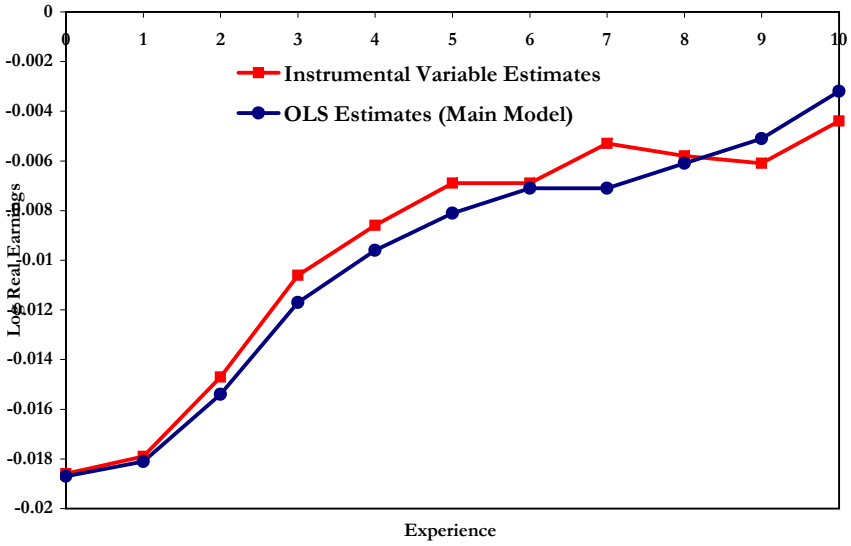
Note: The sample includes males in Canada graduating university (with D>=0) between 1982 and 1995 . Sample sizes reflect cell sample sizes after collapsing the micro data by graduation cohort, province of residence in each year of graduation, and experience year. The national model regresses log annual earnings on the youth unemployment rate in the country, instrumented with the youth unemployment rate in the province of first residence (the columns indicate whether this rate is averaged over the first 1 to 3 years), interacted with experience years 0 to 10, plus province of residence fixed effects, experience fixed effects, and year of graduation fixed effects. The columns indicate additional controls for experience interacted with later unemployment rates. One, two, and three asterix indicates statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively. See text for more details.

Figure 5: Selected Results from Sensitivity Analysis (Effect of Further Unemployment Shocks, Selective Graduation, Selective Participation, Cohort Differences)

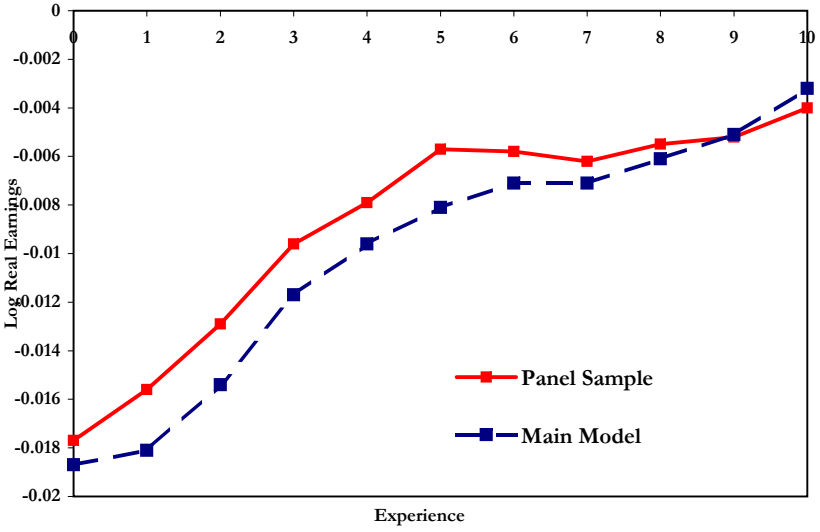
Panel A: Effect of Unemployment Rate at Time of Graduation on Earnings Controlling for Dynamic Effects of Further Unemployment Shocks (by Experience Groups)



Panel B: Effect of Unemployment Rate at Time of Graduation Instrumenting with Unemployment at Time of Predicted Graduation



Panel C: Effect of Unemployment Rate at Time of Graduation for Workers with Positive Earnings Each Period



Panel D: Effect of Unemployment Rate at Time of Graduation on Earnings for Different Groups of Graduation Cohorts

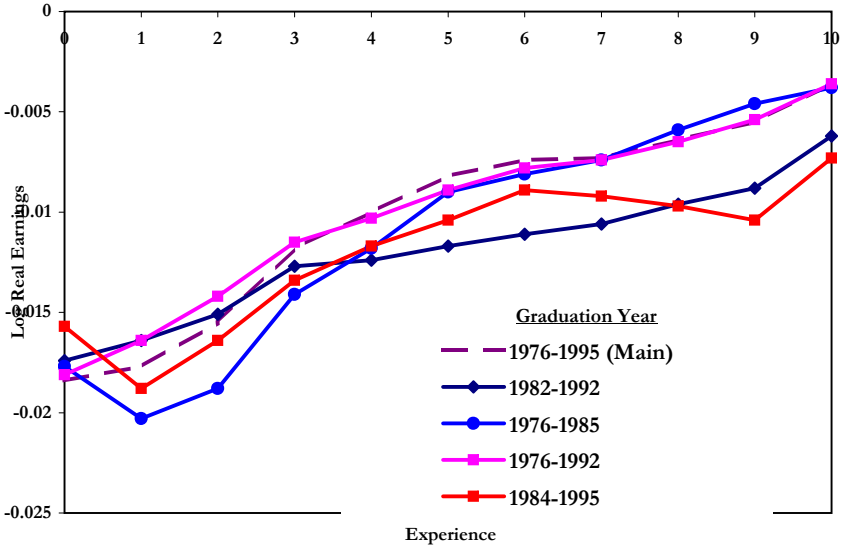


Table 3: Effect of Unemployment Rate at time of Graduation on Labor Force Participation - and Province Mobility - Graduate Sample

	Specification						
Nat./Reg.	**Regional**			**National**		**Regional**	
Outcome	**Fraction Zero Earnings**	**Fraction Not in Sample**	**Fraction on UI**	**Fraction Changed Province**	**Fraction Left First Province**	**Fraction Changed Province**	**Fraction Left First Province**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Experience Year							
0	0.0008	0.0014	0.0017			-	-
	[0.0001]***	[0.0005]***	[0.0003]***			-	-
1	0.0003	0.0002	0.0011	0	0.0007	0.0023	0.001
	[0.0001]***	[0.0003]	[0.0002]***	[0.0003]	[0.0005]	[0.0004]***	[0.0010]
2	0.0002	-0.0001	0.0009	0.0001	0.0003	0.0014	0.0029
	[0.0001]**	[0.0003]	[0.0002]***	[0.0002]	[0.0006]	[0.0002]***	[0.0008]***
3	-0.0001	0	0	0	-0.0001	0.0008	0.0036
	[0.0001]	[0.0003]	[0.0002]	[0.0002]	[0.0005]	[0.0002]***	[0.0008]***
4	0	0.0001	0.0002	0	-0.0005	0.0001	0.0039
	[0.0001]	[0.0002]	[0.0001]	[0.0002]	[0.0005]	[0.0002]	[0.0008]***
5	0	-0.0001	-0.0001	-0.0001	-0.0007	-0.0003	0.0038
	[0.0001]	[0.0003]	[0.0002]	[0.0002]	[0.0006]	[0.0002]	[0.0008]***
6	0	-0.0005	-0.0002	0.0002	-0.0005	-0.0004	0.0036
	[0.0001]	[0.0003]*	[0.0002]	[0.0002]	[0.0006]	[0.0002]*	[0.0008]***
7	0	-0.0002	-0.0002	-0.0003	-0.0008	-0.0008	0.0035
	[0.0001]	[0.0002]	[0.0002]	[0.0002]*	[0.0005]	[0.0002]***	[0.0008]***
8	0	-0.0002	-0.0005	-0.0001	-0.0003	-0.0008	0.0034
	[0.0001]	[0.0003]	[0.0002]***	[0.0003]	[0.0008]	[0.0003]***	[0.0008]***
9	-0.0002	-0.0004	-0.0007	0.0001	-0.0003	-0.0008	0.0031
	[0.0001]***	[0.0002]*	[0.0002]***	[0.0002]	[0.0009]	[0.0003]***	[0.0008]***
10	0	-0.0008	-0.0005	0	-0.0005	-0.0006	0.0031
	[0.0001]	[0.0003]***	[0.0002]***	[0.0002]	[0.0008]	[0.0003]**	[0.0009]***
Constant	-0.0032	0.0227	0.0162	0.006	-0.0399	0.0227	0.0305
	[0.0025]	[0.0118]*	[0.0072]**	[0.0097]	[0.0315]	[0.0068]***	[0.0307]
N	8679	8679	8679	5909	5942	5909	5942
R^2	0.2	0.39	0.34	0.08	0.14	0.4	0.71

Note: Columns indicate outcome variable used as the dependent variable. Each model regresses these outcomes on the youth unemployment rate in the province of first residence, interacted with experience years 0 to 10, plus province of residence fixed effects, experience fixed effects, and year of graduation fixed effects. The coefficients shown are the unemployment rate at college exit and experience interactions. One, two, and three asterix indicates statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively. See text for more details.

Table 4: Effect of Unemployment Rate at time of Graduation on Job and Industry Mobility and Average Employer Characteristics - Graduates Only

Outcome	Specification							
	Fraction Changed Firm	Fraction Changed Industry	Fraction Left First Firm	Fraction Left First Industry	Log Firm Size	Fraction Firm Size > 1000	Average Median Firm Wage	Average Log Firm Payroll
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Experience Year								
0	-	-	-	-	-0.008	-0.0016	-0.0097	-0.0169
	-	-	-	-	[0.0050]	[0.0008]*	[0.0014]***	[0.0058]***
1	0.0029	0.0021	0.0038	0.0025	-0.0115	-0.002	-0.0096	-0.0224
	[0.0008]***	[0.0007]***	[0.0010]***	[0.0011]**	[0.0049]**	[0.0009]**	[0.0011]***	[0.0055]***
2	0.0031	0.0034	0.0046	0.0041	-0.0088	-0.002	-0.0073	-0.0173
	[0.0007]***	[0.0006]***	[0.0011]***	[0.0011]***	[0.0050]*	[0.0008]**	[0.0011]***	[0.0056]***
3	0.0021	0.0023	0.0049	0.0045	-0.0034	-0.0012	-0.0057	-0.0107
	[0.0007]***	[0.0006]***	[0.0009]***	[0.0009]***	[0.0047]	[0.0008]	[0.0010]***	[0.0052]**
4	0.0018	0.0015	0.0052	0.0046	-0.0022	-0.0009	-0.0044	-0.008
	[0.0006]***	[0.0006]**	[0.0009]***	[0.0009]***	[0.0048]	[0.0008]	[0.0011]***	[0.0054]
5	0.0022	0.0019	0.0043	0.0039	0.0025	-0.0003	-0.0039	-0.0023
	[0.0005]***	[0.0005]***	[0.0010]***	[0.0010]***	[0.0051]	[0.0009]	[0.0012]***	[0.0057]
6	0.0015	0.0011	0.0043	0.004	0.0014	-0.0005	-0.0049	-0.0046
	[0.0005]***	[0.0005]**	[0.0010]***	[0.0010]***	[0.0050]	[0.0009]	[0.0012]***	[0.0056]
7	0.0018	0.002	0.0041	0.0039	0.0013	-0.0007	-0.005	-0.0047
	[0.0006]***	[0.0006]***	[0.0011]***	[0.0010]***	[0.0054]	[0.0009]	[0.0012]***	[0.0060]
8	0.0018	0.002	0.0044	0.0042	0.0029	-0.0003	-0.0044	-0.0022
	[0.0008]**	[0.0007]***	[0.0011]***	[0.0010]***	[0.0054]	[0.0009]	[0.0011]***	[0.0060]
9	0.0016	0.002	0.0047	0.0052	0.0044	0.0001	-0.0035	0.0002
	[0.0010]	[0.0009]**	[0.0010]***	[0.0010]***	[0.0055]	[0.0009]	[0.0011]***	[0.0063]
10	0.0013	0.0015	0.005	0.0055	0.0048	0.0002	-0.002	0.0021
	[0.0011]	[0.0011]	[0.0010]***	[0.0010]***	[0.0068]	[0.0010]	[0.0015]	[0.0077]
Constant	0.3407	0.3151	0.1391	0.523	8.1745	0.719	0.8069	7.2971
	[0.0184]***	[0.0187]***	[0.0428]***	[0.0403]***	[0.1953]***	[0.0283]***	[0.0368]***	[0.2203]***
N	5871	5871	5863	5861	8435	8435	8435	8435
R^2	0.8	0.79	0.86	0.77	0.53	0.47	0.75	0.6

Note: Columns indicate the firm or industry mobility variable used as the dependent variable. Each model regresses these outcomes on the youth unemployment rate in the province of first residence, interacted with experience years 0 to 10, plus province of residence fixed effects, experience fixed effects, and year of graduation fixed effects. The coefficients shown are the unemployment rate at college exit and experience interactions. One, two, and three asterix indicates statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively. See text for more details.

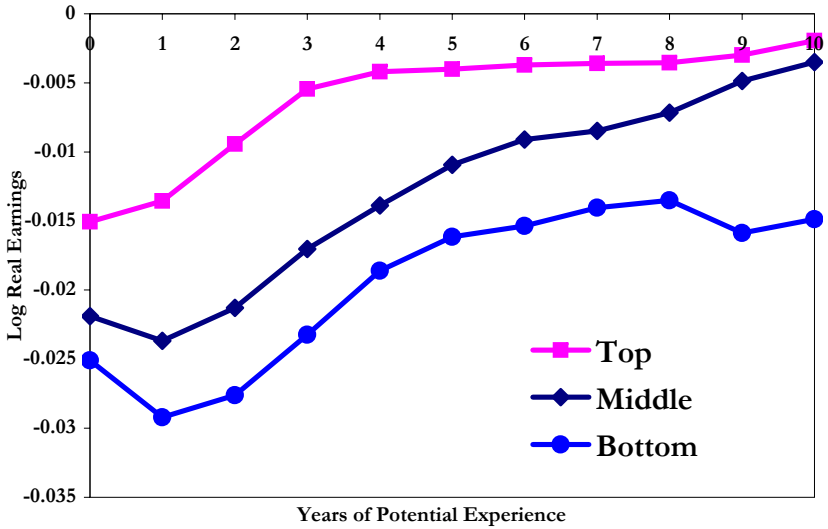
Table 5: Heterogeneity in Initial Loss and Reversion by Worker Groups

Outcome Variable		All Graduates	Position in Distribution of Predicted Annual Earnings: Bottom Quintile	Middle Quintile	Top Quintile
Annual Earnings	**Drop**	-0.0183	-0.0282	-0.0240	-0.0134
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Slope	0.0020	0.0021	0.0025	0.0019
		(0.0000)	(0.0021)	(0.0025)	(0.0019)
	Fade	0.0015	0.0016	0.0021	0.0012
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Average Firm Median Log Earnings	**Drop**	-0.0093	-0.0098	-0.0125	-0.0074
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Slope	0.0010	-0.0001	0.0014	0.0014
		(0.0000)	-(0.0001)	(0.0014)	(0.0014)
	Fade	0.0007	-0.0001	0.0009	0.0009
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Average Firm Employment	**Drop**	-0.0102	-0.0078	-0.0162	-0.0073
		(0.0000)	(0.0003)	(0.0001)	(0.0000)
	Slope	0.0021	0.0004	0.0006	0.0036
		(0.0000)	(0.0004)	(0.0006)	(0.0036)
	Fade	0.0016	-0.0009	0.0008	0.0033
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Fraction Changed Employer	**Jump**	0.0032	0.0012	0.0025	0.0043
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Slope	0.0002	-0.0002	0.0004	0.0003
		(0.0000)	-(0.0002)	(0.0004)	(0.0003)
	Fade	0.0001	0.0002	0.0005	-0.0001
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Fraction Left 1st Employer	**Drop**	0.0030	-0.0010	0.0011	0.0066
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Slope	-0.0002	0.0005	0.0004	-0.0013
		(0.0000)	(0.0005)	(0.0004)	-(0.0013)
	Fade	-0.0001	0.0003	0.0003	-0.0008
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Fraction Zero Earnings	**Drop**	0.0012	-0.0002	0.0009	0.0014
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Slope	-0.0003	-0.0003	-0.0001	-0.0004
		(0.0000)	-(0.0003)	-(0.0001)	-(0.0004)
	Fade	-0.0002	-0.0002	0.0000	-0.0002
		(0.0000)	(0.0000)	(0.0000)	(0.0000)

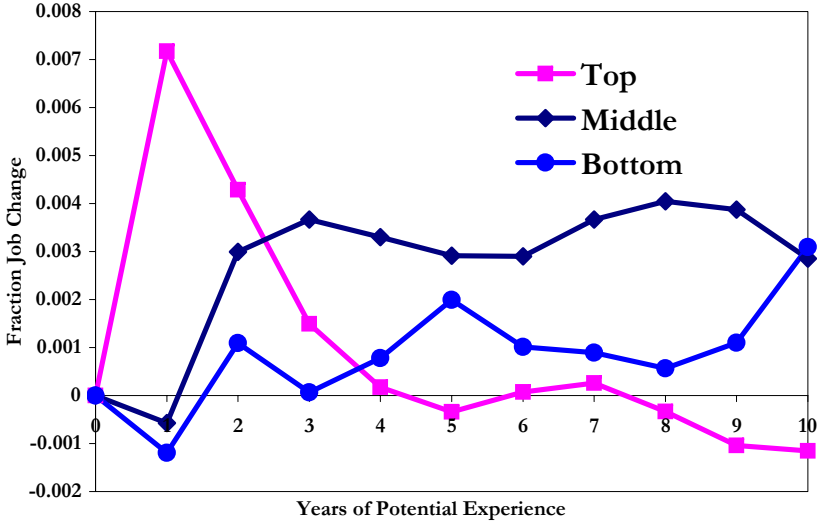
Notes: Coefficients from separate regression models. The initial loss (DROP) is the effect of unemployment at graduation (UR) at experience zero and one, the first phase of the catch up (SLOPE) is the coefficient on the interaction of UR with linear experience for experience years two to six, and the second phase (FADE) of the catch up is same interaction for experience years seven to ten.

Figure 6: Changes of Earnings, Job Mobility, Firm Quality, and Employment due to Entering the Labor Market in a Recession for Workers with Different Predicted Earnings

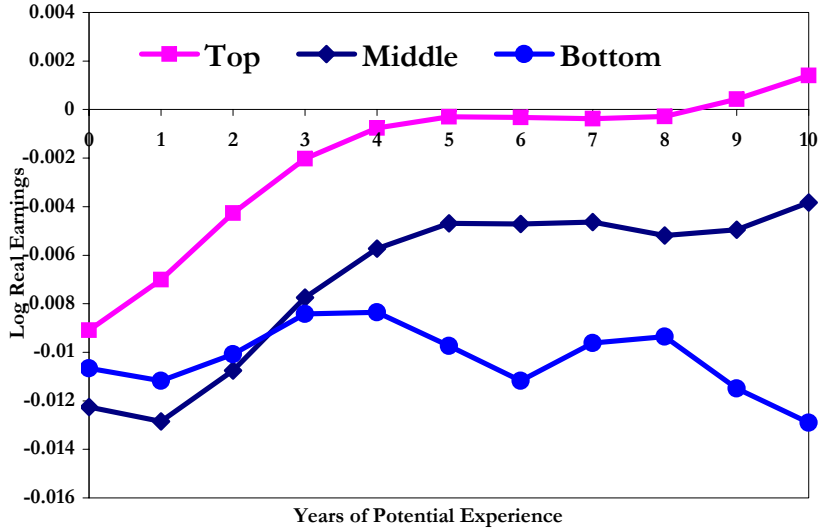
Panel A: Log Real Annual Earnings



Panel B: Probability of Annual Change in Employers



Panel C: Average Firm 'Quality', Graduates Only



Panel D: Fraction Filing With Zero Annual Earnings

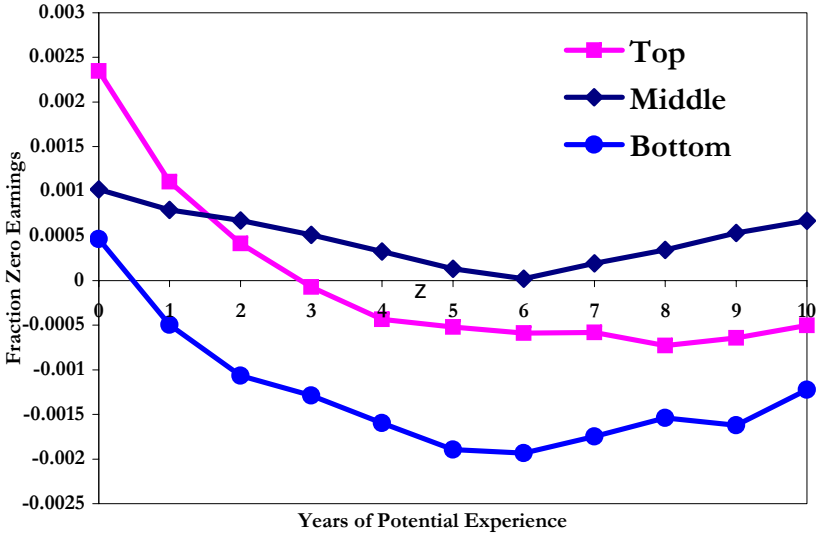
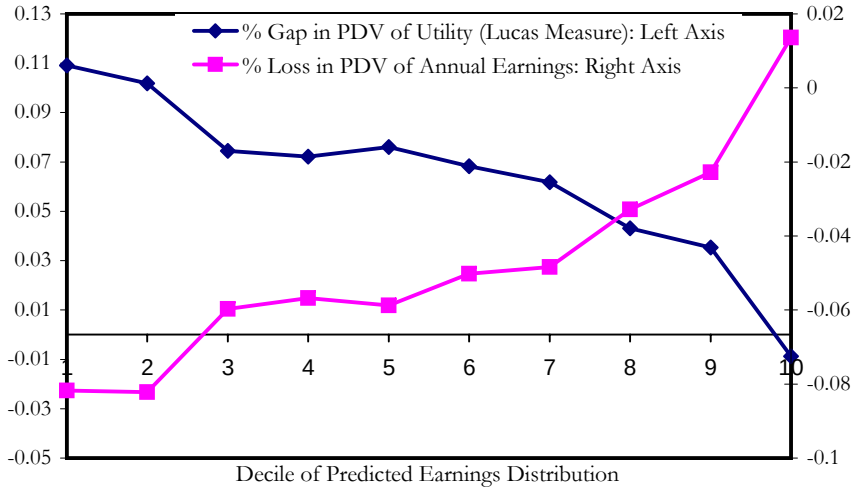
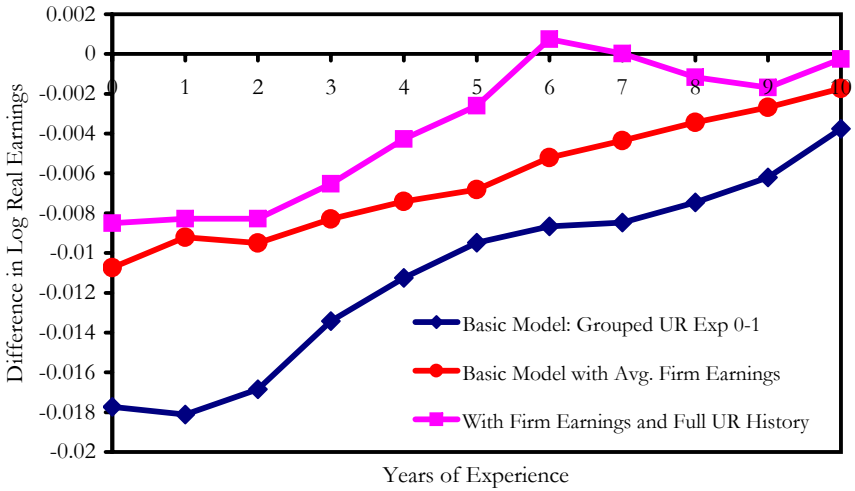


Figure 7: Heterogeneity of Losses from Graduating in a Recession and Channels of Catch-Up by Deciles of Distribution of Predicted Earnings

Panel A: Heterogeneity of Losses as Measured by Present Disctounted Value of Earnings or of Utility



Panel B: Sources of Catch-Up After Early Unemployment Exposure, Cell Level Models, Graduates Only



Panel C: Reversion of Losses After 5 Years in the Labor Market by Decile of Predicted Earning Distribution, College Graduates

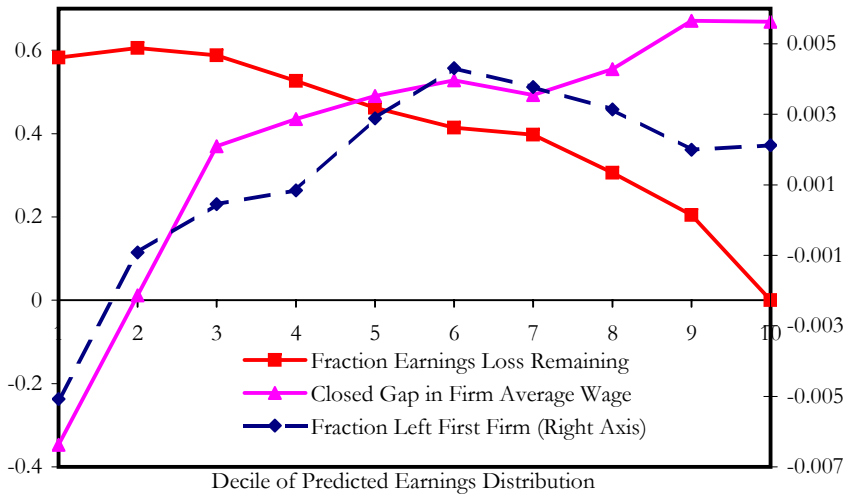


Figure 8A: Effect of Initial Unemployment Rate Controlling for First Firm and Industry Fixed Effects Interacted With Experience - Graduates Only

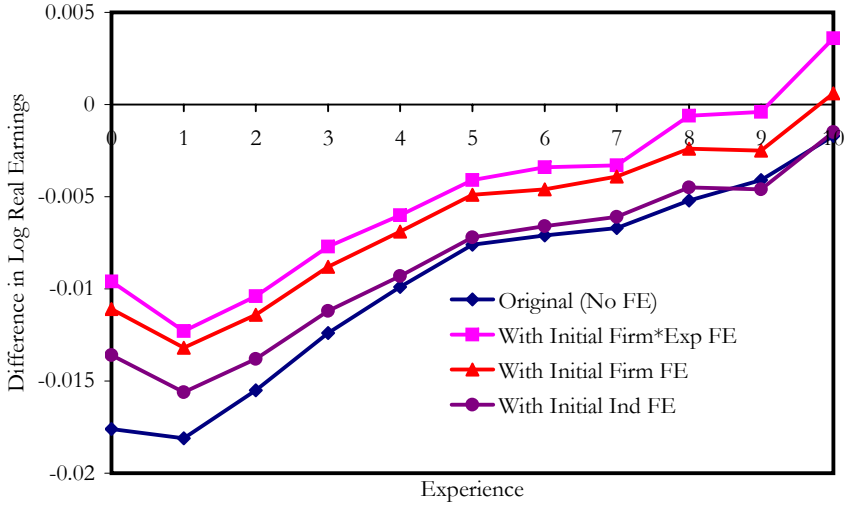


Figure 8B: Effect of Initial Unemployment Rate by Average Quality of First Employer (Above/Below 75th Percentile) - Graduates Only

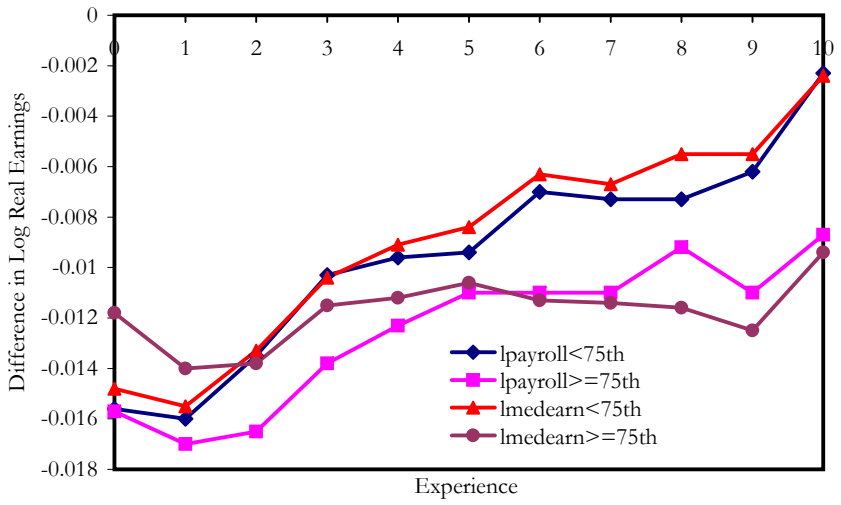


Figure 8C: Differences in Effect of Initial Unemployment Rate by Quartile of Average Industry Turnover Rate

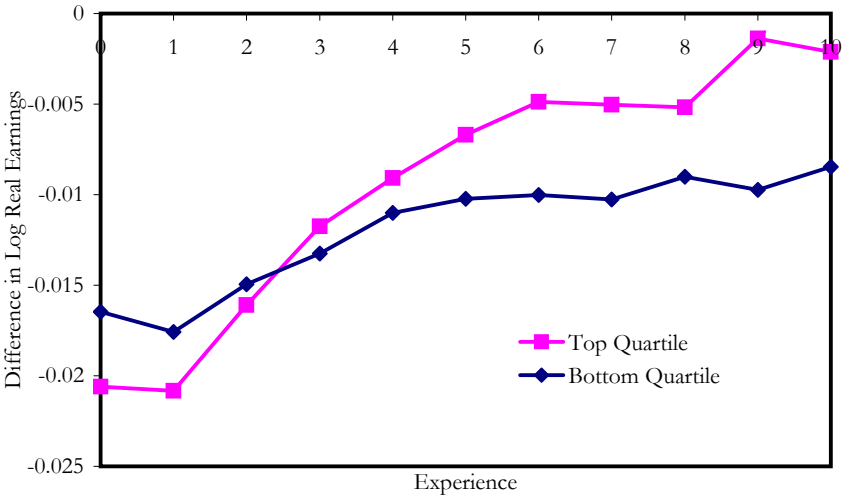


Figure 9: Simulation of Predicted Effect of Decline in Initial Hiring Rate at Good Firms on Earnings in Model of Endogenous Job Search