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# The short- and long-term career effects of graduating in a recession: hysteresis and heterogeneity in the market for college graduates

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June 2008

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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# ABSTRACT

## The Short- and Long-Term Career Effects of Graduating in a Recession: Hysteresis and Heterogeneity in the Market for College Graduates*

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 role of job mobility and firm quality in the propagation of shocks for different groups in the labor market. We find that young graduates entering the labor market in a recession suffer significant initial earnings losses that, on average, eventually fade after 8 to 10 years. Labor market conditions at graduation affect firm quality and job mobility, which can account for 40-50% of losses and catch-up in our sample. We also document that higher skilled graduates suffer less from entry in a recession because they switch to better firms quickly. Lower skilled graduates are permanently affected by being down ranked to low-wage firms. These adjustment patterns are consistent with differential choices of intensity of search for better employers arising from comparative advantage and time-increasing search costs. All results are robust to an extensive sensitivity analysis including controls for correlated business cycle shocks after labor market entry, endogenous timing of graduation, permanent cohort differences, and selective labor force participation.

JEL Classification: J62, J64, J31

Keywords: job search, hysteresis, college graduates, cost of recessions

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## 1. Introduction

Increasing evidence suggests that even short term labor market shocks can have substantial and differing long-term effects on workers' careers.[2] A high degree of persistence and substantial worker heterogeneity has implications for the nature and importance of frictions in the labor market – a key building block in many micro and macro economic models. An important question has been the role of changes in job quality and job mobility in the adjustment of individual workers and the labor market to business cycle shocks.[3] However, lack of longitudinal data on both workers and employers often limits the ability to measure the long-term consequences of short-term labor market shocks and to assess the channels through which different workers recover from the effects of cyclical labor market conditions.

In this paper, we analyze the dynamic 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 the wide coverage of our data to analyze how wages and firm placements are affected by initial labor market conditions, how workers respond to these shocks, and how these short and long-term effects differ for individuals graduating with varying degrees of skill. We provide a theoretical explanation of the pattern of career progression observed in our data based on a model of endogenous job search. In the model, incentives to search for better employers from comparative advantage interact with search costs that increase over time due to the accumulation of firm-specific capital and aging. This leads high-skilled workers to search harder for high-wage firms than low-skilled workers and catch-up before age related costs become important. Lower-skilled workers search less intensely and some

[2] See, e.g., Jacobson, Lalonde, and Sullivan (1993), Beaudry and DiNardo (1991), Baker, Gibbs, and Holmstrom (1994), Oyer (2006, 2008), Kahn (2006), and Bertrand and Mullainathan (2001).

[3] Although a long literature in labor economics assigns an important role to job search, a full assessment of its role in the growth of earnings or in adjustment to shocks stands out (e.g., Topel and Ward 1992). In macroeconomics, a growing recent literature examines the role of worker flows in determining the cyclical properties of unemployment (e.g., Shimer 2005).

never move to better firms before age related search costs start to bind or before they accumulate specific capital at low-wage firms. We evaluate these and other predictions from the model using the detailed information on employer characteristics and career outcomes available in our matched data.

Our data allow us to distinguish between temporary and persistent labor market shocks using 20 years of graduating cohorts over two large recessions with differential strength across ten regions.[4] College graduates are an ideal group to study the effects of initial labor market shocks because we can assess labor market conditions' effects for an entire cohort beginning to search for full-time work. Since graduates differ little in terms of labor market experience, information on college, program, and length of study allow us to categorize our sample into more and less advantaged groups based on predicted labor market success. 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. The study of labor market entrants is also of interest in its own right, since young workers have been shown to be particularly susceptible to external labor market shocks.[5]

Our results suggest several key findings. First, luck matters – graduating in a recession leads to large initial earnings losses that eventually fade, but over a period of eight to ten years 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

[4] 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 in a flexible way, controlling for persistent correlated labor market conditions, or studying other career outcomes than wages with sufficient degree of precision. Often by necessity the range of cohorts studied is limited.

[5] See for example, Katz and Autor (1999), Freeman (1979), and Okun (1973). 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 relative to their older counterparts are particularly at risk of earnings losses (Blanchflower and Oswald 1994), job losses (Farber 2003), and unemployment (Ryan 2001) from a recession. Clearly, this does not mean that older workers are not affected by external labor market conditions. Especially older job losers are known to suffer significant earnings losses.

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, persistent effects from changes in labor market conditions are much larger for individuals in the process of searching for work (at the beginning of their careers) than for individuals already working. The result points to an important role for initial job placement in determining long-term labor market success. We also find that graduates with the lowest predicted earnings (our measure of skill) suffer significantly larger and much more persistent earnings losses than those at the top. Thus, we see a persistent 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 labor market shocks affect job mobility and firm placement. The dynamic adjustment process is characterized by increased mobility across employers and industries and improvements in average firm characteristics. 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 consequently never catch-up. We also find an important degree of persistence of unemployment rate shocks within firms, especially for very large and high paying employers.

Our model of job search that incorporates time-varying costs of mobility and comparative advantage yields a parsimonious explanation of the strength and the heterogeneity in the patterns of persistence and catch-up we find.[6] This does not preclude a role for other important channels.

[6] The model can also predict several other aspects of the recovery process observed in our data, including faster recovery in industries with high average turnover, slower catch-up within high-quality firms, and a positive experience-gradient in firm quality.

Decomposing earnings losses into their sources, we find that lasting reductions in the quality of employers can explain up to 40-50% of persistent earnings losses. This complements influential studies finding unemployment rates have persistent effects for employment spells within firms,[7] and suggests that, at least for labor market entrants, both mobility towards better firms and recovery within firms are important margins of adjustment to labor market conditions.

The paper contributes to recent strands of labor economics by helping to establish that cyclical shocks have persistent effects on careers for a broad segment of the labor market.[8] The paper extends this literature by assessing persistent effects not only on earnings but on job mobility and firm quality. In particular, the paper shows how cyclical changes in job quality can have a lasting impact on workers' careers, and how mobility to better firms is an important channel of recovery after cyclical labor market shocks.[9] We further add to the literature by showing how these effects differ by initial skill. We also offer a coherent theoretical explanation of the persistence and the complex adjustment process we find. The paper also contributes to the literature on job search by providing direct evidence on how job mobility and firm quality reacts to exogenous labor market shocks, and how this pattern differs by workers' educational background.[10]

Our paper also contributes to recent strands of literature in macroeconomics. First, the slow and heterogeneous speed of recovery and the role of job mobility and firm quality we find can have important implications for understanding cyclical adjustment in the labor market either in models of job search (e.g., Shimer 2005, Krause and Lubik 2006a,b) or mismatch (e.g., Shimer 2007, Moscarini

[7] E.g., Beaudry and DiNardo (1991), Baker, Gibbs, and Holmstrom (1994), McDonald and Worswick (1999), and Grant (2003) focus on the effect of unemployment rates on earnings within a given spell of job tenure.
[8] This extends the existing literature documenting that luck can matter for particular occupations (e.g., Oyer 2006, 2008, 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 particular cohorts of workers (e.g., Freeman 1975, Welch 1979, Beaudry and DiNardo 1991, Baker, Gibbs, and Holmstrom 1994, Kahn 2006).
[9] By comparing mobility pattern of different cohorts the paper also adds to the literature on cyclical upgrading. See footnote number 13.
[10] 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.

and Vella 2008). Our results suggest that temporary labor market shocks can persistently alter the allocation of workers to firm-types through cyclical downgrading. Second, we provide an explanation why labor market shocks can have larger effects for lower-skilled labor market entrants.[11] Our data shows large differences in the declines of the present discounted value of earnings due to a recession for more and less advantaged workers.

## 2. A Model of Job Mobility with Endogenous Search and Initial Conditions

The following section presents an augmented model of endogenous on-the-job search that allows us to interpret our empirical results. Our model combines several key features of previous theoretical and empirical research on wage determination to show that age-related mobility costs interact with skill-dependent search incentives to lead to long-lasting and differential effects of labor market conditions. First, search theory predicts that a temporary worsening of the wage offer distribution causes workers entering the labor market in a recession to catch-up by searching for higher paying jobs. Second, evidence suggests high-wage jobs are concentrated in particular firms and sectors.[12] Supply of high-wage jobs appears to be pro-cyclical, leading young and less able workers to be down-ranked to low-wage firms in recessions.[13] Third, models of job assignment or of long-term contracting, for example, can imply persistent recession effects within firms.[14] This is

[11] Lucas' (1987) original measure asked how much additional consumption would make a representative worker 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). Several studies have shown that recessions have different earnings effects for different groups of workers (e.g., Hoynes 2000, Hines et al. 2002, Bils 1985, Solon, Barsky, and Parker 1994), but none were able to trace out differences in the ensuing long-run effects.

[12] Firms and industries pay wage premiums that cannot be easily rationalized by worker characteristics (e.g., Krueger and Summers 1988, Dickens and Katz 1987, Abowd, Kramarz, and Margolis 1999, Abowd, Creecy, and Kramarz 2002).

[13] 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). There appears to be cyclical down-grading of young and lower skilled workers (e.g., Reynolds 1951, Reder 1955, Cutler and Katz 1991, and Hines et al. 2002). Less able workers tend to flow to larger firms and high wage sectors in booms (e.g., Vroman 1977, Albaek and Sorensen 1998, Devereux 2002).

[14] E.g., Prendergast (1993, 1999), Gibbons and Waldman, (1999, 2004), Harris and Holmstrom (1982), MacLeod and Malcolmson (1993). For empirical papers on within-firm wage mobility, see Baker, Gibbs, and Holmstrom (1994) and Beaudry and DiNardo (1991).

more likely to occur in larger firms that may provide rents, insurance, career-options, or other non-pecuniary benefits reducing workers' job mobility. Fourth, job search dynamics may differ by worker age and ability.[15] An increasing empirical literature suggests that the cost of job search increases with age and that higher-skilled young workers are more likely to move between regions or industries in response to adverse labor market shocks.[16] Thus, differences in the response of job mobility and firm quality to recession shocks among alternative skill groups are important for understanding the mechanisms driving persistence in the labor market.[17]

### 2.1 Endogenous Job Search with Skill and Age Differences

***Model Setup.*** We consider the case of an economy of infinitely lived, risk-neutral workers. Workers start their careers employed at one of two types of firms. High-productivity firms pay higher 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.[18] 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.[19] The model is set in discrete time, and recessions are characterized by periods of fewer job openings available at high productivity firms.

[15] Among others, Mortensen (1986), Pissarides (2000), Shimer (2004) discuss the theoretical implications of differential search intensities.
[16] Among others, see Blau and Robins (1990), Bloemen (2005), Boeheim and Taylor (2001), Bound and Holzer (2000), Wozniak (2006), Saks and Wozniak (2007), Neal (1999).
[17] In addition to differences in workers' search behavior, in the presence of rents or complementarities, firms have incentives to select the most able workers for employment, and to reduce the employment of less able workers. A cyclical process of adjustment in hiring and promotion standards has been often noted (e.g., Reder 1955). Rents can arise due to rigid pay scales as in Hall (1974), or unions, as in Solow and McDonald (1985).
[18] This is a way of introducing the effects of comparative or absolute advantage by skill into our model and it allows us to analyze differences in the effect of initial conditions by skill groups. Also introducing wage differences by skill group at the low productivity firm would not alter our insights.
[19] Adding stochastic increases to wages on the job as function of job tenure would add complexity without affecting our main predictions (see Topel 1986, Topel and Ward 1992, Mortensen 1988).

Consistent 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.[20]

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.[21] If p is the fraction of jobs at high productivity firms in the economy, $\lambda$ 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.[22] Both p and $\lambda$ could differ over time, across skill-groups, or across cohorts. 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. The Canadian Census shows that these incident rates rise quickly after graduation. For example, the fraction married rises more than six-fold after graduation until age 30 to reach 68.7%, and reaches 86.3% by age 40. The rate of homeownership nearly

[20] Note that in the absence of job destruction, the fraction of those working at high productivity firms increases steadily within a cohort; however, due to the presence of age-related search costs and specific skills, our model contains an explicit behavioral mechanism limiting this tendency. Introducing job destruction into our models would imply that low-skilled workers graduating in a tight labor market initially employed at the high-wage firm will be gradually pushed down to the low-wage firms. There are also no endogenous quits into non-employment in the model. Since it may be relevant for low-skill workers, the introduction of labor supply decisions would be a promising extension of the model.

[21] 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 to 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 $\theta, \gamma, \tau, \delta_2$ are unaffected, while the derivatives with respect to $\lambda, p$ now depend on the the level of the product $\lambda p$.

[22] 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).

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. In general, these numbers corroborate results from the existing literature that mobility of college graduates is high when workers are young and declines with age.

***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

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

where $\tau$ indexes job tenure, $w_1$ is the starting wage at firm 1, g($\tau$) is a concave function, and $\delta_1$ indexes the returns to tenure at the high wage firm.[23] Since firm 1 pays high skilled workers more, we have that for a low skilled worker $\theta = 1$, while for a high skilled worker $\theta > 1$. $\beta$ is the discount factor.

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

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

where age (a) enters through the cost of job search. The value of job search is captured by

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

Given our assumptions, both $V^1(\tau,\theta)$ and $V^2(\tau,\theta,a)$ 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

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

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

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 does not itself depend on initial conditions a worker faces in the labor market. Instead, these conditions will affect the fraction of workers in any given cohort that is still searching for a job at the high-productivity employer at a given skill and age.

***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, $\frac{ds^*}{d\tau} = -\lambda p \frac{\delta_2}{\gamma} g'(\tau) < 0$. Similarly, search intensity declines with the cost of search, $\frac{ds^*}{d\gamma} = -\frac{\lambda p}{\gamma^2}\left[V^1(0,\theta) - V^2(\tau+1,\theta,a+1)\right] < 0$. These results capture the notion that the incentives to search 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, $\frac{ds^*}{d\theta} = \frac{\lambda p}{\gamma} w_1 > 0$. 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 model predicts various other interaction effects exploited in the empirical and simulation analysis.[24]

[24] Among others, increases in the wage offer distribution p or the natural arrival rate of offers $\lambda$ offset the tendency to reduce search with age; thereby higher frequencies of job offers increase search intensity more for high skilled workers. Similarly, the advantage of high skilled workers is decreasing with mobility costs, which affect them more than low skilled workers, i.e., $d^2 s^* / d\theta d\gamma = -\lambda p w_1 / \gamma^2 < 0$.

## 2.2 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 implications of our model. Since for workers at low-wage firms age and job tenure are equal to the overall time spent in the labor market, for simplicity we will index both by a single variable T; T indicates the relevant time horizon for the effect of initial conditions in our model. Compatible with our empirical evidence, we define a short-term negative labor market shock to be a temporary reduction in the hiring rate of high-wage employers. Let the probability that a worker in a given cohort C is employed by firm 2 in the initial period be $1-p_0^C$, where $p_0^C < p$. The fraction of workers changing from firm 2 to firm 1 in each following period is $\lambda s(t,\theta,...)p$. Then by recursion, after T periods in the labor market the conditional probability of still being at firm 2 for a given skill-level $\theta$ (the conditional CDF of wages in our model) is

$$\Pr\{\text{Firm 2} \mid \text{T}, \theta\} = \left(1 - p_0^C\right)\prod_{t=1}^{T}\left[1 - \lambda p s(t,\theta,...)\right].$$

This probability is an important determinant of the evolution over time of the conditional rate of job mobility and conditional mean earnings of any given cohort of new entrants into the labor market.[25]

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[25] Dropping the skill index for notational simplicity, one obtains for the probability of changing employers and for mean earnings

$$\Pr\{\text{Job Move} \mid T, C\} = \lambda p s(T,..)\Pr\{\text{Firm 2} \mid T, C\}$$

$$E\{w \mid T, C\} = \omega_1(T,C) - \left[\omega_1(T,C) - \omega_2(T,C)\right]\Pr\{\text{Firm 2} \mid T, C\},$$

where $\omega_1(T,C)$ and $\omega_2(T,C)$ are conditional mean earnings for workers in firm 1 and 2 at time T and cohort C, respectively. Since $\omega_1(T,C) - \omega_2(T,C) > 0$ under weak conditions for all T, convergence of the mean wage after an initial down ranking of workers to lower quality firms will eventually occur. (Note that $\omega_j(T,C) = E\{w \mid \text{Firm j, T, C}\},\ j = 1,2$ depends on search intensity and on initial conditions through average job tenure and average ability; $\omega_1(T,C) - \omega_2(T,C) > 0$ holds as long as $\delta_1 \geq \delta_2$ and $E\{g(\tau) \mid \text{Firm 1, T}\}$ converges reasonably fast to g(T). This will hold in particular for smaller values of $\tau^*$ (as T> $\tau^*$), the tenure year at which we assume the returns to tenure to become constant. As argued above, a small value of $\tau^*$ fits empirical estimates of the causal returns to job tenure.)

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

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

$R(T,\theta)$ captures the change of the marginal effect of initial conditions over time on the probability of being in the low state for skill-level $\theta$. It determines how fast mean wages converge after an initial shock, and how the rate of job mobility responds.[26] The rate of convergence differs by skill, with time spent in the labor market (indexing increases in age and tenure at the low-productivity firm for those that are searching), and with other parameters affecting the optimal choice of search intensity.

***Implication 1: "Time Dependent Search."*** Implication 1 follows directly from our comparative static results above – increases in job tenure reduce the rate of decay $\left(dR(T,\theta)/d\tau > 0\right)$. 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.[27] A long literature argues that it is highly probable that workers accumulate at 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 $\left(dR(T,\theta)/d\gamma > 0\right)$. For example, we know that marriage rates of male college graduates begin rising quickly after graduation. In so far as their spouses work or perhaps have children, their search costs

[26] The second equality in equation (2) holds approximately for small values of the product $\lambda ps(T,\theta,...)$.

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

might rise, reducing their ability to shed the effects of initial conditions by moving and taking jobs at better firms.[28]

***Implication 2: "Differences by Skill Group."*** Differentiating the rate of decay by our index of skill $\theta$ shows that high skill workers catch-up faster from bad initial conditions, i.e., $dR(T,\theta)/d\theta < 0$. 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., $\frac{d^2R(T,\theta)}{d\gamma d\theta} = -\lambda \frac{d^2 s^*(T,\theta)}{d\gamma d\theta} = \lambda p \frac{w_1}{\gamma^2} > 0.$ That is, if aging plays a role, the difference in search intensity between high and low skilled workers should be strong initially but decline as workers age.

***Implication 3: "Catch-Up On-the-Job."*** Once a worker finds a job at a type 1 firm, given our assumptions on g($\tau$), 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

[28] With a fixed intensity of search, the rate of decay would be constant $R(T,\theta) \equiv \overline{R} = -\lambda sp$. In this case, a 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 of mean wages would occur within 5 to 7 years after entry into the labor market (e.g., Cristensen et al. 2005). However, the rate of decay does not appear constant in our data. Moreover, if we simulate our model, 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.

function of external labor market conditions (Gibbons and Waldman 2004), something we discuss as a possible extension of our model below.

***Implication 4: "Zero Search."*** In our model, job search is only positive if $\Delta J \equiv J\left(\tau+1,\theta,a+1;s^*(T,\theta,...)>0\right)-J\left(\tau+1,\theta,a+1;s^*(T,\theta,...)=0\right)>0.$ 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.[29]

***Extensions.*** Our model's parsimony helps highlight our main implications. A variety of extensions could be added to provide a richer set of outcome predictions. 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.[30] In this case, workers would be affected by initial labor market conditions even after they found a better employer. This

[29] To see this, note that $\Delta J = \pi(s)[V^1(\theta,0)-V^2_{s>0}(\tau+1,\theta,a+1)]+[V^2_{s>0}(\tau+1,\theta,a+1)-V^2_{s=0}(\tau+1,\theta)]-\psi(s,a).$ 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.

[30] See Harris and Holmstrom (1982) for models of implicit insurance contracts; see Gibbons and Waldman (2004) for model 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).

has been shown to be empirically relevant (e.g., Beaudry and DiNardo 1991, Baker, Gibbs, and Holmstrom 1994). 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 complexity of our basic model without core additional insight.

Third, another explanation for why lower skilled workers suffer more in a recession may be if they benefit more from human capital accumulation at highly productive employers. This could be introduced into our model by allowing for a non-zero chance that low skilled workers skills improve (their $\theta$ increases) after spending some time at firm 1. This would tend to reduce 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' decisions.[31]

***Further Implications.*** 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, Moscarini and Vella 2008) 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 long time. We also provide a mechanism through which the allocation of workers to firms could be permanently affected by a temporary shock. The time dependent search costs we emphasize imply that some workers are less responsive to firm wage differentials than others, weakening one channel leading towards assortative matching (e.g., Lentz 2007, Moscarini and Vella 2008). Similarly, such

[31] 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 and accumulate specific (or general) human capital or not (and collect unemployment benefits). 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 5.

costs are likely to dampen the cyclical flows between sectors emphasized in Krause and Lubik (2006a).

Another important question is how costly the inefficiencies due to search frictions are in terms of lost output from increased mismatch between workers and firms. Consider the case of age-related frictions. Since a temporary aggregate shock can persistently alter the allocation of workers to firms, this leads to a lasting cohort-specific increase in the degree of mismatch due to search frictions (e.g., Moscarini and Vella 2008). If wages are approximately equal to workers' productivity, the resulting total loss in output can be approximated by the long-term earnings losses we estimate. We find below that for some cohorts, the earnings losses are shown to be quite large and very persistent, implying potentially important efficiency losses.[32]

Last, our model predicts that temporary shocks can lead to lasting increases in earnings inequality, and this is confirmed in our empirical results. To explore this aspect, we have conducted a simulation exercise, with two salient results (see the Sensitivity Appendix V in Oreopoulos, von Wachter, and Heisz 2008). First, the persistence due to age-related costs 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. Second, the larger the initial shocks the more likely the age-related slow-down in search occurs before the initial effect has dissipated, especially for lower-skilled college graduates. Thus, larger recessions exhibit more lasting increases in inequality and mismatch.

## 3. Empirical Strategy and Matched Data

### 3.1. Cell-Level Regression Strategy and Sensitivity

[32] 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.

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 provinces and across cohorts, we collapse the individual level data at the level of graduation cohort (c), initial region of residence (r), and calendar year (t) 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).[33] The cell level model on which most of the estimates in the paper are based on is

$$\bar{y}_{crt} = \alpha + \beta_e UR_{cr0} + \phi_t + \theta_r + \gamma_e + \chi_c + u_{crt} \quad (3)$$

where $\theta_r$, $\chi_c$, $\gamma_e$, and $\phi_t$ represent unrestricted fixed effects for first region of residence, year of graduation, year of potential labor market experience (e), and calendar year. 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 $\beta_e$ on the initial unemployment rates measure *changes* in experience profiles in earnings and other outcomes resulting from province-cohort-specific variation in unemployment rates.[34] To account for group specific error-components, we cluster standard errors at the cohort-region level.

We interpret the variation in $UR_{cr0}$ to arise from changes in aggregate labor demand that are uncorrelated with characteristics of different graduation cohorts. To make sure we pick up mainly

[33] Note that below, to estimate versions of equation (4), 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.

[34] 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 (3) 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 C2) suggest that the linearity assumption is highly plausible.

effects occurring due to demand conditions and avoid influences from cohort-specific changes in labor supply of young workers, in our sensitivity analysis we have also used the unemployment rate for all workers as measure of initial labor market shock.[35] Remaining differences between graduation cohorts at the national level are taken out by cohort fixed effects. Below and in the Supplementary Appendix of Oreopoulos, von Wachter, and Heisz (2008) we address other potential biases (and many robustness checks, such as different specification, sample, or cohort restrictions). In particular, we conduct multiple specification and robustness checks to show that our results are unaffected by selective changes in the timing of college graduation or by selective labor force participation.

***Dynamic Effects.*** Since the state of regional labor markets continues to influence workers' earnings even after labor market entry (e.g., Blanchflower and Oswald 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 faces in his career. 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 entire history of regional unemployment rates that workers experience throughout their career. This helps to distinguish the role of labor market conditions at entry (at the time when all cohorts search for work) from the effect of labor market conditions when working or entering a new firm in mid-career (as stressed for example by Beaudry and DiNardo 1991). This also allows us to assess whether

[35] To assess the role of participation changes, we also replicated our results using the employment-population-ratio for 15 to 24 year olds. It appears that year-to-year variations in cyclical labor market conditions that identify our estimates in our data move at a higher frequency than age-specific population, participation, or enrollment trends. This is confirmed by Beaudry et al. (2000) show that 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. 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. Similarly, changes in female labor participation are unlikely to be correlated with province-specific changes in unemployment rates.

the effects of aggregate unemployment rates at time of entry differ from that experienced by more mature workers.

In Section 4 we begin exploring this issue by examining whether the effect of the early unemployment rate remains stable even when we include the cohort's current unemployment rate. In addition, we also allow for persistent effects of the aggregate unemployment rate a worker was exposed to at each experience year (e) in the relevant region ($r_e$), denoted by $UR_{r_e e}$. 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

$$\bar{y}_{crt} = \phi_t + \theta_r + \chi_c + \gamma_e + \beta_{e,0} UR_{cr0} + \beta_{e,1} UR_{r_1 1} + \beta_{e,2} UR_{r_2 2} + ... + \beta_{e,10} UR_{r_{10} 10} + \varepsilon_{crt} \qquad (4)$$

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 (4). In our preferred specification, we use a restricted model in which we constrain the effects of unemployment to be the same in pairwise groups of experience years. For more detail see Sensitivity Appendix II in Oreopoulos, von Wachter, and Heisz (2008).

***Canadian Administrative Data*** 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.[36] The data contains exceptional 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 at the firm level, with year fixed effects taken out. All firm characteristics in our empirical analysis 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).[37]

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.[38] As shown in Table A1 of the Supplementary Appendix in Oreopoulos, von Wachter, and Heisz (2008; hereafter called the Supplementary Appendix), even within this relatively homogeneous sample there is a high rate of drop out and high variance in college duration. Despite the use of administrative data, there may still be some measurement error in actual graduation in our data. Thus, our main sample excludes early 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 (based on length of program in first or second year), and keep only workers with non-negative differences. The right columns of Appendix

[36] 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.
[37] The information is at the firm level; for simplicity, we use the terms firm, company, and employer interchangeably.
[38] 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.

Table A1 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.[39]

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.[40] We impose some additional basic sample restrictions and limit the degree of missing observations 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. None of these restrictions affect our results.

Figure A1 in the Supplementary Appendix shows that the general experience profiles in annual earnings and job mobility for our baseline Canadian data are similar to those for the United States. 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. Male Canadian graduates tend to move to firms that on average pay more and are larger the longer they progress through the labor market.[41]

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.[42] Figure 1 shows the time series of annual unemployment

[39] By restricting our main discussion to graduates, we are also more likely to pick 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. The results hardly differ when replicated with the full sample.

[40] The alternative, province of college, gives similar results for both our basic estimates as well as our instrumental variable results.

[41] 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 Murphy and Welch 1990), frequent job changes (Topel and Ward 1992), 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). Panel C of Appendix Figure A1 and Appendix Table A5 also suggest that average firm size tends to grow with labor market experience for college graduates in the U.S., too.

[42] 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.

rates at the provincial level. The figure displays a high degree of regional heterogeneity. During this period, an increase of unemployment rates of 5 percentage points (or about two standard deviations) describes a typical large recession.[43]

## 4. The Persistent Effect of Initial Labor Market Conditions on Earnings

Figure 2 plots mean earnings by experience and year of college completed using our baseline 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). 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 regression, they significantly improve the fit of the model. The figure also shows a clear pattern of convergence. 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 Figure 3, which graphs national unemployment rates for young workers and wages at different years of experience by graduation cohort (both expressed as deviations from their means across cohorts). The correlations in the figure strongly suggest that part of the initial but fading earnings differences in Figure 2 are driven by variation in initial labor market conditions.

The correlations at the national level shown in Figure 3 are also used to produce results in columns 1-2 and columns 4-5 of Table 1. The table shows the long-term effects of national

[43] If we regress regional unemployment rates on year and region fixed effects, the $R^2$ is 0.9, which is a common finding in the U.S. and other country. The remaining variation in regional unemployment rate allows us to obtain precise estimates of the effect of province recession shocks and to include further interaction terms, such as region-specific year effects. We should stress that our results are robust for excluding large Canadian provinces such as Ontario or Quebec.

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 ($D \geq 0$), 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.[44]

### 4.1. 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 3. The shifts in experience profiles due to an initial provincial unemployment shock are shown in Column 3 of Table 1 for all workers with at least some college and Column 6 for our baseline 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 graduates are slightly more precise (Column 6), there is little difference in the point estimates for graduates and all workers with some college (Column 3). This is apparent in Figure 4, Panel A, 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.

The similarity between the national and regional results suggests we can exclude a strong correlation of initial unemployment rates at the national level with changing unobserved cohort characteristics. Below, we show that higher persistence in our regional results is not driven by more persistent unemployment shocks. National estimates may be more affected by measurement error problems due to mis-assignment of the relevant initial labor market shock. Inter-regional mobility is

[44] Note that the effects in Table 1 exhibit a pattern of over-shooting in experience year 10 which is significant with quadratic cohort trends. While this has potentially interesting behavioral implications, it is not confirmed in the regional specifications, and may thus be due to the particular cyclical pattern of national unemployment rates.

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 also may explain why results from the national model are not larger than the regional model.

Using the results from our main regional model, 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 ten years after graduation. These results are consistent with estimates from the literature on the "wage curve" in the U.S. (Blanchflower and Oswald 1994). 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, partly due to her focus on graduates entering the strong recession of the early 1980s.

***Dynamic Effects.*** Due to the presence of continuing exposure to adverse labor market conditions, the estimates in Table 1 represent a summary of the earnings losses the average worker can expect due to entry in a depressed labor market. To isolate the extent to which our baseline results occur primarily from initial labor market conditions while beginning one's fulltime job search and not from correlated labor market conditions in later years, 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 shows results after adding an interaction between experience and the regional unemployment rate prevalent in the

relevant year and current province of residence, as well as fixed effects for current province of residence.[45] As predicted, the initial unemployment rate effect is reduced by persistence of labor market conditions, but the difference is small. Results by Beaudry and DiNardo (1991), McDonald and Worswick (1999), and Grant (2003) 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 can persist for job changers. As shown in the remaining columns of Table 2, the basic results are not affected if we allow for persistent effects of other labor market conditions as discussed in Section 3. A part of the effect of initial unemployment rates is due to persistent effects of initial and continuing regional labor market conditions, but the majority of the effect we find is driven by the very first shock alone.

To put the magnitude of the effect of initial labor market conditions into further perspective, column 7 of Table 2 shows the dynamic effect of a shock occurring at experience years two to three from the grouped model with full history controls. Panel A of Figure 5 displays the corresponding coefficient estimates that are comparable to our main result in Panel A of Figure 4. 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 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.[46] The result is notable in suggesting the greater

[45] Note that since we only observe full history of province of residence for cohorts graduating 1982 onward, Table 2 uses only these cohorts

[46] Our sample of cohorts is small at later experience years, such that the cohort variation shown in Supplementary Appendix Figure C2 limits our ability to estimate the average dynamic effects of shocks at later experience years. "To further explore the difference between labor market entrants and workers already in the labor market, we also estimated the effects of unemployment rate conditions for workers by experience level on job mobility, regional mobility, firm quality, and unemployment (see Oreopoulos, von Wachter, and Heisz 2006, Table 6). The results confirm the exceptional effect of economic conditions at time of entry compared to workers already in the labor market.

relative importance that economic conditions have at the beginning of one's labor market career than after finding an initial job.

***Sensitivity Analysis.*** Our overall results hold up well against a variety of sensitivity checks. Figure 5 (Panel B) addresses the question of selective timing of college graduation, which is discussed in detail in Sensitivity Appendix I of our Supplementary Appendix (Oreopoulos et al. 2008). 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 in the predicted year of graduation (based on starting year of college and typical degree-duration) as an instrument our estimates confirm the main ordinary least squares results. Although all our results carry over 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, Panel C shows that there are only small (and insignificant) differences in the effects when we only include workers always present with positive earnings. 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 slightly larger and more persistent effects), our results are quite similar for different groups of labor market entrants.[47]

We have also 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 (Supplementary Appendix Figure C3, Panel B) suggesting workers do not selectively enter advanced degree programs due to unemployment. We also tried various ways of

[47] Coefficient estimates and standard errors for Panels B-D of Figure 5 (and many other sensitivity checks) are shown in the Supplementary Appendix in Oreopoulos et al. (2008).

excluding workers with repeatedly missing wages, and find little effect on our results.[48] 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. [49] 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 Supplementary Appendix Figure C1, Panel D), which barely show any differences from the main 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. [50]

***Effects on Employment.*** If unemployment rates affect participation, part of the recovery process in earnings we find may be due to sample selection. Similarly, losses in employment could depress wages by reducing accumulation of labor market experience. Table 3 replicates the same results as in Table 1 using as outcome variables 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 point estimates for our preferred specification are displayed in Figure 4, Panel D. The table and figure show an initially significant increase in fraction zero earnings and the fraction of unemployment insurance (UI) claimants that fades within three experience years. The effects are numerically small and become small and insignificant when we

[48] Supplementary Appendix Figure C3, Panel A shows the results with those who permanently stop filing included.

[49] As shown in Supplementary Appendix Figure C1, Panel C the results 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 (Oreopoulos et al. 2008, Sensitivity Appendix III).

[50] The results in 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 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 (Supplementary Appendix Figure C1, 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 (Supplementary Appendix Figure C1, Panel B). 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 Table 2, the driving force behind our main results is the shock in the very first years after entry into the labor market.

control for persistence of local unemployment rates (not shown). In other words, a temporary unemployment rate shock has no persistent effects on employment or participation of male college graduates.[51]

Since our sample does not contain information on time worked, we also replicated our results with the Canadian Census (see Sensitivity Appendix IV in Oreopoulos et al. 2008). 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. Thus, neither reduction in the accumulation of experience nor selective entry or exit from the earnings sample of workers of different abilities affect the main pattern of reversion we see.[52]

### 4.2. 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, 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. 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.[53] Since individuals are likely to be sorted into

[51] The effects are very similar for the sample of all workers (see Supplementary Appendix Table D1 and Figure D1). Overall, the loss in experience due to labor market entry in recessions is not very large for the average college student. 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. 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.

[52] Only workers in the lowest skill group have significantly *lower* propensity to become unemployed (see Figure 6, Panel D). Thus, for these workers increases in labor supply and experience accumulation may help to explain part of the process of catch-up. Section 2 discusses how this could be integrated in our model ('Extensions').

[53] 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

colleges, these estimates will capture both differences in innate ability as well as differences in college quality.[54] 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 3, Panel A for the full sample). Table 4 summarizes the key structure of losses by quintile and compares them to results for the full sample. For exposition, the table displays 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.

***Overall 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 graphs the percentage decline in the present discounted value of annual earnings by deciles of the predicted earnings distribution. We discount earnings at an interest rate of five percent and only include the first ten years of earnings in our calculation. This assumes

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final specification we interact major and college dummies. 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, see Supplementary Appendix Figure G1), 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.

[54] This is discussed extensively in Black and Smith (2004), 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 similar data to ours, Betts et al. (forthcoming) find that the effects of observable measures of college quality on earnings are small.

that the difference in annual earnings has decayed after ten years. We thus understate the loss for less advantaged workers whose earnings have not fully recovered by that time. Given the short time horizon we use, we view our calculations merely as indicative of the full life-time loss in earnings.

Figure 7 has two key messages. First, there is an important gradient in the cost of recessions in predicted earnings – those individuals with lower earnings capacity face four to five times the cost 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 median worker in our sample they are much higher than what is typically found in the literature.[55]

## 5. Predicted and Actual Mechanisms of Recovery

The predictions from our model outlined in Section 2 hold up well when compared with our empirical results for the channels of recovery after an adverse initial labor market shock. In our stylized model, an initial shock consists of a temporary shift in the number of job openings at high productivity firms. Besides being a convenient modeling decision, this also turns out to capture important features of our data.[56] Figure 4, Panel C, shows that graduates in our data entering the

[55] The median worker in our sample loses about 22,000 Canadian Dollars (in 2005 prices), about 6% of the present discounted value of earnings in the first ten years in the labor market. This compares to average annual earnings in the first experience year for the median worker of about 25,000 Canadian Dollars (in 2005 prices). In Oreopoulos et al. (2006), we also show the fraction increase in annual earnings a worker would require to be indifferent between a noisy earnings path and an alternative stable path using a constant relative risk aversion utility function. This corresponds conceptually to the original Lucas measure. The results convey the same message as Figure 7. 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.

[56] High wage sectors have more pro-cyclical employment (e.g., Bils and McLaughlin 2001), and we find a corresponding pattern for firms. 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.

labor market during times of high unemployment are more likely begin work at lower quality employers. The corresponding coefficient estimates are shown in Table 5.

If workers' search costs increase with tenure and age, our model predicts that the effects from initial shocks decline through temporary increases in job mobility that occur less frequently over time. Figure 4 shows that after an initial downranking, firm quality improves quickly in the first 3-5 years in the labor market when job mobility is higher than average.[57] As the effect of initial unemployment on job mobility declines (Panel B of Figure 4), improvements in firm quality visibly slow down (Panel C). Reversion in firm quality continues, but at a reduced rate.

Our results in Figure 6 confirm that the catch-up process appears to occur in two phases, especially for the middle-skilled workers in our sample (*Implication 1*). In the first phase of catch-up, workers experience rapid improvements in the quality of their employers through job mobility. This phase lasts four to five years. Improvement in employer quality is absent in the second phase, where reversion appears to occur within firm type (*Implication 3*). The catch-up process within firms appears to be completed in the course of a few years, consistent with returns to tenure mainly playing a role in the first years on a job.[58]

Also consistent with our model, the results in Figure 6 indicate important differences in catch-up for workers with different skill levels (*Implication 2*). High skilled workers experience large temporary increases in rates of job mobility and completely close the gap in employer quality within

[57] As found in the U.S. by Topel and Ward (1992), we find that job mobility in Canada 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). Table 5 also reports effects on the propensity of change among 2-digit industry classes. In addition to job shopping workers also actively search for a match with the 'right' industry (e.g., Neal 1995 or McCall 1990). Note that we find a similar pattern of cyclical downgrading towards low-wage industries as we find for low-wage firms (see Supplementary Appendix Table E3 in Oreopoulos et al. 2008), but that downgrading also occurs within industries.

[58] A few qualifications of this interpretation are in order. First, 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. Second, 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.

four years (Figure 6). Medium skilled workers experience above-average job mobility and increases in firm quality within the first four years. College graduates at the bottom of the skill distribution experience little increases in job mobility and improvement in firm quality in the years after graduation, but instead are permanently down graded to lower-paying employers and sectors (*Implication 4*). For these workers, catch-up within firms is particularly important.

***What's behind the catch-up process?*** To assess the magnitude of alternative channels underlying the catch-up process, we added controls for a cohort's average firm quality and current and lagged regional unemployment rates in a regression of average log annual wages to our cell-level regression. Since recessions do not appear to affect the timing of graduation or labor force participation in our data, the inclusion of cell-level variables allows decomposing the persistent effect of the initial unemployment rate on earnings into the part explained by differences and changes in firm quality, by persistent effects of unemployment rates, and by other factors.

Figure 8 shows the effect of initial unemployment rates in years 0-1 in the labor market on earnings for workers entering the labor market in 1982 or later (since only for these cohorts we can match workers to initial firms).[59] 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 in the fifth year in the labor market. Thus, temporary reduction in firm quality *plus*

[59] The coefficient estimates are contained in Supplementary Appendix Table I1. Appendix Table I2 shows that the same results hold separately within skill group, but are more pronounced for the medium skilled workers.

continuing exposure to adverse labor market conditions correlated with the effect at entry explain a large fraction of the earnings losses we find.

***Additional Implications.*** Our model predicts that a higher 'natural' rate of arrival of job offers $\lambda$ 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 9, Panel A). As predicted by the model, the results show that the decay of earnings losses is significantly faster in sectors that have higher average turnover rates.[60]

Second, if an important source of reversion of earnings losses is driven by differences in firm quality, the earnings loss for recession graduates that are lucky to find a first job at a high wage firm should be minimal. 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 9, Panel B).[61] The result offers further evidence 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

[60] A simulation exercise contained in Sensitivity Appendix V (Oreopoulos et al. 2008) highlights additional predictions from the model relating to firm-hiring rates that help understand the pattern in our data. First, the fact that high skilled workers 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, suggesting that steady state hiring rates at good firms ( $p$ ) appear to be higher for high skilled workers.

[61] Coefficients estimates and standard errors for Figure 9 are contained in Supplementary Appendix Tables F. Figure 9, Panel B, also shows results for the interaction of initial firm fixed effects and experience effects. The results suggest that find firm-specific experience profiles do not explain an important part of earnings losses. Note that since 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, the results in Figure 9, Panel B, tends to overstate the importance of the first employer.

(Figure 9, Panel C). 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 a high-wage 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.[62]

Finally, the model is consistent with the general patterns of career development of college graduates in Canada. In particular, our search model predicts that with rising experience an increasing proportion of workers is employed at high-wage firms. We find evidence of this with positive concave experience profiles in firm-size and average firm-wages (Supplementary Appendix Figure A1). Improvements in firm quality can explain an important part of initial earnings growth in Canada, and similar trends appear in US data (Oreopoulos et al. 2008).

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. A key insight of our model is that effects of initial unemployment rates lead to permanent earnings differences only if coupled with search frictions that intensify with age. Without a distinction between 'newly minted,' flexible workers and workers settling down, nothing would prevent workers to keep seeking better jobs once they have entered

[62] 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 strategy affects our results (results 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.

the labor market. Another key insight is that these adjustment processes can differ by workers' skill level. Under realistic assumptions on comparative advantage, low skilled workers are more likely to be affected by time-increasing mobility costs and to be persistently down-ranked to lower paying firms. Thereby, low-skilled workers are more likely to experience permanent effects from initial labor market conditions.

## 6. 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 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 with better employers in the presence of age-dependent search costs and comparative advantage. We derive the predictions of our model for the long-term effects of recessions and compare them to the process of recovery we observe in the data. We find that recessions initially lead workers to start at less attractive employers. As implied by our model, an important part of earnings catch-up occurs by workers moving to higher-paying firms, especially in the first years after the shock. The importance of mobility towards better firms and the differences between more and less advantaged workers support an important role for job search that is influenced by comparative advantage and evolving search frictions. Lack of job search or lower offer rates from high-wage firms could explain why the least advantaged are permanently down-ranked to lower wage firms.

On balance we believe that our search model delivers a parsimonious explanation of the high and differential degree of persistence and the role of firm quality we find in our data. Our model's emphasis of the role of job search does not preclude contributions of other relevant mechanisms explaining the catch-up process, such as gradual sorting and employer learning (e.g., Gibbons, Katz, Lemieux, and Parent 2005), human capital accumulation (e.g., Neal 1995), or recovery on-the-job due to contracting (e.g., Beaudry and DiNardo 1991) or job assignment (e.g., Gibbons and Waldman 2004). Some of these mechanisms could be integrated into the model, but we leave an explicit theoretical and empirical analysis to future work. To further examine the implications of our results for economic efficiency, it would also be important to embed our model in a general equilibrium framework that explicitly accounts for the hiring decisions and wage setting of firms and the ensuing sorting process. Last, by focusing on male college graduates we have left out other groups of workers – such as high school graduates and women – that could 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.[63] 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

[63] 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.

Our baseline sample compares well with Census data for the same underlying population. Supplementary Figure A2 of our Supplementary Appendix, for example, shows mean earnings profiles generated from a 1995 cross section of our baseline data with analogous profiles generated from the 1996 Canadian Census (that surveys 1995 annual earnings) of college graduate males. Predicted differences over potential experience are highly similar.

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.[64] 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.[65] 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.[66] 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. Supplementary Appendix Table A3, Panel A and B 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).

[64] 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.

[65] 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.

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

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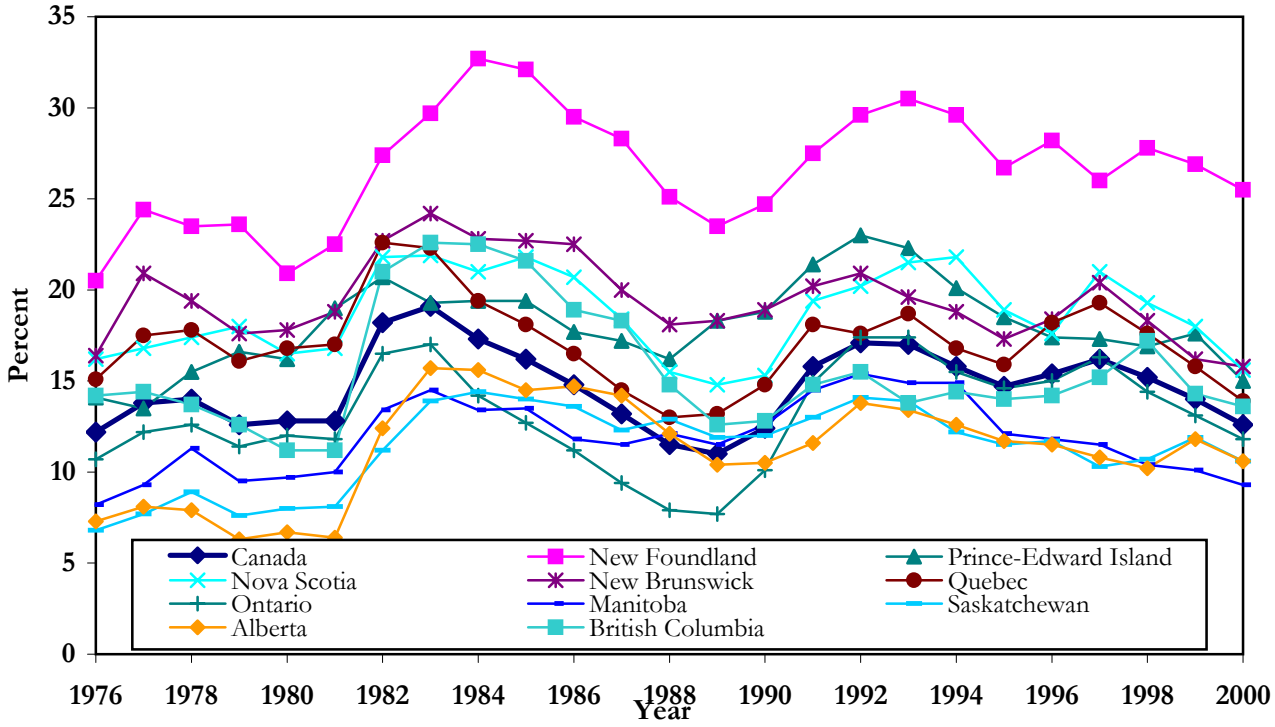
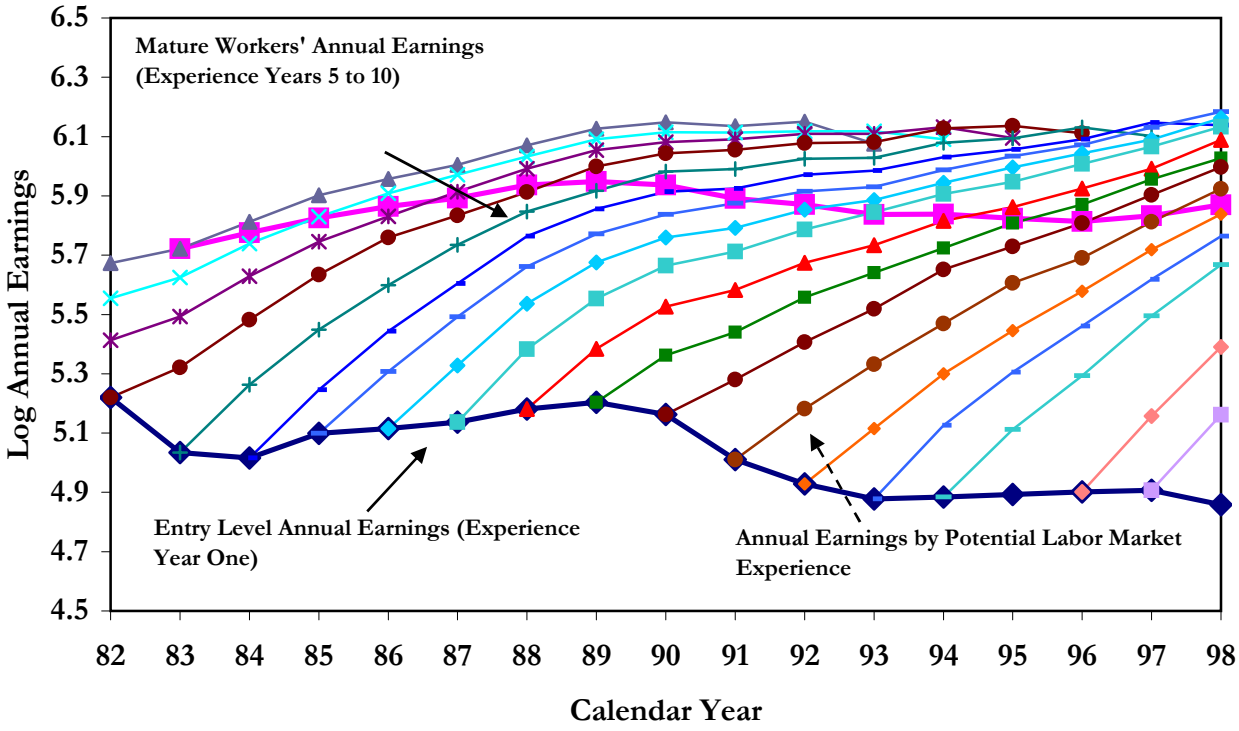
**Figure 1: Unemployment Rates Ages 15-24 for Canada and Provinces 1976-2000**



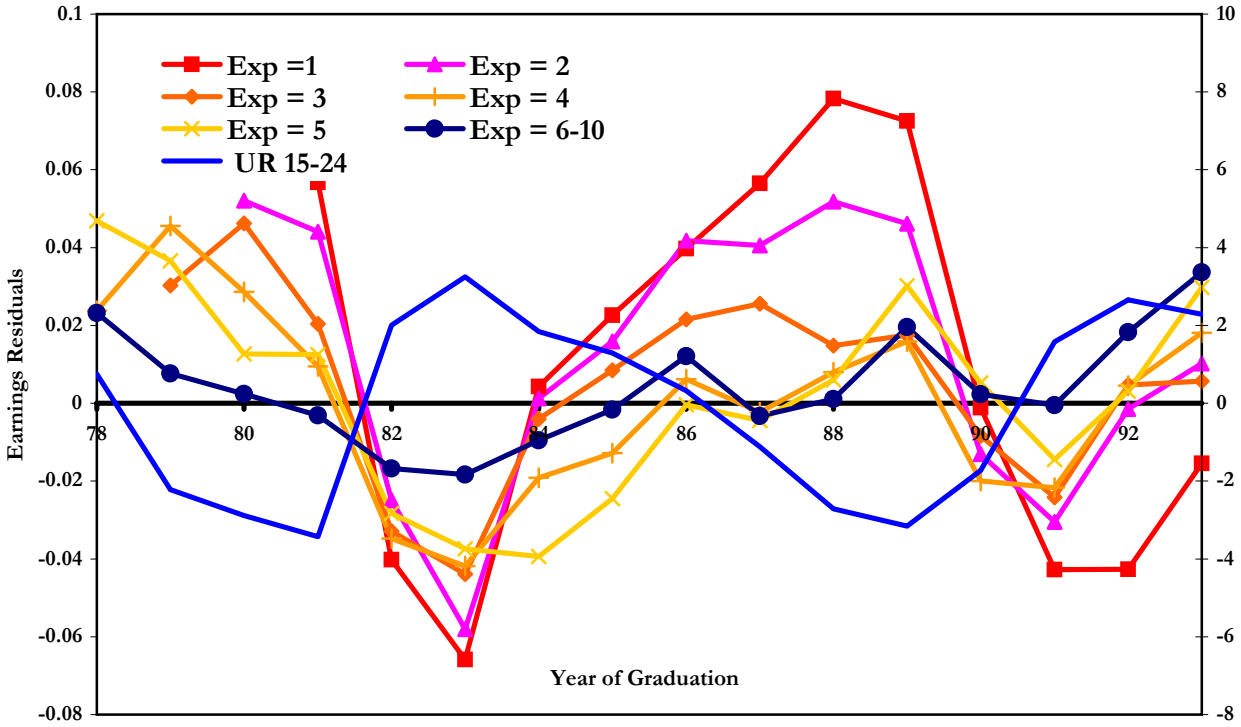

Source: Statistics Canada

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




Notes: The figure plots average log annual earnings profiles by year of degree completion for our baseline sample (all males in our administrative data that began a full-time undergraduate program at a post-secondary school institution in Canada between the ages of 17 and 20 from 1976 to 1995). See text and data appendix for more details.

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




Notes: The figure is constructed by first regressing log earnings from the baseline sample on fixed effects for year of college completion. The figure plots the average residuals from this regression for different years of experience. The figure also shows the national 15 to 24 year-old unemployment rate matched to the year of college completion (these values are from Statistics Canada). See text for more details.

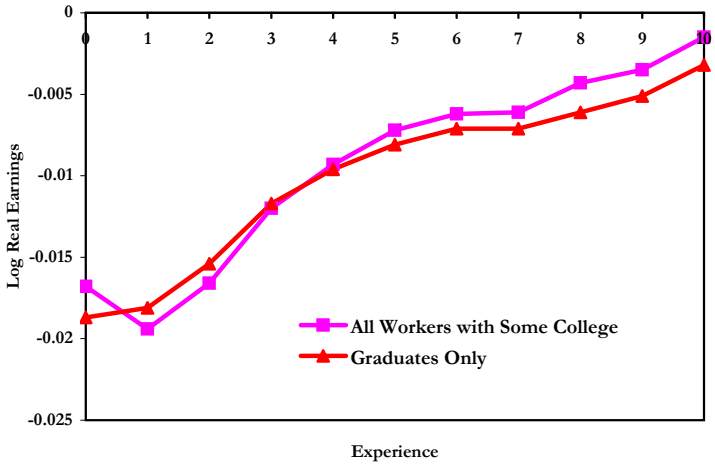
**Table 1: Effect of Unemployment Rate at time of Graduation on Log Real Earnings by Potential Experience**

| | 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 |

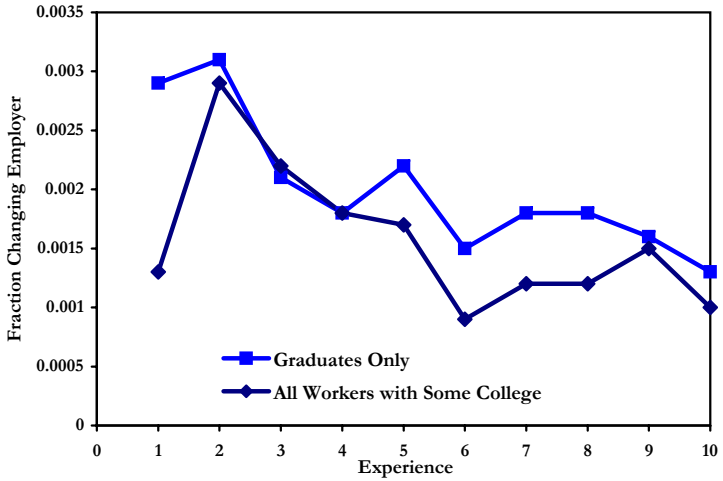
Notes: The sample includes males in Canada leaving university between 1976 and 1995 (see the data appendix). 'D' indicates the difference between the actual year left and the predicted year of graduation based on year of entry and program. Sample sizes reflect cell sample sizes after collapsing the micro 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 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 first residence fixed effects, experience fixed effects, and year of graduation fixed effects (see equation 4 in the text). The coefficients shown are the unemployment rate at college exit and experience interactions. Standard errors clustered at the first province cohort level are in square brackets. 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)**

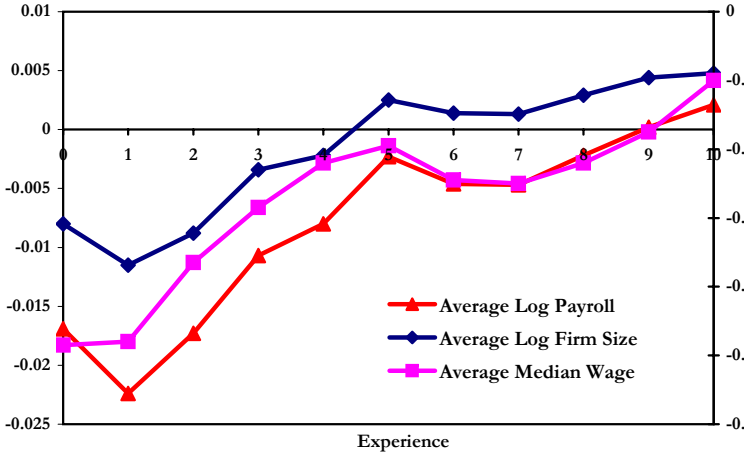
**Panel A: Log Real Annual Earnings**



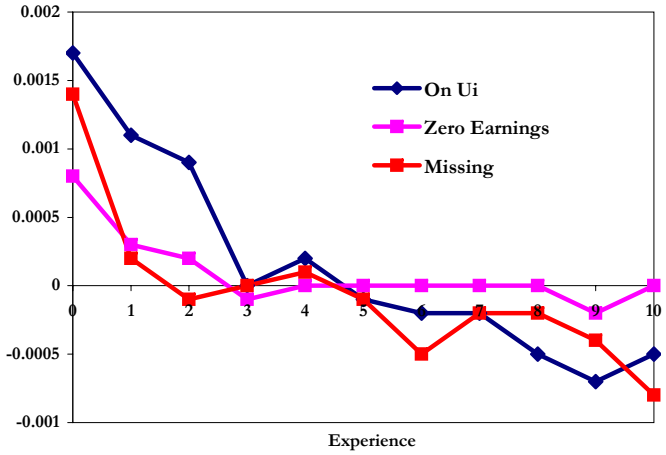

**Panel B: Probability of Annual Change in Employers**




**Panel C: Average Firm 'Quality', Graduates Only**




**Panel D: Fraction not Working, Graduates Only**




Notes: The figures show coefficients from regressing specified outcome variables on regional unemployment rates at the end of college completion interacted with experience dummies, controlling for effects for cohort of graduation, experience, and region of first residence (equation 4 in the paper). Panel A and B are based on the sample of all 17 to 20 year olds who started a college program in the data and our main sample of only college graduates. Panel A shows coefficient estimates with log annual earnings as the outcome variable. Panel B shows coefficient estimates using a dummy variable for whether an individual was classified working in a different firm as the one indicated in the previous year as the outcome variable. Panel C and D only show results based on our main sample of college graduates. Panel C shows coefficient estimates using measures of current firm quality as the outcome of interest: the employer's average log total payroll (averaged across all years in the dataset), average log employee size, and average median log wage. Panel D shows coefficient estimates for employment status measures: dummy variables for whether receiving any unemployment insurance in a given year, whether recorded as having zero earnings, or whether not recorded as filing a tax return in a given year. See text for more details.

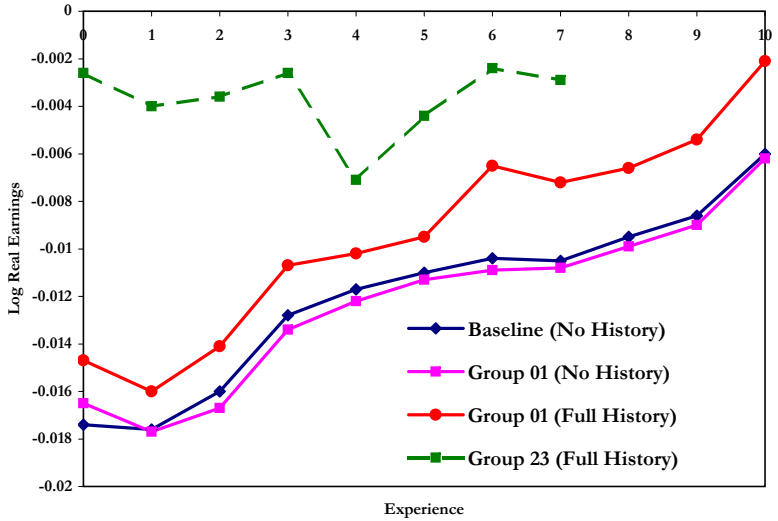
**Table 2: Effect of Unemployment Rate at time of Graduation With Controls for UR History, Basic and Grouped Model - Graduate Sample, Regional Model, Cohorts 1982-1995**

| Coefficient Shown | Specification | | | | | | |
|---|---|---|---|---|---|---|---|
| | Effect of UR at Experience Year Zero | | | | Effect of Average UR in Experience Years 0-1 | | Effect of Avg. UR in Exp. Years 2-3 Controlling for Full UR History |
| Model | Baseline: No Controls for UR History | Controlling for Current UR*Exp | Controlling for UR History in Exp=1,2,3 | Controlling for Full UR History | No Controls for UR History | Controlling for Full UR 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 | --- |

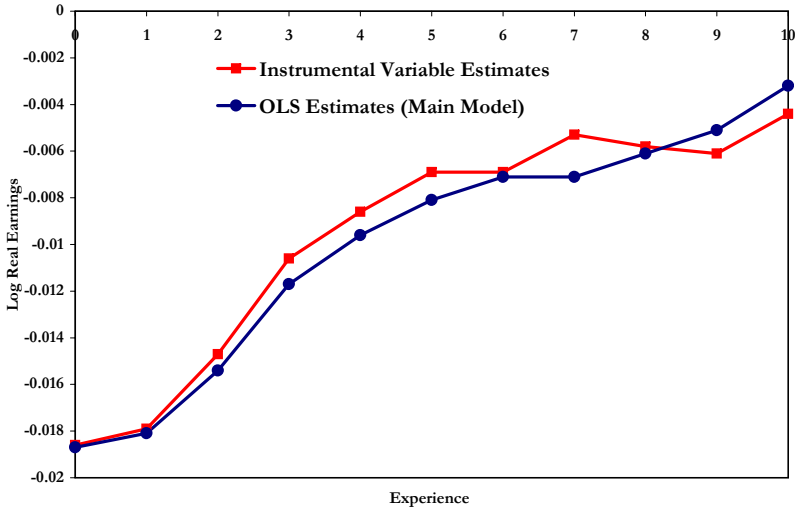
Notes: The sample includes males in Canada graduating university (with D>=0) between 1982 and 1995 (see the data appendix). Sample sizes reflect cell sample sizes after collapsing the micro data by graduation cohort, province of residence in each year of graduation, and experience year. As in Table 1, Column 6, all models regress the log annual earnings on the youth unemployment rate in the province of first residence (the columns indicate whether this rate is averaged over the first 0-1 or 2-3 years), interacted with experience years 0 to 10, plus province of first residence fixed effects, experience fixed effects, and year of graduation fixed effects. All models all include fixed effects for the current province of residence. The columns indicate additional controls for experience interacted with later unemployment rates. Column 2 includes the unemployment rate in the current province of residence interacted with experience as additional controls. Column 3 includes the unemployment rate in the province of residence of experience year 1, 2, and 3 interacted with experience. Column 4, 6, and 7 do the same for unemployment rates encountered in all ten experience years we consider. Standard errors clustered at the first province cohort level are in square brackets. 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, Graduates Only (Effect of Further Unemployment Shocks, Selective Graduation, Selective Participation, Cohort Differences)**

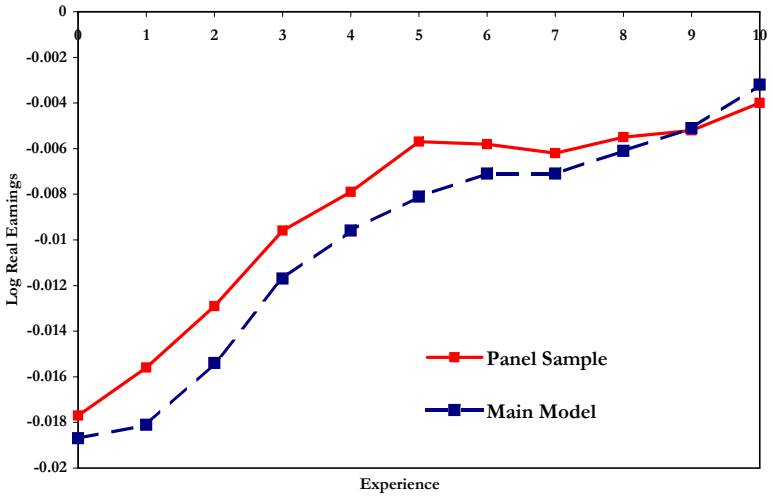
**Panel A: Effect of Unemployment Rate at Time of Graduation on Earnings Controlling for Dynamic Effects of Further Unemployment Shocks (by Experience Groups)**



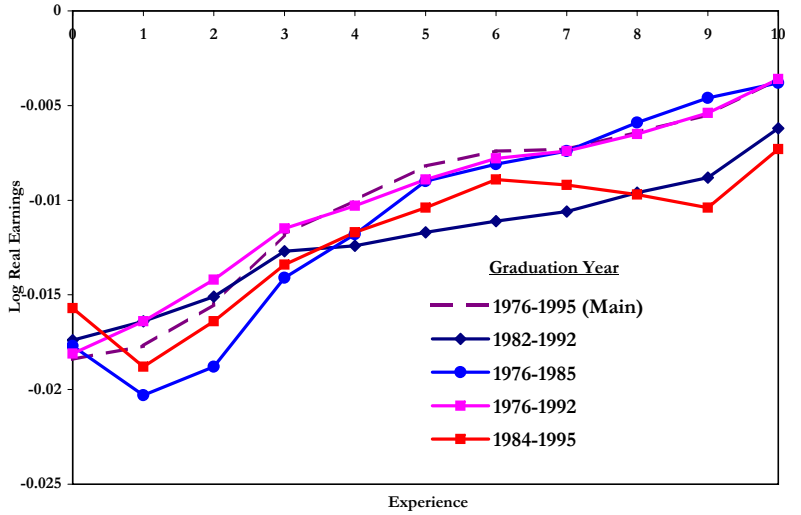

**Panel B: Effect of Unemployment Rate at Time of Graduation Instrumenting with Unemployment at Time of Predicted Graduation**




**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**




Notes: The figures show coefficients from regressing specified outcome variables on regional unemployment rates at the end of college completion, controlling for effect for year of graduation, experience, and province of first residence (equation 4 in the paper). Panel A displays coefficients from Table 2 columns 1, 5, 6, and 7. Panel B compares baseline coefficient estimates with those using predicted unemployment rate at completion based on time of entry and program length as instrumental variables. Panel C compares baseline coefficient estimates with those from the sample with individuals having positive earnings in every year since college completion. Panel D compares baseline coefficient estimates that use the sample of graduates between 1976 and 1995 with various other, smaller, cohort samples. See text and Supplementary Appendix for more details.

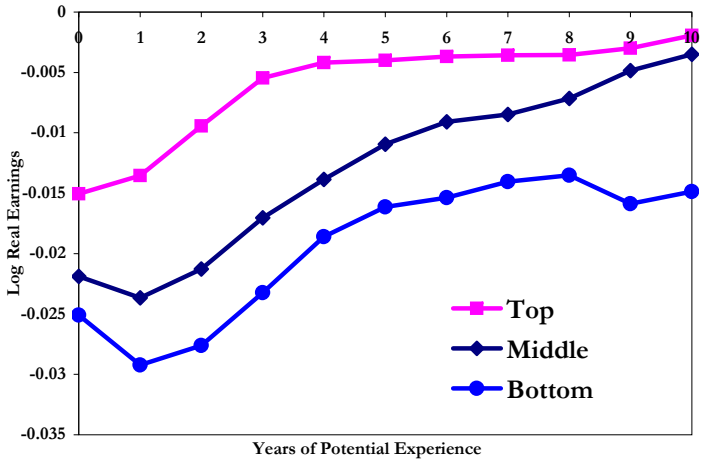
**Table 3: Effect of Unemployment Rate at time of Graduation on Labor Force Participation and Province Mobility - Graduate Sample**

| | 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 |

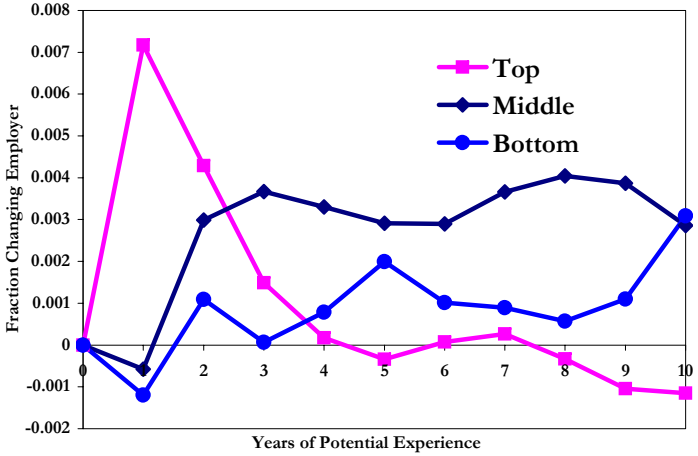
Notes: Columns indicate outcome variable used as the dependent variable. The models in columns 1-3 and 6-7 regresses these outcomes on the youth unemployment rate in the province of first residence, interacted with experience years 0 to 10, plus province of first residence fixed effects, experience fixed effects, and year of graduation fixed effects. Model 4-5 do not include first province of residence effects and use the national rate of youth unemployment. The coefficients shown are the unemployment rate at college exit and experience interactions. Standard errors clustered at the first province cohort level are in square brackets. 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 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 (Graduates Only)**

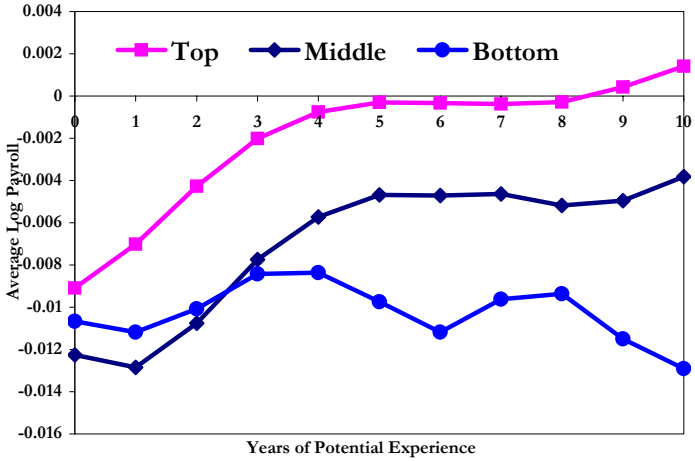
**Panel A: Log Real Annual Earnings**



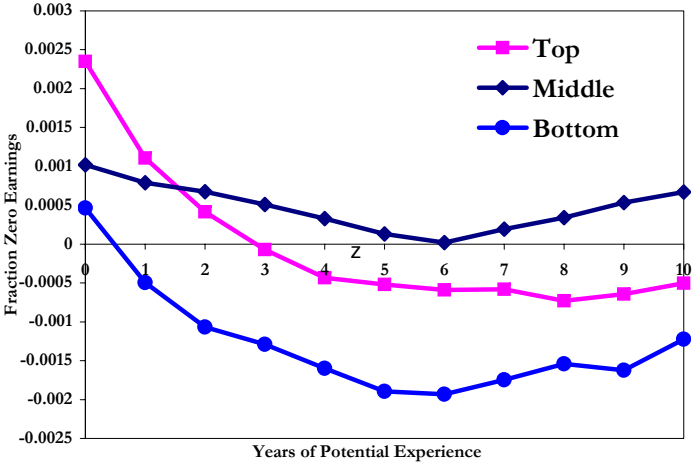

**Panel B: Probability of Annual Change in Employers**




**Panel C: Average Firm 'Quality', Graduates Only**




**Panel D: Fraction Filing With Zero Annual Earnings**



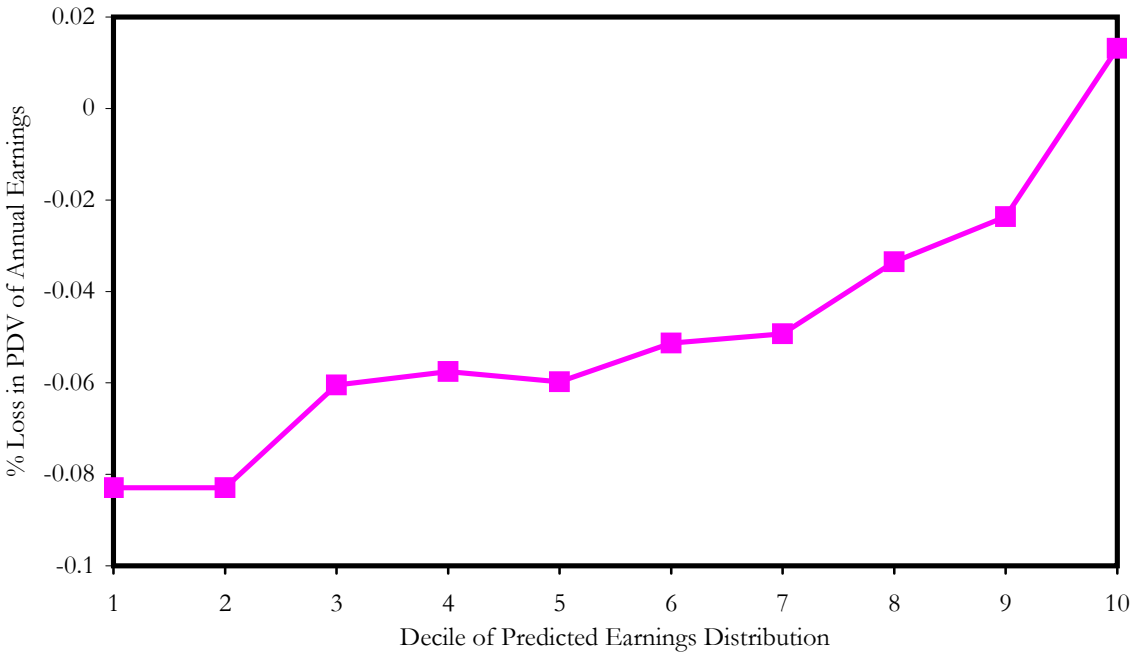

Notes: The figures show coefficients from regressing specified outcome variables on regional unemployment rates at the end of college completion, controlling for effects for year of graduation, experience, and province of first residence (equation 4 in the paper). The samples are divided into predicted skill groups, based on program of study and college (see text for more details). Panel A shows coefficient estimates with log annual earnings as the outcome variable. Panel B shows coefficient estimates using a dummy variable for whether an individual was classified working in a different firm as the one indicated in the previous year as the outcome variable. Panel C shows coefficient estimates using the employer's average log total payroll (averaged across all years in the dataset) as a measure for firm quality. Panel D shows coefficient estimates for whether recorded as having zero earnings or whether not recorded as filing a tax return in a given year.

**Table 4: Heterogeneity in Initial Loss and Reversion by Worker Groups (Graduates Only)**

| Outcome Variable | Effect of UR at Graduation by Year Since Graduation | All Graduates | Position in Distribution of Predicted Annual Earnings at Time of Graduation | | |
|---|---|---|---|---|---|
| | | | Bottom Quintile | Middle Quintile | Top Quintile |
| | | (1) | (2) | (3) | (4) |
| **Annual Earnings** | **Drop** | -0.0183 | -0.0282 | -0.0240 | -0.0134 |
| | *(Dummy Year 0-1)* | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| | **Slope** | 0.0020 | 0.0021 | 0.0025 | 0.0019 |
| | *(Slope Year 2-6)* | (0000)*** | (0.0021) | (0.0025) | (0.0019) |
| | **Fade** | 0.0015 | 0.0016 | 0.0021 | 0.0012 |
| | *(Slope Year 7-10)* | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| **Average Firm Median Log Earnings** | **Drop** | -0.0093 | -0.0098 | -0.0125 | -0.0074 |
| | | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| | **Slope** | 0.0010 | -0.0001 | 0.0014 | 0.0014 |
| | | (0000)*** | -(0.0001) | (0.0014) | (0.0014) |
| | **Fade** | 0.0007 | -0.0001 | 0.0009 | 0.0009 |
| | | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| **Average Firm Employment** | **Drop** | -0.0102 | -0.0078 | -0.0162 | -0.0073 |
| | | (0000)*** | (0000)*** | (0001)*** | (0000)*** |
| | **Slope** | 0.0021 | 0.0004 | 0.0006 | 0.0036 |
| | | (0000)*** | (0.0004) | (0.0006) | (0.0036) |
| | **Fade** | 0.0016 | -0.0009 | 0.0008 | 0.0033 |
| | | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| **Fraction Changed Employer** | **Drop** | 0.0032 | 0.0012 | 0.0025 | 0.0043 |
| | | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| | **Slope** | 0.0002 | -0.0002 | 0.0004 | 0.0003 |
| | | (0000)*** | -(0.0002) | (0.0004) | (0.0003) |
| | **Fade** | 0.0001 | 0.0002 | 0.0005 | -0.0001 |
| | | (0000)*** | (0000)*** | (0000)*** | (0.0000) |
| **Fraction Left 1st Employer** | **Drop** | 0.0030 | -0.0010 | 0.0011 | 0.0066 |
| | | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| | **Slope** | -0.0002 | 0.0005 | 0.0004 | -0.0013 |
| | | (0000)*** | (0.0005) | (0.0004) | -(0.0013) |
| | **Fade** | -0.0001 | 0.0003 | 0.0003 | -0.0008 |
| | | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| **Fraction Zero Earnings** | **Drop** | 0.0012 | -0.0002 | 0.0009 | 0.0014 |
| | | (0000)*** | (0000)*** | (0000)*** | (0000)*** |
| | **Slope** | -0.0003 | -0.0003 | -0.0001 | -0.0004 |
| | | (0000)*** | -(0.0003) | -(0.0001) | -(0.0004) |
| | **Fade** | -0.0002 | -0.0002 | 0.0000 | -0.0002 |
| | | (0000)*** | (0000)*** | (0.0000) | (0000)*** |

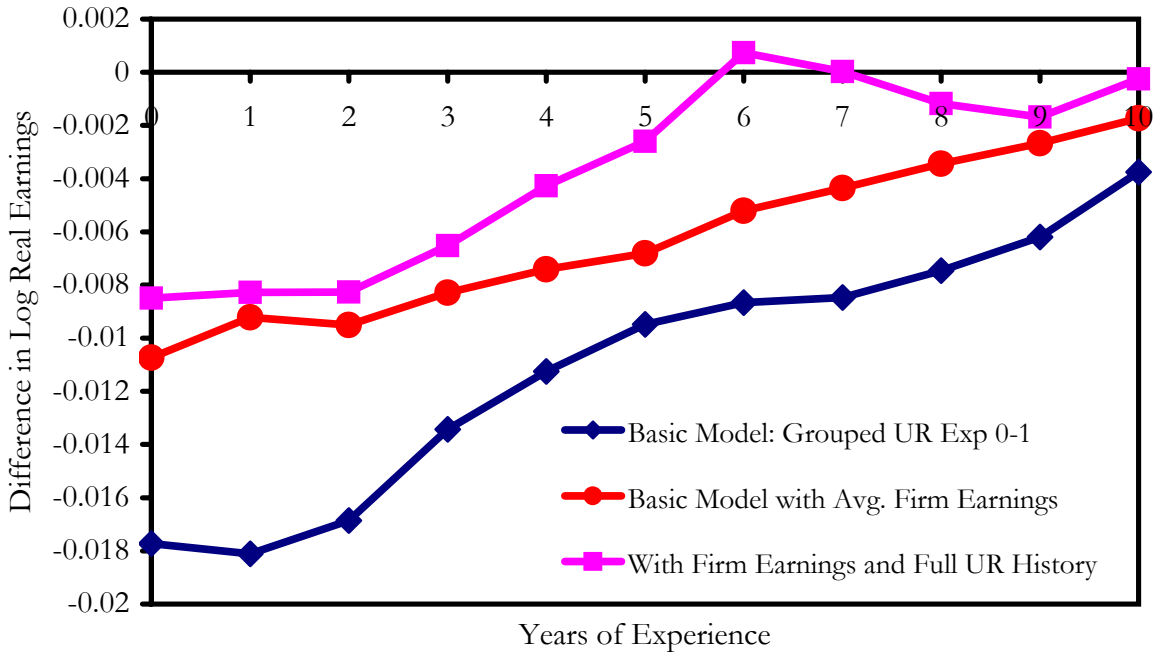
Notes: Coefficients from separate regression models of outcomes listed in the first column on DROP, SLOPE, and FADE parameterization of effect of unemployment rate at graduation, controlling for effects for year of graduation, experience, and province of first residence. The initial loss (DROP) is the effect of unemployment at graduation 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. Column 1 shows the results for the full sample of college graduates, whereas columns 2-4 show the results separately for college graduates in the first, third, and fifth quintile of predicted earnings at the time of graduation. Standard errors clustered at the first province cohort level are in square brackets. 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 7: Heterogeneity of Losses from Graduating in a Recession as Measured by Approximate Loss in Present Discounted Value of Earnings**




Notes: The figure shows the percentage loss in the present discounted value of annual earnings in the first ten years after graduation due to graduation in a recession by deciles of the distribution of predicted earnings, assuming an interest rate of five percent. and that losses fade after 10 years in the labor market. Please see text for details. The numbers have been smoothed by a moving average.

**Figure 8: Sources of Catch-Up After Early Unemployment Exposure, Cell Level Models (Graduates Only)**




Notes: The figure shows coefficients on initial unemployment rate interacted with year since graduation for a model where the effect of unemployment in the first two experience years are grouped together (UR Exp 0-1) controlling for effects for year of graduation , experience, and province of first residence for workers graduating from 1982 to 1995; the figure also shows the same coefficients when average firm quality at the experience-graduation cohort-first province level interacted with experience was added as regressor; as well as the same coefficient when in addition the history of unemployment shocks was allowed to have persistent effects. Please see text for details.

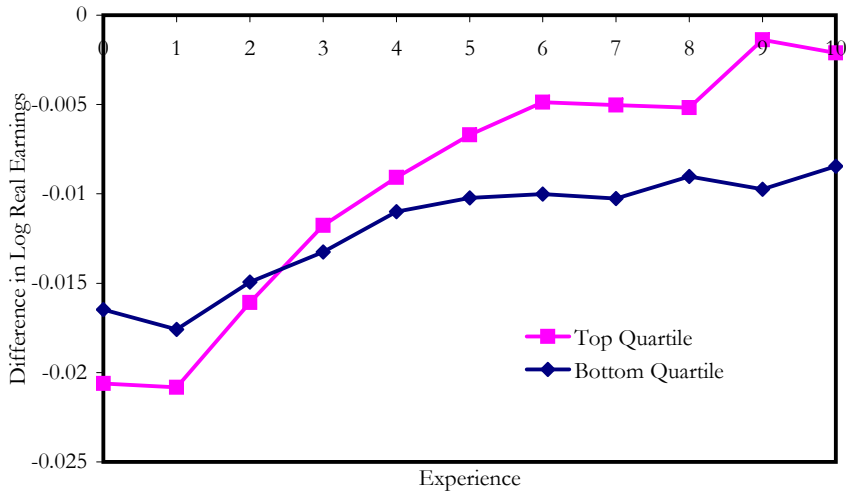
**Table 5: Effect of Unemployment Rate at time of Graduation on Job and Industry Mobility and Average Employer Characteristics - Graduates Only**

| 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 |

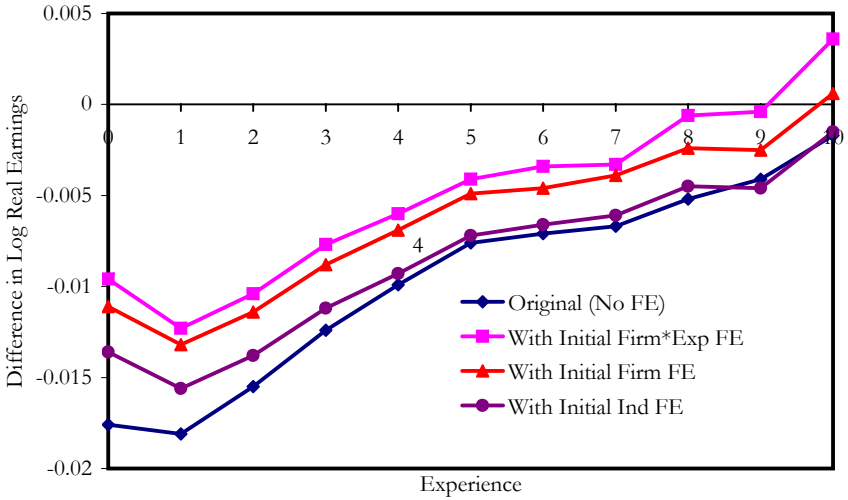
Notes: Columns indicate the firm or industry mobility variable used as the dependent variable. Each model regresses these outcomes on the youth unemployment rate in the province of first residence, interacted with experience years 0 to 10, plus province of first residence fixed effects, experience fixed effects, and year of graduation fixed effects. The coefficients shown are the unemployment rate at college exit and experience interactions. The coefficients shown are the unemployment rate at college exit and experience interactions. Standard errors clustered at the first province cohort level are in square brackets. 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 9: The Effect of Entering the Labor Market in a Recession for Workers for Alternative Specifications (Graduates Only)**

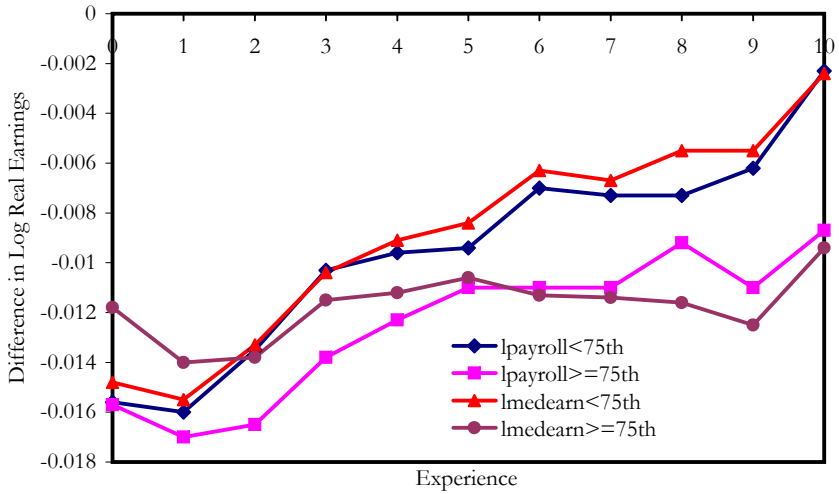
**Panel A: Differences in Effect of Initial Unemployment Rate by Quartile of Average Industry Turnover Rate**




**Panel B: Effect of Initial Unemployment Rate Controlling for First Firm and Industry Fixed Effects Interacted With Experience**




**Panel C: Effect of Initial Unemployment Rate by Average Quality of First Employer (Above/Below 75th Percentile)**




Notes: Panel A shows coefficients on initial unemployment rate interacted with year since graduation when fixed effect for initial employer, initial industry, or interactions of initial employer fixed effects with experience profiles are added to our main model. Panel B shows shows coefficients on initial unemployment rate interacted with year since graduation and interacted with whether initial employer's log payroll (lpayroll) or log median earnings (lmedaern) were above or below its 75th percentile (sorted at the worker level). Panel C shows coefficients on initial unemployment rate interacted with year since graduation for models run separately for workers employed in industries with average turnover rates in the top or bottom quartiles. Turnover rates were calculated as the fraction of workers at a firm in a given year not working at the same firm the previous year, averaged across years and across 3-digit industry category.

**Supplementary Appendix**

# "The Short- and Long-Term Career Effects of Graduating in a Recession: Hysteresis and Heterogeneity in the Market for College Graduates"

Philip Oreopoulos, Till von Wachter, and Andrew Heisz

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| Page 5 | Sensitivity Appendix IV: Weeks Worked and Weekly Earnings in the Canadian Census |
| Page 6 | Sensitivity Appendix V: Simulation Exercise |
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| Page 9+ | Tables and Figures of Supplementary Appendix |

**Sensitivity Appendix I: Accounting for Selective College Graduation**

The decision to leave college may be a function of the business cycle.[1] 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 Table H3 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 A1).

Panels D to F of Appendix Table H3 show the same specifications for those workers on or above grade (see also Appendix Tables H1 and H2 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.[2] 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.[3]

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.

---

[1] 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.

[2] Additional results in Appendix Tables H suggest 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.

[3] 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.

The first two columns of Appendix Table H4 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 H3 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.[4] 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 analyze the effects of early labor market conditions on the long-term career outcomes of Canadian college graduates.

**Sensitivity Appendix II: 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.[5] Although shocks are highly persistent initially, the auto-covariance structure dips to zero after three to four years.[6] 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.[7] 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 a simple omitted variable bias calculation.[8] At each

[4] 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.

[5] As shown in Figure 4, 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. We also included unemployment histories based on unemployment rates for all workers, with no differences in the results.

[6] 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 Appendix Figures B.

[7] As shown in Appendix Figure C1, Panel D and discussed in Section 4, this has little bearing on our original results.

[8] With the notation of Equation (4) the omitted variable bias of the coefficients on the first unemployment rates is

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 6 of Oreopoulos et al. 2006) 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 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.[9] 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 5 (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.[10]

**Sensitivity Appendix III: The Role of Regional Mobility**

In our NBER Working Paper (Oreopoulos et al. 2006) we compare the effect of initial unemployment rates on the gains from regional mobility by experience (columns 6 and 7 of Table 5).[11] 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, Table 5 (Oreopoulos et al. 2006). This is also shown in Figure D3 in the Supplementary Appendix, which shows that the effect of graduating in a tight labor market fades faster for those moving province, but that the main results are driven by those staying in the same province.

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$$p\lim \hat{\beta}_{e,0} = \beta_{e,0} + \sum_{d=1}^{e} \beta_{e-d,d} \frac{\mathrm{cov}(UR_{rc0}, UR_{r_d d})}{\mathrm{var}(UR_{rc0})}.$$

[9] 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.

[10] 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 Appendix Figure B2).

[11] See also Supplementary Appendix Tables D5 and D6.

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.[12] 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.

**Sensitivity Appendix IV: Weeks Worked and Weekly Earnings in the Canadian Census**

Since our sample does not contain information on time worked, we also replicated our results with the Canadian Census (Appendix Table C5). We use four years from the Census (1981, 1986, 1991, and 1996). Due to the different nature of the data we have to make assumptions on the timing and province of college graduation. The fact that the main effects on annual earnings are very similar to our results is reassuring. 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.[13]

[12] 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 Appendix Figure D3).

[13] 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 C3). 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.

**Sensitivity Appendix V: 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 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 $p_0$).[14]

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 (Appendix Figure J1, Panel B); the effect averages out in part at the mean (Appendix Figure J1, 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 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.

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[14] 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 $\gamma$ 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.

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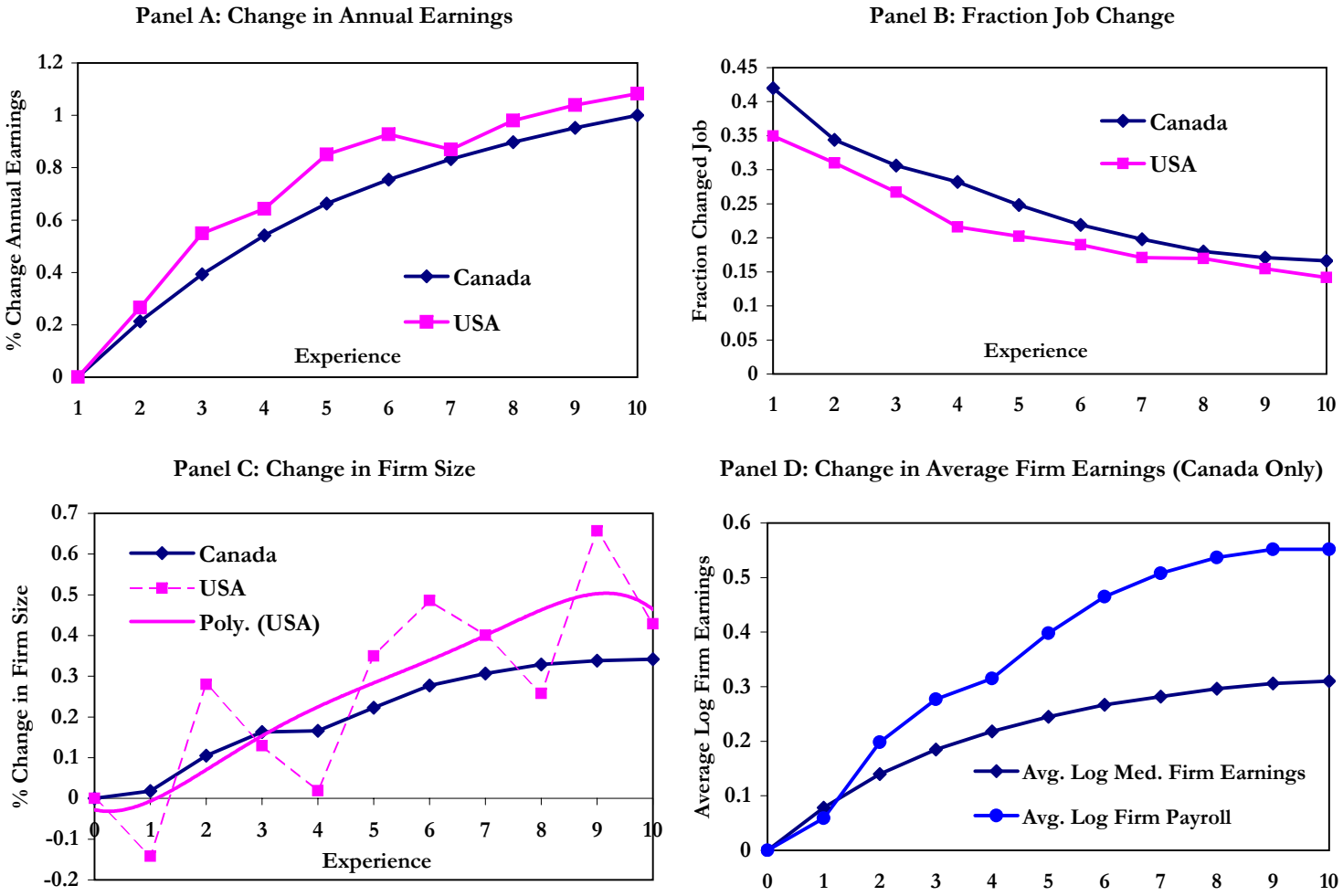
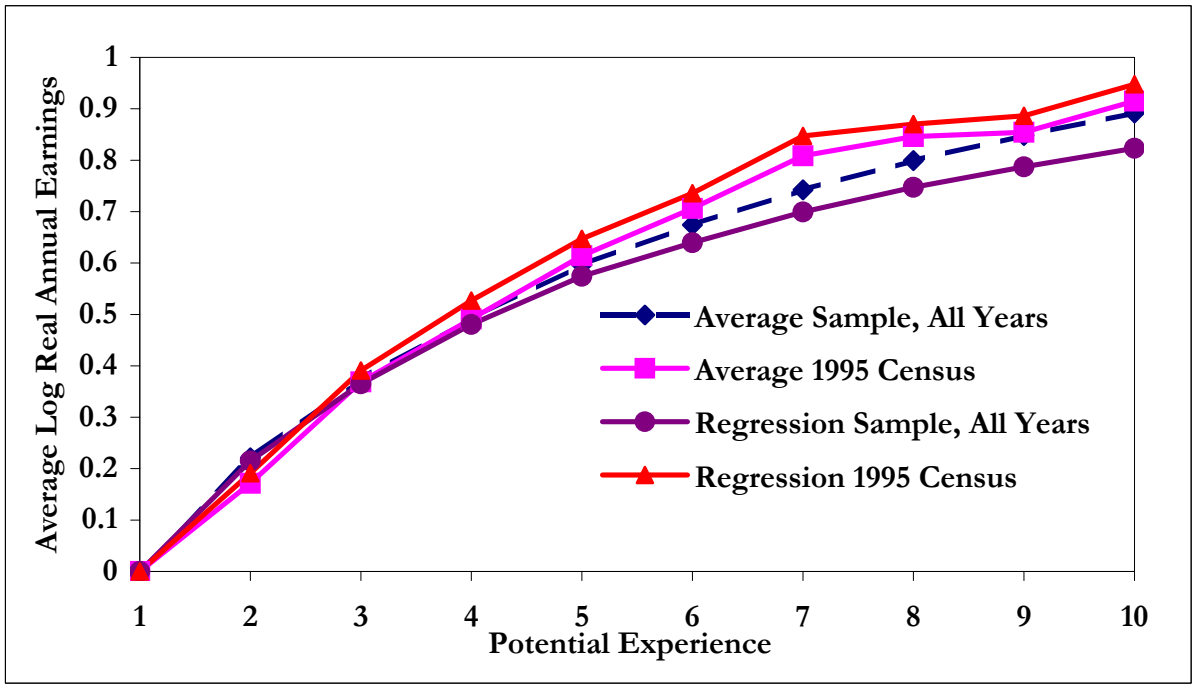
**Appendix Figure A1: Experience-Profiles in Earnings, Mobility, and Firm Charachteristics for workers with some college in Canada (Administrative Data) and U.S. (Current Population Survey)**



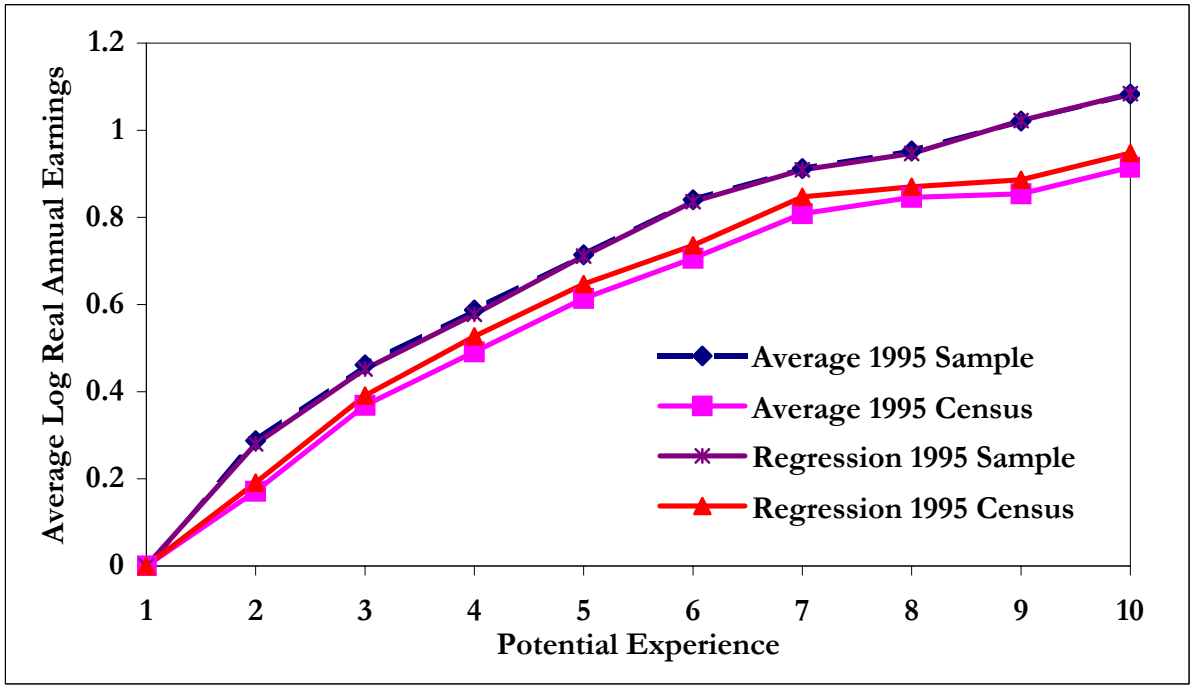

Notes: The figure shows average cross-sectional profiles in potential labor market experience (years since graduation) in Canada and the U.S.; the Canadian figures are derived from the administrative data we use in the paper; the U.S. data are taken from various years of the Current Population Survey (CPS). The underlying sample are all workers with some college in the relevant range of potential experience. Panel A shows percentage increases in annual earnings (for the U.S. from the March Demographic Supplement of the CPS in 1994-1996). Panel B shows the fraction of workers changing jobs in a given experience year (for the U.S., these figures are calculated as the fraction of workers with one year of tenure from the CPS' tenure, mobility, and pension supplements from 1979 to 2000.). Panel C shows the percentage change in firm employment (for Canada, this is average firm employment taken over all years the firm was alive from 1982 to 1999, controlling for year fixed effects; for the U.S., this is current firm size from firm size brackets taken from Supplements to the CPS in 1979, 1983, and 1988; for the U.S., we also show a polynomial approximation). Panel D shows average firm log median earnings or firm log payroll taken over all years the firm was alive from 1982 to 1999, controlling for year fixed effects (see text for details).

**Appendix Figure A2: Compare Census Experience Profile with Sample Profile, with and without Controlling for Region and Years of College (Graduate Sample)**

**Panel A: All Sample Years**




**Panel B: Single Year 1995**




Notes: Figures compare cumulative growth in annual earnings for male workers with a college degree in the 1996 Census with the earnings data drawn from income tax records matched to administrative university data. Only cohorts graduating from 1976 to 1995 are included. Other restrictions on the administrative data are the same as in the paper. Since the distribution of years of college and regions are different in the two sample, the figures also compare estimates controlling for fixed effects for years of college and region of residence.

**Appendix Table A1: Descriptive Statistics from Administrative College Data 1976-1995**

**Panel A: Duration of College**

| | Entire Sample (Some College) | | | | Graduates (Actual ≥ Predicted Year) | | | |
|---|---|---|---|---|---|---|---|---|
| | **Years Until BA** | **In Graduate Sample** | **Fraction Above Grade** | **Predicted-Actual BA Years** | **Years Until BA** | **In Graduate Sample** | **Fraction Above Grade** | **Predicted-Actual BA Years** |
| **At Exp. Zero** | 3.31 | 0.63 | 0.26 | -0.10 | 4.11 | 0.89 | 0.40 | 0.86 |
| | (1.29) | (0.38) | (0.37) | (1.69) | (0.59) | (0.11) | (0.39) | (1.08) |
| | **Fraction D >1** | **Fraction D >2** | **Fraction D<-1** | **Fraction D<-2** | **Fraction D >0** | **Fraction D >1** | **Fraction D >2** | -- |
| **At Exp. Zero** | 0.13 | 0.06 | 0.23 | 0.10 | 0.52 | 0.20 | 0.09 | -- |

**Panel B: Unemployment Rates Ages 15-24**

| | Average | Standard Deviation | Maximum | Minimum |
|---|---|---|---|---|
| **National** | 14.76 | 2.42 | 19.2 | 11.0 |
| **Province** | 14.13 | 3.98 | 32.7 | 6.3 |
| **National Detrended** | 0 | 2.41 | 4.53 | -3.83 |
| **Province Demeaned** | 0 | 3.01 | 6.53 | -7.12 |

| **Panel C: Provinces** | Sample Size | | Unemployment Rate | |
|---|---|---|---|---|
| | **N** | **Fraction** | **Average** | **Std. Dev.** |
| **Nova Scotia** | 1,143 | 0.84 | 18.99 | 2.50 |
| **PEI** | 109 | 0.08 | 18.91 | 2.08 |
| **Newfoundland** | 2,535 | 1.86 | 27.11 | 3.51 |
| **New Brunswick** | 7,281 | 5.33 | 20.07 | 2.13 |
| **Quebec** | 10,472 | 7.66 | 17.20 | 2.60 |
| **Ontario** | 71,995 | 52.69 | 13.03 | 3.14 |
| **Manitoba** | 10,308 | 7.54 | 12.59 | 1.81 |
| **Saskatchewan** | 4,557 | 3.34 | 11.84 | 2.26 |
| **Alberta** | 11,742 | 8.59 | 11.68 | 3.08 |
| **British Columbia** | 16,493 | 12.07 | 15.93 | 3.86 |

Notes: See text and Data Appendix. D=Actual Graduation Year - Graduation Year Based on Program Duration.

**Appendix Table A2, Panel A. Sample Size by Graduation Cohort and Experience**

| Graduation Year | Years Since Graduation | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **1976** | | | | | | | 3732 | 3732 | 3732 | 3732 | 3732 | 18660 |
| **1977** | | | | | | 6875 | 6875 | 6875 | 6875 | 6875 | 6875 | 41250 |
| **1978** | | | | | 7863 | 7863 | 7863 | 7863 | 7863 | 7863 | 7863 | 55041 |
| **1979** | | | | 7780 | 7780 | 7780 | 7780 | 7780 | 7780 | 7780 | 7780 | 62240 |
| **1980** | | | 7869 | 7869 | 7869 | 7869 | 7869 | 7869 | 7869 | 7869 | 7869 | 70821 |
| **1981** | | 7899 | 7899 | 7899 | 7899 | 7899 | 7899 | 7899 | 7899 | 7899 | 7899 | 78990 |
| **1982** | 8033 | 8033 | 8033 | 8033 | 8033 | 8033 | 8033 | 8033 | 8033 | 8033 | 8033 | 88363 |
| **1983** | 9146 | 9146 | 9146 | 9146 | 9146 | 9146 | 9146 | 9146 | 9146 | 9146 | 9146 | 100606 |
| **1984** | 8746 | 8746 | 8746 | 8746 | 8746 | 8746 | 8746 | 8746 | 8746 | 8746 | 8746 | 96206 |
| **1985** | 9584 | 9584 | 9584 | 9584 | 9584 | 9584 | 9584 | 9584 | 9584 | 9584 | 9584 | 105424 |
| **1986** | 9379 | 9379 | 9379 | 9379 | 9379 | 9379 | 9379 | 9379 | 9379 | 9379 | 9379 | 103169 |
| **1987** | 9307 | 9307 | 9307 | 9307 | 9307 | 9307 | 9307 | 9307 | 9307 | 9307 | 9307 | 102377 |
| **1988** | 9621 | 9621 | 9621 | 9621 | 9621 | 9621 | 9621 | 9621 | 9621 | 9621 | 9621 | 105831 |
| **1989** | 9391 | 9391 | 9391 | 9391 | 9391 | 9391 | 9391 | 9391 | 9391 | 9391 | 9391 | 103301 |
| **1990** | 9408 | 9408 | 9408 | 9408 | 9408 | 9408 | 9408 | 9408 | 9408 | 9408 | | 94080 |
| **1991** | 9288 | 9288 | 9288 | 9288 | 9288 | 9288 | 9288 | 9288 | 9288 | | | 83592 |
| **1992** | 9770 | 9770 | 9770 | 9770 | 9770 | 9770 | 9770 | 9770 | | | | 78160 |
| **1993** | 10429 | 10429 | 10429 | 10429 | 10429 | 10429 | 10429 | | | | | 73003 |
| **1994** | 14416 | 14416 | 14416 | 14416 | 14416 | 14416 | | | | | | 86496 |
| **1995** | 10117 | 10117 | 10117 | 10117 | 10117 | | | | | | | 50585 |
| **Total** | 136,635 | 144,534 | 152,403 | 160,183 | 168,046 | 164,804 | 154,120 | 143,691 | 133,921 | 124,633 | 115,225 | |

**Appendix Table A2, Panel B. Sample with Non-Missing Earnings by Graduation Cohort and Experience**

| Graduation Year | Years Since Graduation | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
| **1976** | | | | | | | 3416 | 3364 | 3387 | 3367 | 3429 | 16963 |
| **1977** | | | | | | 6320 | 6263 | 6322 | 6227 | 6303 | 6233 | 37668 |
| **1978** | | | | | 7284 | 7199 | 7199 | 7073 | 7173 | 7050 | 7168 | 50146 |
| **1979** | | | | 7119 | 7058 | 7088 | 6934 | 7026 | 6937 | 7032 | 7097 | 56291 |
| **1980** | | | 7226 | 7134 | 7208 | 7073 | 7139 | 7041 | 7135 | 7194 | 7138 | 64288 |
| **1981** | | 7166 | 7115 | 7160 | 7069 | 7097 | 7004 | 7102 | 7139 | 7131 | 7096 | 71079 |
| **1982** | 7083 | 7204 | 7274 | 7170 | 7214 | 7131 | 7209 | 7287 | 7218 | 7201 | 7288 | 79279 |
| **1983** | 7863 | 8144 | 8130 | 8249 | 8201 | 8221 | 8284 | 8221 | 8214 | 8221 | 8351 | 90099 |
| **1984** | 7723 | 7796 | 7896 | 7763 | 7858 | 7906 | 7876 | 7774 | 7835 | 7895 | 7899 | 86221 |
| **1985** | 8422 | 8637 | 8561 | 8637 | 8689 | 8672 | 8599 | 8616 | 8689 | 8693 | 8742 | 94957 |
| **1986** | 8443 | 8456 | 8512 | 8557 | 8524 | 8440 | 8457 | 8475 | 8476 | 8560 | 8571 | 93471 |
| **1987** | 8308 | 8428 | 8453 | 8375 | 8318 | 8311 | 8364 | 8383 | 8453 | 8473 | 8672 | 92538 |
| **1988** | 8790 | 8776 | 8717 | 8661 | 8670 | 8658 | 8668 | 8746 | 8773 | 8854 | 9029 | 96342 |
| **1989** | 8621 | 8530 | 8451 | 8433 | 8460 | 8411 | 8440 | 8557 | 8666 | 8785 | 9391 | 94745 |
| **1990** | 8532 | 8454 | 8427 | 8421 | 8445 | 8452 | 8532 | 8658 | 8742 | 9408 | | 86071 |
| **1991** | 8325 | 8300 | 8294 | 8302 | 8392 | 8410 | 8510 | 8632 | 9288 | | | 76453 |
| **1992** | 8650 | 8707 | 8737 | 8806 | 8814 | 8895 | 9044 | 9770 | | | | 71423 |
| **1993** | 9284 | 9389 | 9410 | 9371 | 9462 | 9650 | 10429 | | | | | 66995 |
| **1994** | 12756 | 12863 | 12941 | 13160 | 13376 | 14416 | | | | | | 79512 |
| **1995** | 9149 | 9152 | 9291 | 9403 | 10117 | | | | | | | 47112 |
| **Total** | 121949 | 130002 | 137435 | 144721 | 153159 | 150350 | 140367 | 131047 | 122352 | 114167 | 106104 | |

**Appendix Table A3: Cross-Sectional Experience Profiles in Annual Earnings, Unemployment, Participation, and Job Change, Canada and USA**

| | Entire Sample (Some College) | | | | Graduates (Actual ≥ Predicted Year) | | | |
|---|---|---|---|---|---|---|---|---|
| **Panel A: Average Experience Profile Canada (Income Tax Records, 1982-1999)** | | | | | | | | |
| **Year of Exp.** | **Average Log Earnings** | **Fraction on UI** | **Frac. Not in Labor Force** | **Fraction Changed Firm** | **Average Log Earnings** | **Fraction on UI** | **Frac. Not in Labor Force** | **Fraction Changed Firm** |
| **0** | 8.83 | 0.016 | 0.111 | - | 8.93 | 0.020 | 0.102 | - |
| **1** | 9.30 | 0.023 | 0.103 | 0.42 | 9.49 | 0.020 | 0.094 | 0.40 |
| **2** | 9.51 | 0.023 | 0.100 | 0.35 | 9.71 | 0.020 | 0.093 | 0.31 |
| **3** | 9.69 | 0.021 | 0.099 | 0.31 | 9.87 | 0.016 | 0.093 | 0.28 |
| **4** | 9.84 | 0.017 | 0.091 | 0.28 | 9.99 | 0.013 | 0.085 | 0.25 |
| **5** | 9.96 | 0.016 | 0.090 | 0.25 | 10.10 | 0.012 | 0.085 | 0.22 |
| **6** | 10.05 | 0.015 | 0.092 | 0.22 | 10.18 | 0.011 | 0.086 | 0.20 |
| **7** | 10.13 | 0.013 | 0.090 | 0.20 | 10.25 | 0.009 | 0.084 | 0.18 |
| **8** | 10.20 | 0.012 | 0.089 | 0.18 | 10.30 | 0.008 | 0.082 | 0.17 |
| **9** | 10.25 | 0.011 | 0.086 | 0.17 | 10.36 | 0.007 | 0.082 | 0.16 |
| **10** | 10.30 | 0.010 | 0.081 | 0.17 | 10.40 | 0.007 | 0.077 | 0.16 |
| **Panel B: Average Experience Profile USA (March Current Population Survey 1994-1996)** | | | | | | | | |
| **Year of Exp.** | **Average Log Earnings** | **Fraction Unem-ployed** | **Frac. Not in Labor Force** | **Fraction Changed Firm[a]** | **Average Log Earnings** | **Fraction Unem-ployed** | **Frac. Not in Labor Force** | **Fraction Changed Firm[a]** |
| **1** | 8.94 | 0.047 | 0.150 | 0.349 | 8.91 | 0.044 | 0.144 | 0.386 |
| **2** | 9.21 | 0.068 | 0.132 | 0.310 | 9.30 | 0.064 | 0.128 | 0.326 |
| **3** | 9.49 | 0.045 | 0.120 | 0.267 | 9.57 | 0.041 | 0.119 | 0.258 |
| **4** | 9.59 | 0.038 | 0.054 | 0.216 | 9.62 | 0.036 | 0.054 | 0.208 |
| **5** | 9.79 | 0.028 | 0.055 | 0.202 | 9.84 | 0.025 | 0.059 | 0.198 |
| **6** | 9.87 | 0.040 | 0.052 | 0.190 | 9.91 | 0.032 | 0.055 | 0.180 |
| **7** | 9.81 | 0.030 | 0.048 | 0.171 | 9.89 | 0.024 | 0.048 | 0.183 |
| **8** | 9.92 | 0.028 | 0.039 | 0.170 | 9.98 | 0.019 | 0.036 | 0.169 |
| **9** | 9.98 | 0.015 | 0.037 | 0.155 | 10.05 | 0.012 | 0.037 | 0.146 |
| **10** | 10.03 | 0.023 | 0.034 | 0.142 | 10.12 | 0.021 | 0.035 | 0.133 |

Notes: Years of experience refer to potential labor market experience in the U.S. (age-years of education-6), and years since graduation in Canada. In the U.S. data, graduates refer to workers with a college degree or more; those with some college are workers with more than a high school but less than a college degree. See notes to Appendix Figure A1 and Data Appendix for further details.

[a]These figures are calculated as the fraction of workers with one year of tenure from the CPS' tenure, mobility, and pension supplements from 1979 to 2000.

**Appendix Table A4: Experience Profile in Mobility and Firm Characteristics, Canada 1982-1999, Graduates Only**

**Panel A. Mobility Outcomes by Potential Labor Market Experience**

| Year of Exp. | Difference >=0 (Graduates) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Fraction Changed Industry 1 | Fraction Changed Industry 2 | Fraction Changed Industry 3 | Fraction Changed Province | Fraction Left 1st Firm | Fraction Left 1st Industry 1 | Fraction Left 1st Industry 2 | Fraction Left 1st Province |
| **0** | -- | -- | -- | -- | -- | -- | -- | -- |
| **1** | 0.308 | 0.352 | 0.365 | 0.040 | 0.399 | 0.31 | 0.35 | 0.052 |
| **2** | 0.220 | 0.257 | 0.270 | 0.029 | 0.558 | 0.42 | 0.48 | 0.086 |
| **3** | 0.186 | 0.220 | 0.233 | 0.027 | 0.65 | 0.48 | 0.56 | 0.104 |
| **4** | 0.163 | 0.194 | 0.207 | 0.024 | 0.709 | 0.52 | 0.61 | 0.115 |
| **5** | 0.141 | 0.169 | 0.181 | 0.021 | 0.745 | 0.55 | 0.64 | 0.124 |
| **6** | 0.126 | 0.151 | 0.163 | 0.020 | 0.769 | 0.56 | 0.66 | 0.133 |
| **7** | 0.113 | 0.135 | 0.146 | 0.015 | 0.784 | 0.57 | 0.67 | 0.138 |
| **8** | 0.104 | 0.124 | 0.134 | 0.012 | 0.799 | 0.58 | 0.68 | 0.143 |
| **9** | 0.098 | 0.118 | 0.128 | 0.011 | 0.813 | 0.59 | 0.69 | 0.147 |
| **10** | 0.098 | 0.116 | 0.126 | 0.009 | 0.827 | 0.61 | 0.71 | 0.150 |

**Panel B. Firm Outcomes by Potential Labor Market Experience**

| Year of Exp. | Difference >=0 (Graduates) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean Log Firm Size | Actual Mean Firm Size | Fraction Firm > 100 | Fraction Firm > 500 | Fraction Firm > 1000 | Fraction Firm > 5000 | Avg. Log Med. Firm Earnings | Avg. Log Firm Payroll |
| **0** | 6.94 | 27705 | 0.73 | 0.59 | 0.53 | 0.34 | 0.62 | 5.94 |
| **1** | 6.95 | 26563 | 0.74 | 0.59 | 0.53 | 0.33 | 0.70 | 6.00 |
| **2** | 7.03 | 28549 | 0.75 | 0.60 | 0.54 | 0.33 | 0.76 | 6.14 |
| **3** | 7.07 | 29701 | 0.75 | 0.61 | 0.55 | 0.34 | 0.81 | 6.22 |
| **4** | 7.08 | 30210 | 0.75 | 0.61 | 0.55 | 0.34 | 0.84 | 6.26 |
| **5** | 7.13 | 31429 | 0.76 | 0.62 | 0.55 | 0.35 | 0.87 | 6.34 |
| **6** | 7.17 | 33207 | 0.76 | 0.62 | 0.56 | 0.36 | 0.89 | 6.41 |
| **7** | 7.20 | 34164 | 0.76 | 0.63 | 0.56 | 0.36 | 0.91 | 6.45 |
| **8** | 7.21 | 34981 | 0.76 | 0.63 | 0.56 | 0.37 | 0.92 | 6.48 |
| **9** | 7.21 | 35286 | 0.76 | 0.63 | 0.57 | 0.37 | 0.93 | 6.50 |
| **10** | 7.20 | 35810 | 0.76 | 0.63 | 0.57 | 0.37 | 0.94 | 6.50 |

Notes: See text and Data Appendix.

**Appendix Table A5: Firm Size and Average Firm Wages Experience -- USA**

| | All Workers (Some College) | | | | At Least 16 Years of Schooling | | | |
|---|---|---|---|---|---|---|---|---|
| **Year of Experience** | **Log Firm Size** | **Fraction Firm Size > 100** | **Fraction Firm Size > 500** | **Fraction Firm Size > 1000** | **Log Firm Size** | **Fraction Firm Size > 100** | **Fraction Firm Size > 500** | **Fraction Firm Size > 1000** |
| **0** | 5.30 | 0.58 | 0.42 | 0.33 | 5.70 | 0.62 | 0.49 | 0.40 |
| **1** | 5.16 | 0.52 | 0.40 | 0.33 | 5.65 | 0.61 | 0.47 | 0.40 |
| **2** | 5.58 | 0.62 | 0.46 | 0.37 | 5.86 | 0.66 | 0.51 | 0.41 |
| **3** | 5.43 | 0.59 | 0.42 | 0.34 | 5.52 | 0.59 | 0.44 | 0.36 |
| **4** | 5.32 | 0.58 | 0.39 | 0.33 | 5.52 | 0.60 | 0.42 | 0.36 |
| **5** | 5.65 | 0.61 | 0.47 | 0.36 | 5.89 | 0.64 | 0.50 | 0.40 |
| **6** | 5.79 | 0.64 | 0.48 | 0.39 | 5.89 | 0.64 | 0.50 | 0.42 |
| **7** | 5.70 | 0.63 | 0.48 | 0.38 | 5.80 | 0.65 | 0.50 | 0.39 |
| **8** | 5.56 | 0.59 | 0.45 | 0.37 | 5.68 | 0.63 | 0.47 | 0.39 |
| **9** | 5.96 | 0.67 | 0.51 | 0.44 | 6.18 | 0.71 | 0.54 | 0.46 |
| **10** | 5.73 | 0.63 | 0.48 | 0.40 | 5.88 | 0.67 | 0.50 | 0.40 |

Notes: Pension and Benefit Supplements to The Current Population Survey, 1979, 1983, 1988. Sample size is 4607 for all workers with 13 to 18 years of schooling and 2987 for workers with at least 16 years of schooling.

**Appendix Table A6: Experience Profile in Mobility and Firm Characteristics, Canada 1982-1999, All Workers with Some College**

**Panel A. Mobility Outcomes by Potential Labor Market Experience**

| Year of Exp. | All Workers With Some College | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Fraction Changed Industry 1 | Fraction Changed Industry 2 | Fraction Changed Industry 3 | Fraction Changed Province | Fraction Left 1st Firm | Fraction Left 1st Industry 1 | Fraction Left 1st Industry 2 | Fraction Left 1st Province |
| **0** | -- | -- | -- | -- | -- | -- | -- | -- |
| **1** | 0.329 | 0.374 | 0.387 | 0.029 | 0.423 | 0.33 | 0.37 | 0.034 |
| **2** | 0.253 | 0.293 | 0.306 | 0.028 | 0.586 | 0.45 | 0.51 | 0.059 |
| **3** | 0.217 | 0.252 | 0.265 | 0.027 | 0.677 | 0.52 | 0.59 | 0.076 |
| **4** | 0.191 | 0.225 | 0.239 | 0.025 | 0.736 | 0.56 | 0.64 | 0.090 |
| **5** | 0.165 | 0.195 | 0.208 | 0.022 | 0.772 | 0.59 | 0.67 | 0.099 |
| **6** | 0.144 | 0.170 | 0.183 | 0.021 | 0.791 | 0.60 | 0.69 | 0.105 |
| **7** | 0.127 | 0.151 | 0.162 | 0.019 | 0.806 | 0.61 | 0.70 | 0.110 |
| **8** | 0.114 | 0.136 | 0.146 | 0.018 | 0.82 | 0.62 | 0.71 | 0.116 |
| **9** | 0.108 | 0.129 | 0.139 | 0.016 | 0.831 | 0.63 | 0.72 | 0.120 |
| **10** | 0.105 | 0.124 | 0.134 | 0.015 | 0.844 | 0.64 | 0.74 | 0.124 |

**Panel B. Firm Outcomes by Potential Labor Market Experience**

| Year of Exp. | All Workers With Some College | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean Log Firm Size | Actual Mean Firm Size | Fraction Firm > 100 | Fraction Firm > 500 | Fraction Firm > 1000 | Fraction Firm > 5000 | Avg. Log Med. Firm Earnings | Avg. Log Firm Payroll |
| **0** | 6.76 | 26978 | 0.70 | 0.56 | 0.50 | 0.32 | 0.52 | 5.66 |
| **1** | 6.78 | 26419 | 0.71 | 0.56 | 0.50 | 0.31 | 0.60 | 5.73 |
| **2** | 6.87 | 28656 | 0.72 | 0.58 | 0.52 | 0.32 | 0.67 | 5.88 |
| **3** | 6.92 | 29858 | 0.73 | 0.58 | 0.52 | 0.33 | 0.72 | 5.99 |
| **4** | 6.93 | 30342 | 0.73 | 0.58 | 0.52 | 0.33 | 0.76 | 6.03 |
| **5** | 6.98 | 31373 | 0.73 | 0.59 | 0.53 | 0.34 | 0.80 | 6.12 |
| **6** | 7.04 | 33148 | 0.74 | 0.60 | 0.54 | 0.34 | 0.83 | 6.21 |
| **7** | 7.07 | 34202 | 0.74 | 0.60 | 0.54 | 0.35 | 0.86 | 6.26 |
| **8** | 7.09 | 35085 | 0.74 | 0.61 | 0.54 | 0.35 | 0.87 | 6.31 |
| **9** | 7.10 | 35465 | 0.74 | 0.61 | 0.55 | 0.35 | 0.89 | 6.33 |
| **10** | 7.10 | 35933 | 0.74 | 0.61 | 0.55 | 0.36 | 0.89 | 6.35 |

Notes: See text and Data Appendix.

**Appendix Table A7: Longitudinal Experience Profiles in Career Outcomes, Full Sample with and without Cohort, Year, Region Controls and Cross-Sectional Experience Profile Calendar Year 1995 with Region Controls (Graduate Sample Only)**

| Years Since Graduation | Earnings | | | Firm Size | | | Firm Wage | | | Payroll | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All Years | | 1995 | All Years | | 1995 | All Years | | 1995 | All Years | | 1995 |
| | Average | Controls | Controls | Average | Controls | Controls | Average | Controls | Controls | Average | Controls | Controls |
| **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **1** | 0.563 | 0.560 | 0.476 | 0.002 | 0.040 | 0.128 | 0.078 | 0.082 | 0.084 | 0.058 | 0.103 | 0.194 |
| **2** | 0.782 | 0.775 | 0.753 | 0.084 | 0.148 | 0.125 | 0.140 | 0.149 | 0.193 | 0.197 | 0.275 | 0.288 |
| **3** | 0.942 | 0.928 | 0.933 | 0.123 | 0.222 | 0.293 | 0.184 | 0.197 | 0.257 | 0.274 | 0.395 | 0.513 |
| **4** | 1.062 | 1.043 | 1.058 | 0.133 | 0.270 | 0.356 | 0.217 | 0.235 | 0.328 | 0.314 | 0.481 | 0.653 |
| **5** | 1.169 | 1.142 | 1.196 | 0.187 | 0.312 | 0.494 | 0.245 | 0.255 | 0.358 | 0.397 | 0.545 | 0.848 |
| **6** | 1.248 | 1.213 | 1.314 | 0.229 | 0.350 | 0.604 | 0.267 | 0.271 | 0.418 | 0.465 | 0.603 | 1.000 |
| **7** | 1.320 | 1.278 | 1.391 | 0.255 | 0.382 | 0.601 | 0.282 | 0.284 | 0.429 | 0.510 | 0.650 | 1.014 |
| **8** | 1.377 | 1.328 | 1.434 | 0.266 | 0.409 | 0.614 | 0.297 | 0.297 | 0.456 | 0.540 | 0.694 | 1.054 |
| **9** | 1.428 | 1.371 | 1.511 | 0.269 | 0.432 | 0.672 | 0.306 | 0.308 | 0.466 | 0.556 | 0.732 | 1.124 |
| **10** | 1.472 | 1.409 | 1.565 | 0.259 | 0.450 | 0.651 | 0.311 | 0.314 | 0.470 | 0.554 | 0.763 | 1.109 |

| Years Since Graduation | Industry Mobility | | | Firm Mobility | | | On UI | | | Zero Earnings | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All Years | | 1995 | All Years | | 1995 | All Years | | 1995 | All Years | | 1995 |
| | Average | Controls | Controls | Average | Controls | Controls | Average | Controls | Controls | Average | Controls | Controls |
| **0** | -- | -- | -- | -- | -- | -- | 0.020 | 0.045 | 0.042 | 0.047 | 0.032 | 0.038 |
| **1** | 0.351 | 0.334 | 0.340 | 0.398 | 0.363 | 0.375 | 0.020 | 0.046 | 0.046 | 0.036 | 0.020 | 0.030 |
| **2** | 0.256 | 0.241 | 0.260 | 0.309 | 0.278 | 0.301 | 0.020 | 0.047 | 0.053 | 0.035 | 0.020 | 0.025 |
| **3** | 0.217 | 0.194 | 0.210 | 0.272 | 0.231 | 0.254 | 0.016 | 0.044 | 0.048 | 0.034 | 0.020 | 0.022 |
| **4** | 0.191 | 0.164 | 0.158 | 0.245 | 0.199 | 0.201 | 0.013 | 0.041 | 0.048 | 0.030 | 0.019 | 0.018 |
| **5** | 0.165 | 0.139 | 0.129 | 0.216 | 0.172 | 0.165 | 0.012 | 0.040 | 0.045 | 0.031 | 0.020 | 0.024 |
| **6** | 0.148 | 0.124 | 0.112 | 0.196 | 0.154 | 0.146 | 0.011 | 0.039 | 0.048 | 0.032 | 0.021 | 0.021 |
| **7** | 0.132 | 0.109 | 0.093 | 0.177 | 0.137 | 0.125 | 0.009 | 0.037 | 0.044 | 0.033 | 0.022 | 0.017 |
| **8** | 0.122 | 0.099 | 0.088 | 0.165 | 0.125 | 0.117 | 0.009 | 0.037 | 0.044 | 0.033 | 0.023 | 0.024 |
| **9** | 0.114 | 0.091 | 0.068 | 0.155 | 0.114 | 0.097 | 0.007 | 0.037 | 0.040 | 0.035 | 0.025 | 0.019 |
| **10** | 0.110 | 0.084 | 0.066 | 0.148 | 0.106 | 0.094 | 0.007 | 0.037 | 0.041 | 0.033 | 0.023 | 0.020 |

Notes: For full sample (All Years), model with controls includes fixed effects for cohort of graduation, region of first residence, and year. For year 1995, model with controls includes fixed effects for region of first residence.

**Appendix B: Auto-Covariance Structure of Regional Unemployment Rates**

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). Additional lags are not significant.

The auto-covariance structure of the unemployment rate for the observations in our sample controlling for cohort, region, and year fixed effects is shown in the Figure. (These correspond to the auxiliary regression coefficients that pre-multiply the effects of the omitted unemployment rate history in the omitted variable bias calculation of Section 2.) Although shocks are highly persistent initially, the auto-covariance structure dips to zero after three to four years. Thus, the inclusion of two to three lags should suffice to absorb most of omitted variable bias.

To account for the high persistence of unemployment shocks, often an ARIMA(1,1,0) process is specified instead of an AR(2). It is often difficult to distinguish the two processes in short samples, but given a prior of stationarity for the unemployment rate we opt for the latter. A strand of literature in time series econometrics models the unemployment rate accounting directly for asymmetry and short-run persistence in the dynamics of unemployment rates (e.g., Koop and Potter 1999, Rothman 1998), although the AR(2)/ARIMA(1,1,0) appears to be a common choice (Montgomery et al. 1998). On the time series properties of the unemployment in Canada see Fauvel et al. (1999) or Mikhail et al. (2003).

**References:**

Fauvel, Yvon, Alain Paquet, and Christian Zimmerman (1999). 'Short-Term Forecasting of National and Provincial Employment in Canada.' Working Paper No. R-99-6E Applied Research Branch, Strategic Policy, Human Resource Development Canada.

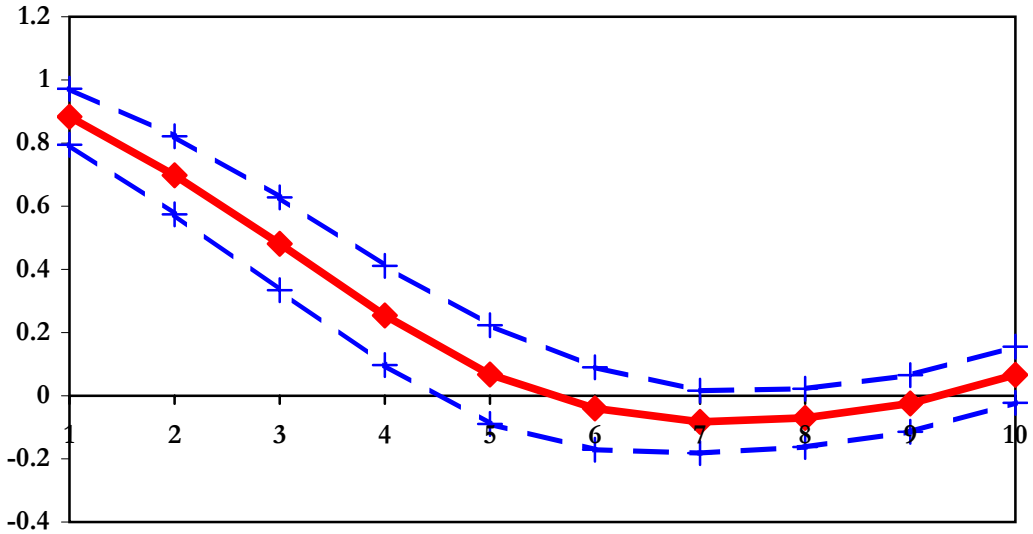
Mikhail, Ossama, Curtis Eberwein, and Jagdish Handa (2003). 'Testing and Estimating Persistence in Canadian Unemployment.' Mimeo, University of Central Florida.

Montgomery, Alan, Victor Zarnovitz, Ruey Tsay, and George Tiao (1998). 'Forecasting the U.S. Unemployment Rate.' Journal of the American Statistical Association 93 pp. 478-493.

Rothman, Philip (1998). 'Forecasting Asymmetric Unemployment Rates.' Review of Economics and Statistics pp . 164-168.

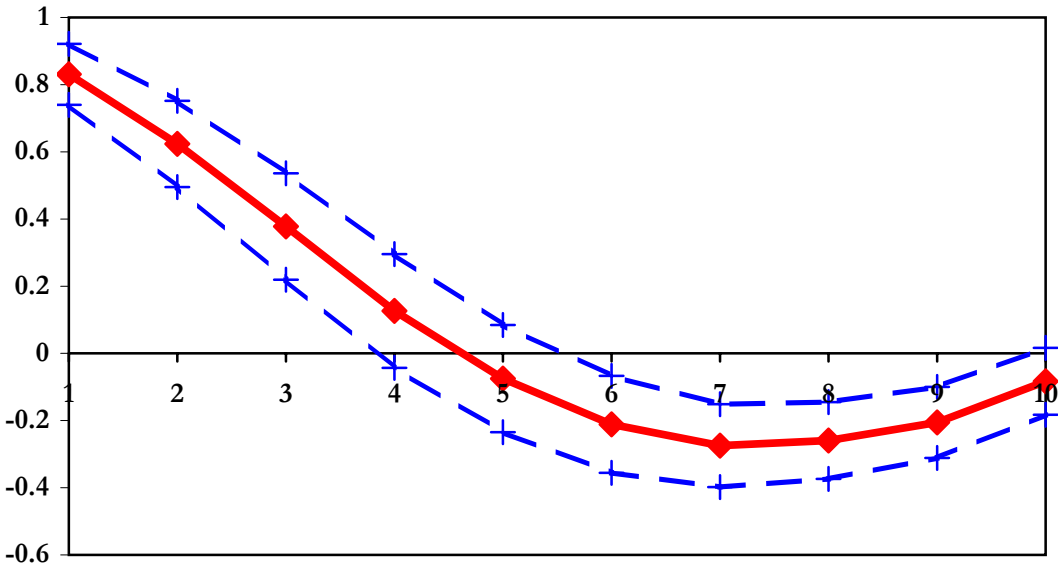
**Appendix Figure B1: Auto-Covariance of Unemployment Rate at Ages 15-24, Regional Graduate Sample**

**Panel A: Cohorts 1982-1995**




**Year since Graduation**

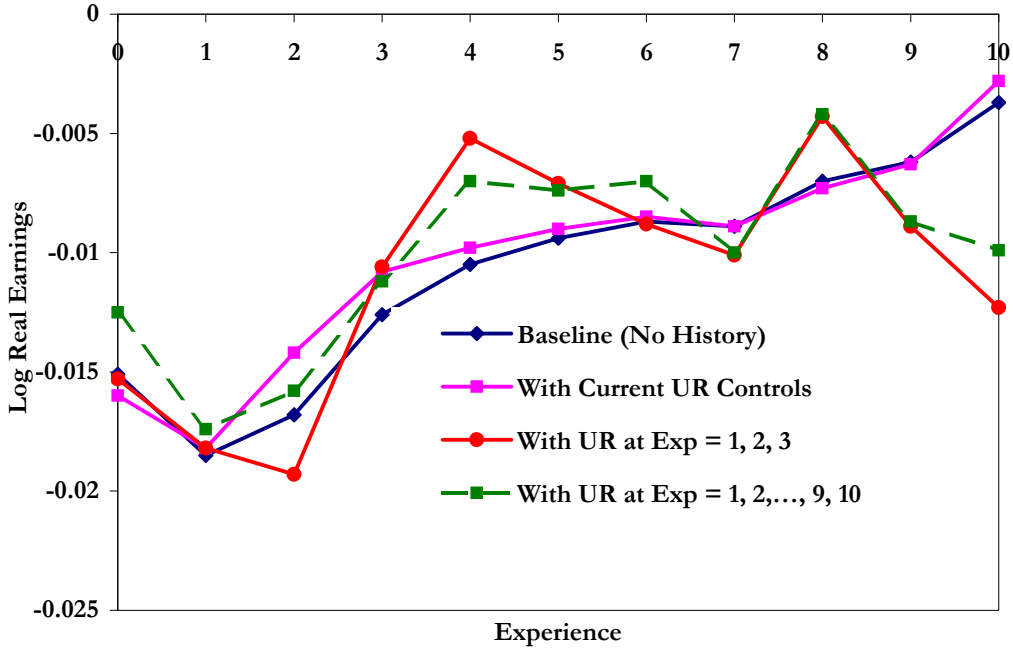
**Panel B: Cohorts 1976-1995**



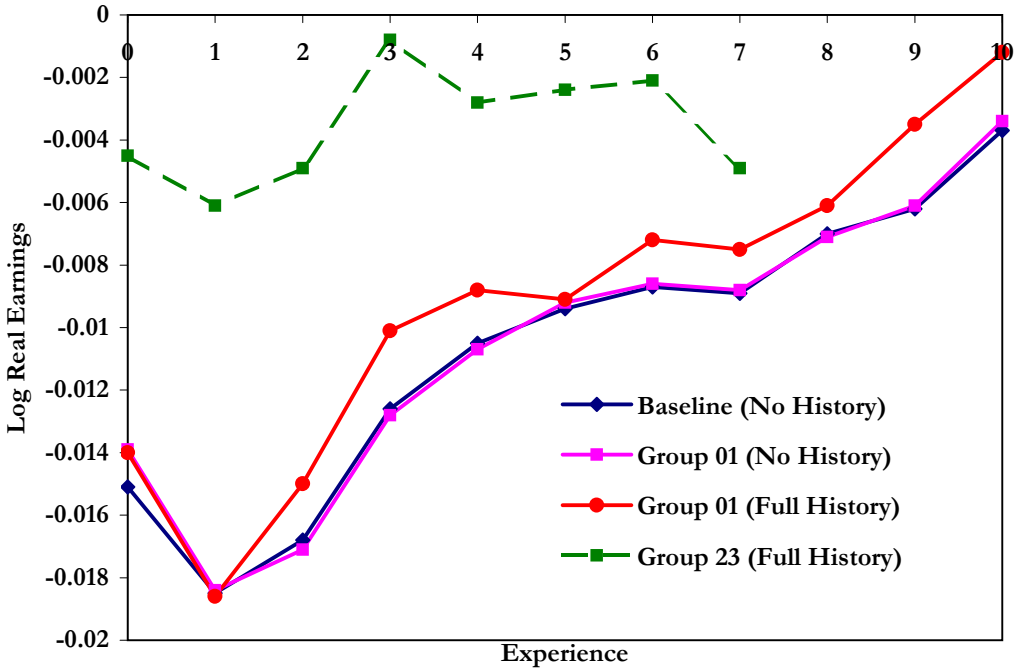

**Year since Graduation**

Notes: Figure displays regression coefficients of regional unemployment rates in given experience year on unemployment rate at graduation, controlling for fixed effects for region of first residence, region of current residence, and year of graduation. The regression are weighted by individuals present in the respective cell and cohort-range.

**Appendix FigureB2 (A): Effect of Unemployment Rate at Time of Graduation on Log Real Earnings With Controls for Unemployment Rate History: 1982-1995 Cohorts, Full Sample**




**Appendix Figure B2 (B): Grouped Model of Effect of Unemployment Rate at Time of Graduation on Log Real Earnings With Controls for Unemployment Rate History: 1982-1995 Cohorts, Full Sample**




Notes: See notes and discussion of Figure 5 in text.

**Appendix Table B1: Effect of Unemployment Rate at time of Graduation With Controls for UR History, Basic and Grouped Model - Full Sample, Regional Model, Cohorts 1982-1995**

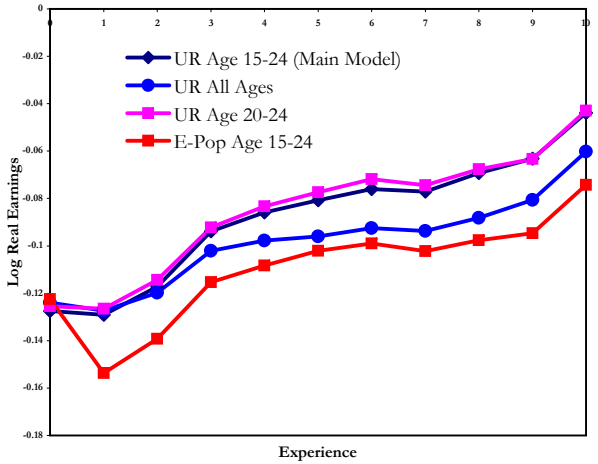
| Model | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Baseline (No UR History) | With Current UR Only | With History in Exp=1,2,3 | With Full UR History | Baseline (No UR History) | Baseline Group 0-1 (No Hist.) | Group 01 With Full History | Group 23 With Full History |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Experience Year** | | | | | | | | |
| **0** | -0.0151 | -0.016 | -0.0153 | -0.0125 | -0.0151 | -0.0139 | -0.014 | --- |
| | [0.0032]*** | [0.0032]*** | [0.0031]*** | [0.0029]*** | [0.0032]*** | [0.0034]*** | [0.0036]*** | --- |
| **1** | -0.0185 | -0.0182 | -0.0182 | -0.0174 | -0.0185 | -0.0184 | -0.0186 | --- |
| | [0.0028]*** | [0.0054]*** | [0.0052]*** | [0.0052]*** | [0.0028]*** | [0.0029]*** | [0.0032]*** | --- |
| **2** | -0.0168 | -0.0142 | -0.0193 | -0.0158 | -0.0168 | -0.0171 | -0.015 | -0.0045 |
| | [0.0025]*** | [0.0028]*** | [0.0056]*** | [0.0051]*** | [0.0025]*** | [0.0025]*** | [0.0029]*** | [0.0030] |
| **3** | -0.0126 | -0.0108 | -0.0106 | -0.0112 | -0.0126 | -0.0128 | -0.0101 | -0.0061 |
| | [0.0023]*** | [0.0023]*** | [0.0048]** | [0.0042]*** | [0.0023]*** | [0.0025]*** | [0.0028]*** | [0.0027]** |
| **4** | -0.0105 | -0.0098 | -0.0052 | -0.007 | -0.0105 | -0.0107 | -0.0088 | -0.0049 |
| | [0.0023]*** | [0.0023]*** | [0.0047] | [0.0038]* | [0.0023]*** | [0.0024]*** | [0.0027]*** | [0.0033] |
| **5** | -0.0094 | -0.009 | -0.0071 | -0.0074 | -0.0094 | -0.0092 | -0.0091 | -0.0008 |
| | [0.0022]*** | [0.0023]*** | [0.0051] | [0.0040]* | [0.0022]*** | [0.0023]*** | [0.0034]*** | [0.0052] |
| **6** | -0.0087 | -0.0085 | -0.0088 | -0.007 | -0.0087 | -0.0086 | -0.0072 | -0.0028 |
| | [0.0024]*** | [0.0024]*** | [0.0056] | [0.0045] | [0.0024]*** | [0.0025]*** | [0.0042]* | [0.0054] |
| **7** | -0.0089 | -0.0089 | -0.0101 | -0.01 | -0.0089 | -0.0088 | -0.0075 | -0.0024 |
| | [0.0025]*** | [0.0025]*** | [0.0055]* | [0.0045]** | [0.0025]*** | [0.0027]*** | [0.0042]* | [0.0042] |
| **8** | -0.007 | -0.0073 | -0.0043 | -0.0042 | -0.007 | -0.0071 | -0.0061 | -0.0021 |
| | [0.0024]*** | [0.0024]*** | [0.0050] | [0.0038] | [0.0024]*** | [0.0026]*** | [0.0034]* | [0.0040] |
| **9** | -0.0062 | -0.0063 | -0.0089 | -0.0087 | -0.0062 | -0.0061 | -0.0035 | -0.0049 |
| | [0.0024]** | [0.0024]** | [0.0051]* | [0.0041]** | [0.0024]** | [0.0026]** | [0.0036] | [0.0049] |
| **10** | -0.0037 | -0.0028 | -0.0123 | -0.0099 | -0.0037 | -0.0034 | -0.0012 | -0.0015 |
| | [0.0025] | [0.0025] | [0.0051]** | [0.0042]** | [0.0025] | [0.0027] | [0.0040] | [0.0047] |
| **Constant** | 8.9864 | 9.0247 | 9.0278 | 8.9509 | 8.9864 | 8.9719 | 9.0123 | --- |
| | [0.1300]*** | [0.1303]*** | [0.1272]*** | [0.1239]*** | [0.1300]*** | [0.1334]*** | [0.1387]*** | --- |
| **N** | 8304 | 8304 | 8304 | 7704 | 8304 | 8304 | 8038 | --- |
| **$R^2$** | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | --- |

Notes: Robust standard errors in brackets. See notes and discussion of Table 2 in text.

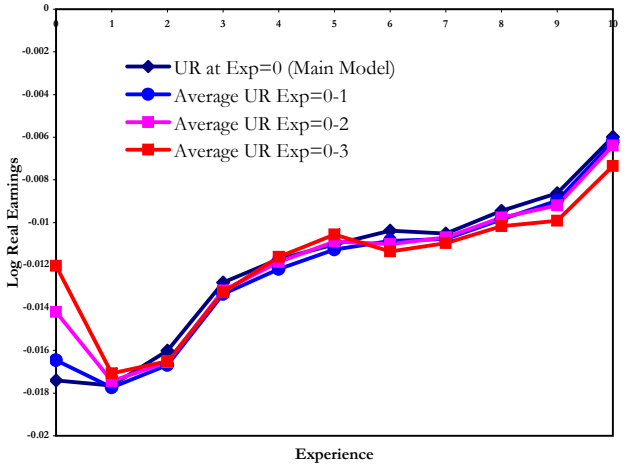
* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Figure C1: Effect of Unemployment Rate at Time of Graduation on Log Real Earnings, Alternative Models, Regional Graduate Models for Cohort 1982-1995 (Unless Otherwise Noted)**

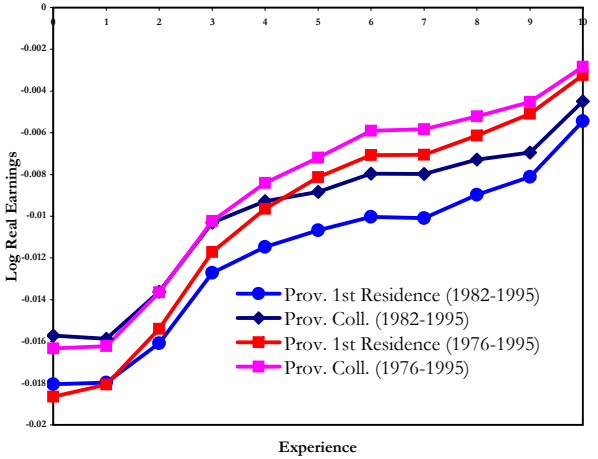
Panel A: Different Early Labor Market Conditions (2 Std.Dev. Shock)



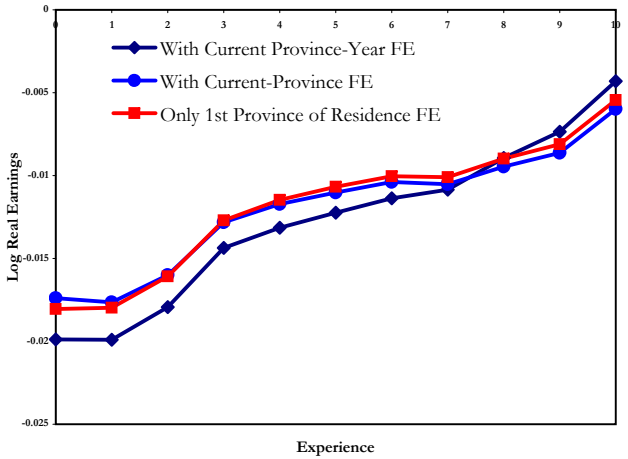

Panel B: Different Early Labor Market Horizons (Average UR)




Panel C: Shock in Region of College vs. Region of First Residence

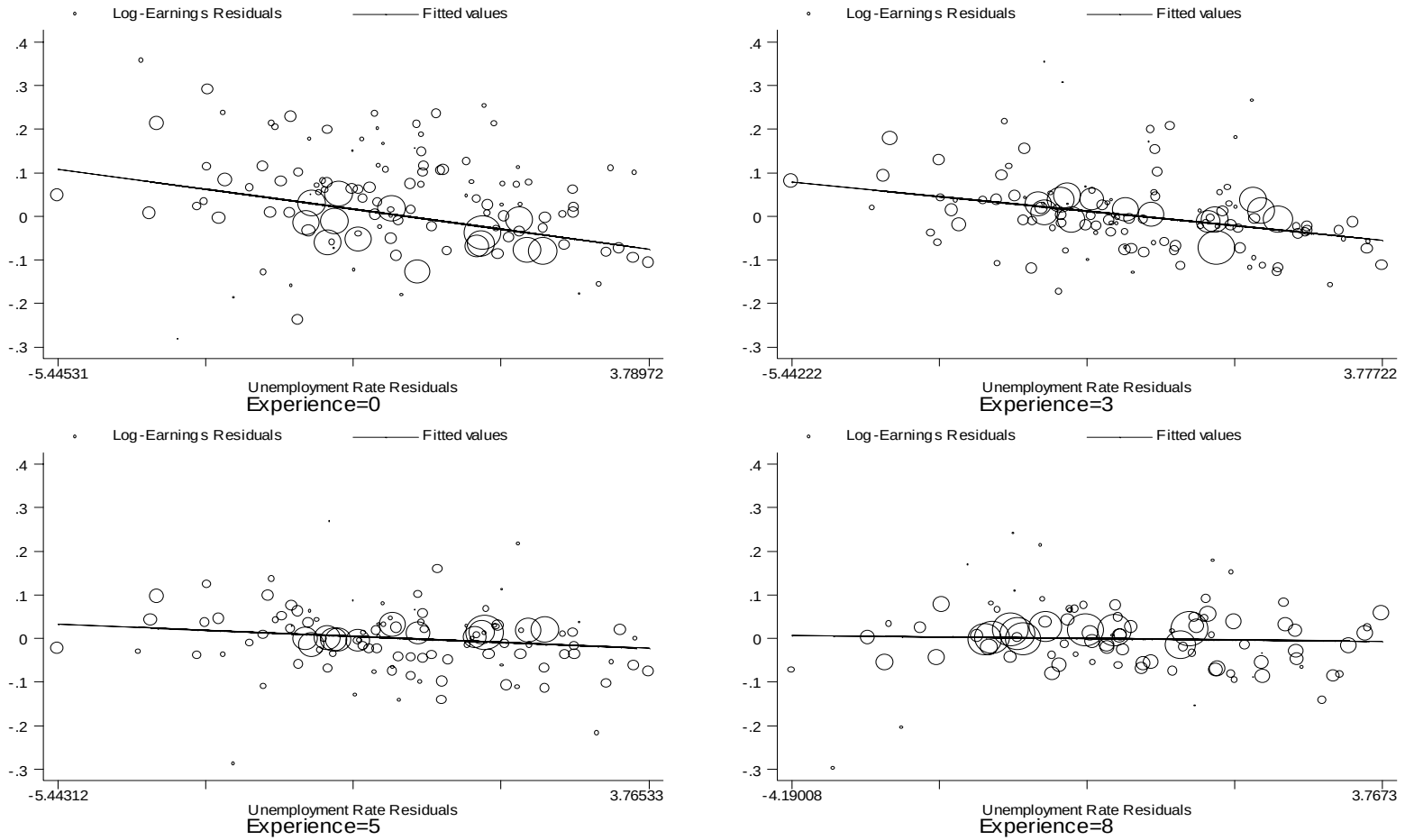



Panel D: Current Province and Current Province-Year Controls




Notes: Panel A shows the main coefficients from the basic regional regression specification using alternative measures of the state of the labor market. To make effects comparable, the figure shows the coefficients multiplied by two standard deviations of the respective measure. Panel A shows the main coefficients from a basic regional regression specification using the average unemployment rates in the first years of labor market experience. Panel C compare estimates of the effect of the regional unemployment rate in the year of graduation in the province of college attendande and the province of first residence for different cohort ranges. Panel D compares the main coefficients from the basic regional model with fixed effects for province of first residence with models when also fixed effects for either current-province or current-province-current-year are included.

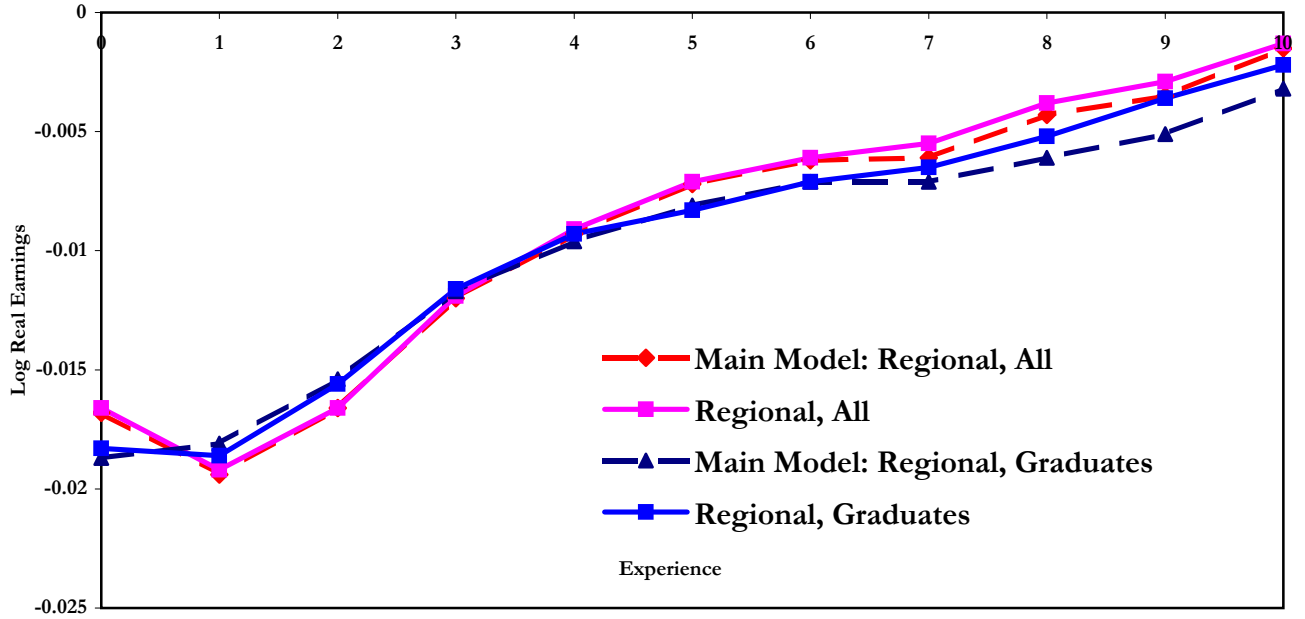
**Appendix Figure C2: Regression Residuals of Separate Regressions of Log Annual Earnings and Unemployment Rates including Fixed Effect for Current Year, First Province of Residence, and Year of Graduation, Plotted for Various Experience Years with Corresponding Line of Regression of Earnings Residuals on Unemployment Rate Residuals**



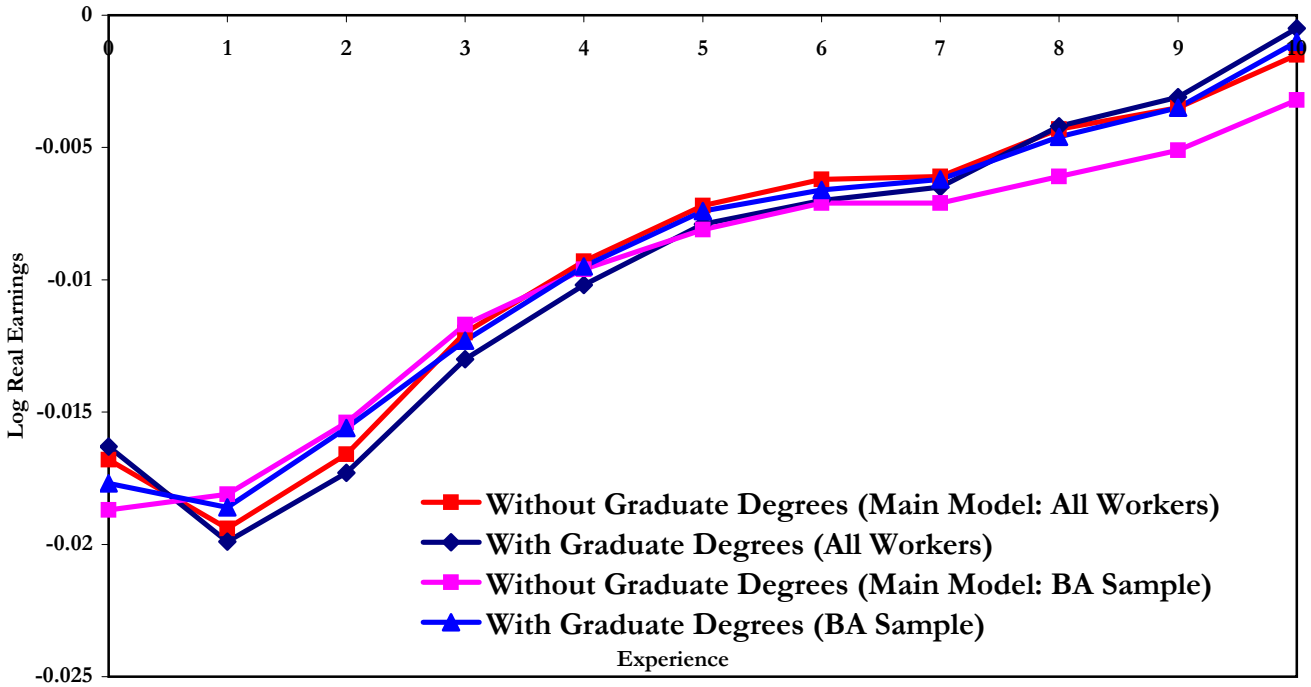

Notes: Circles correspond to cell sizes. "Fitted Residuals" refer to the predicted regression line of a regression of earnings residuals on unemployment rate residuals, weighted by cell sizes.

**Appendix Figure C3: Effect of Unemployment Rate at Time of Graduation on Log Real Earnings for Different Samples: Regional Models, Some College (All) and Graduate Sample, All Cohorts**

**Panel A: Including Workers Who Stop Filing Income Taxes (Excluded From Main Models)**




**Panel B: Estimates for Sample Including Graduate Degrees**



**Appendix Table C1: Effect of Unemployment Rate at time of Graduation on Log Real Earnings by Potential Experience for Workers with Positive Earnings Every Period (Panel Sample)**

| | 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** | -0.0212 | -0.0229 | -0.0172 | -0.0235 | -0.0234 | -0.0177 |
| | [0.0058]*** | [0.0038]*** | [0.0027]*** | [0.0042]*** | [0.0033]*** | [0.0025]*** |
| **1** | -0.0153 | -0.0167 | -0.0186 | -0.0134 | -0.0135 | -0.0156 |
| | [0.0067]** | [0.0030]*** | [0.0023]*** | [0.0060]** | [0.0027]*** | [0.0021]*** |
| **2** | -0.0106 | -0.0118 | -0.0153 | -0.0087 | -0.0093 | -0.0129 |
| | [0.0045]** | [0.0025]*** | [0.0021]*** | [0.0039]** | [0.0020]*** | [0.0019]*** |
| **3** | -0.0066 | -0.0072 | -0.0111 | -0.0031 | -0.0039 | -0.0096 |
| | [0.0034]* | [0.0022]*** | [0.0021]*** | [0.0030] | [0.0013]*** | [0.0017]*** |
| **4** | -0.0052 | -0.0049 | -0.0084 | -0.0019 | -0.0024 | -0.0079 |
| | [0.0035] | [0.0023]* | [0.0020]*** | [0.0034] | [0.0015] | [0.0016]*** |
| **5** | -0.0046 | -0.003 | -0.0059 | -0.0006 | -0.0002 | -0.0057 |
| | [0.0035] | [0.0019] | [0.0020]*** | [0.0030] | [0.0013] | [0.0017]*** |
| **6** | -0.0018 | -0.0011 | -0.006 | 0.0001 | 0.0009 | -0.0058 |
| | [0.0040] | [0.0018] | [0.0021]*** | [0.0032] | [0.0016] | [0.0018]*** |
| **7** | -0.0023 | -0.0019 | -0.006 | -0.0015 | -0.0003 | -0.0062 |
| | [0.0052] | [0.0023] | [0.0020]*** | [0.0041] | [0.0019] | [0.0018]*** |
| **8** | -0.0004 | 0 | -0.0048 | -0.0017 | 0.0002 | -0.0055 |
| | [0.0059] | [0.0028] | [0.0020]** | [0.0040] | [0.0017] | [0.0017]*** |
| **9** | 0.0034 | 0.0034 | -0.0045 | 0.0014 | 0.0034 | -0.0052 |
| | [0.0060] | [0.0027] | [0.0020]** | [0.0042] | [0.0017]* | [0.0018]*** |
| **10** | 0.0071 | 0.0041 | -0.0035 | 0.005 | 0.0048 | -0.004 |
| | [0.0070] | [0.0027] | [0.0020]* | [0.0049] | [0.0021]** | [0.0018]** |
| **Constant** | 7.1728 | -7.4295 | 8.8027 | 7.4451 | -5.1739 | 8.9846 |
| | [0.3142]*** | [2.2783]*** | [0.0966]*** | [0.2565]*** | [0.7255]*** | [0.0675]*** |
| **N** | 43728 | 43728 | 43728 | 26084 | 26084 | 26084 |
| **R-squared** | 0.74 | 0.75 | 0.78 | 0.89 | 0.89 | 0.91 |

Notes: Robust standard errors in brackets. See notes to Table 1 for information on regression specification. See also discussion and notes of Figure 5.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table C2: Effect of Unemployment Rate at time of Graduation on Log Real Earnings by Potential Experience - Including Workers that Permanently Stop Filing Income Taxes**

| | 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** | -0.0195 | -0.0211 | -0.0166 | -0.022 | -0.0223 | -0.0183 |
| | [0.0045]*** | [0.0037]*** | [0.0026]*** | [0.0035]*** | [0.0036]*** | [0.0023]*** |
| **1** | -0.0168 | -0.0181 | -0.0192 | -0.0169 | -0.0171 | -0.0186 |
| | [0.0049]*** | [0.0027]*** | [0.0024]*** | [0.0047]*** | [0.0026]*** | [0.0021]*** |
| **2** | -0.0132 | -0.0141 | -0.0166 | -0.0121 | -0.0125 | -0.0156 |
| | [0.0032]*** | [0.0024]*** | [0.0022]*** | [0.0029]*** | [0.0018]*** | [0.0020]*** |
| **3** | -0.0085 | -0.009 | -0.0119 | -0.0061 | -0.0066 | -0.0116 |
| | [0.0023]*** | [0.0021]*** | [0.0021]*** | [0.0023]** | [0.0015]*** | [0.0018]*** |
| **4** | -0.0063 | -0.0062 | -0.0091 | -0.0037 | -0.004 | -0.0093 |
| | [0.0026]** | [0.0025]** | [0.0019]*** | [0.0029] | [0.0018]** | [0.0017]*** |
| **5** | -0.0069 | -0.0058 | -0.0071 | -0.0044 | -0.0041 | -0.0083 |
| | [0.0030]** | [0.0020]*** | [0.0019]*** | [0.0027] | [0.0016]** | [0.0017]*** |
| **6** | -0.0027 | -0.0023 | -0.0061 | -0.0028 | -0.0022 | -0.0071 |
| | [0.0032] | [0.0019] | [0.0020]*** | [0.0026] | [0.0017] | [0.0018]*** |
| **7** | -0.0022 | -0.0019 | -0.0055 | -0.0019 | -0.001 | -0.0065 |
| | [0.0041] | [0.0022] | [0.0020]*** | [0.0031] | [0.0014] | [0.0018]*** |
| **8** | 0.0008 | 0.0009 | -0.0038 | -0.0001 | 0.0011 | -0.0052 |
| | [0.0049] | [0.0027] | [0.0020]* | [0.0033] | [0.0014] | [0.0018]*** |
| **9** | 0.0044 | 0.0041 | -0.0029 | 0.0031 | 0.0042 | -0.0036 |
| | [0.0049] | [0.0028] | [0.0020] | [0.0034] | [0.0018]** | [0.0018]** |
| **10** | 0.0073 | 0.005 | -0.0013 | 0.0054 | 0.005 | -0.0022 |
| | [0.0049] | [0.0029]* | [0.0020] | [0.0034] | [0.0022]** | [0.0018] |
| **Constant** | 7.0909 | -3.9354 | 8.7626 | 7.4203 | -2.112 | 9.0364 |
| | [0.2579]*** | [2.3657] | [0.1041]*** | [0.2068]*** | [0.7413]** | [0.0661]*** |
| **N** | 14645 | 14645 | 14645 | 1731 | 1731 | 1731 |
| **R-squared** | 0.76 | 0.76 | 0.79 | 0.97 | 0.97 | 0.99 |

Notes: Robust standard errors in brackets. See notes to Table 1 for information on regression specification. See also Appendix Figure C3, Panel A.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table C3: Effect of Unemployment Rate at time of Graduation on Log Real Earnings by Potential Experience Including Workers With Post-Graduate Degrees**

| | Specification | | | |
|---|---|---|---|---|
| **National/Regional** | **Regional** | **Regional** | **Regional** | **Regional** |
| **With Graduates** | **No** | **Yes** | **No** | **Yes** |
| **D>=0?** | **No** | **No** | **Yes** | **Yes** |
| | **(1)** | **(2)** | **(3)** | **(4)** |
| **Experience Year** | | | | |
| **0** | -0.0168 | -0.0163 | -0.0187 | -0.0177 |
| | [0.0026]*** | [0.0025]*** | [0.0024]*** | [0.0023]*** |
| **1** | -0.0194 | -0.0199 | -0.0181 | -0.0186 |
| | [0.0024]*** | [0.0024]*** | [0.0021]*** | [0.0022]*** |
| **2** | -0.0166 | -0.0173 | -0.0154 | -0.0156 |
| | [0.0022]*** | [0.0021]*** | [0.0019]*** | [0.0021]*** |
| **3** | -0.012 | -0.013 | -0.0117 | -0.0123 |
| | [0.0021]*** | [0.0019]*** | [0.0017]*** | [0.0020]*** |
| **4** | -0.0093 | -0.0102 | -0.0096 | -0.0095 |
| | [0.0020]*** | [0.0018]*** | [0.0016]*** | [0.0018]*** |
| **5** | -0.0072 | -0.0079 | -0.0081 | -0.0074 |
| | [0.0019]*** | [0.0017]*** | [0.0016]*** | [0.0016]*** |
| **6** | -0.0062 | -0.007 | -0.0071 | -0.0066 |
| | [0.0020]*** | [0.0019]*** | [0.0017]*** | [0.0018]*** |
| **7** | -0.0061 | -0.0065 | -0.0071 | -0.0062 |
| | [0.0020]*** | [0.0018]*** | [0.0017]*** | [0.0017]*** |
| **8** | -0.0043 | -0.0042 | -0.0061 | -0.0046 |
| | [0.0019]** | [0.0017]** | [0.0017]*** | [0.0015]*** |
| **9** | -0.0035 | -0.0031 | -0.0051 | -0.0035 |
| | [0.0019]* | [0.0018]* | [0.0017]*** | [0.0016]** |
| **10** | -0.0015 | -0.0005 | -0.0032 | -0.001 |
| | [0.0020] | [0.0019] | [0.0017]* | [0.0017] |
| **Constant** | 8.8017 | 8.7677 | 9.0456 | 9.0136 |
| | [0.1012]*** | [0.1024]*** | [0.0668]*** | [0.0649]*** |
| **N** | 14407 | 26219 | 8679 | 15941 |
| **R-squared** | 0.8 | 0.76 | 0.95 | 0.82 |

Notes: Robust standard errors in brackets. See notes to Table 1 for information on regression specification. See also Appendix Figure C3, Panel B.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table C4: Effect of Unemployment Rate at time of Graduation on Log Real Earnings by Potential Experience -- Different Graduation Cohorts**

| | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area** | **National** | | | | **Regional** | | | |
| **Trend** | **Quadratic** | | | | **N.A.** | | | |
| **D>=0?** | **Yes** | | | | **Yes** | | | |
| **Cohorts** | **1978-1995** | **1982-1995** | **1978-1992** | **1982-1992** | **1978-1995** | **1982-1995** | **1978-1992** | **1982-1992** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** |
| **Experience Year** | | | | | | | | |
| **0** | -0.0212 | -0.0497 | -0.0245 | -0.0164 | -0.0174 | -0.0177 | -0.0181 | -0.0157 |
| | [0.0036]*** | [0.0069]*** | [0.0034]*** | [0.0025]*** | [0.0032]*** | [0.0045]*** | [0.0024]*** | [0.0026]*** |
| **1** | -0.0127 | -0.0277 | -0.0163 | -0.0168 | -0.0164 | -0.0203 | -0.0164 | -0.0188 |
| | [0.0031]*** | [0.0020]*** | [0.0023]*** | [0.0026]*** | [0.0028]*** | [0.0040]*** | [0.0023]*** | [0.0023]*** |
| **2** | -0.0094 | -0.0179 | -0.0115 | -0.0113 | -0.0151 | -0.0188 | -0.0142 | -0.0164 |
| | [0.0032]** | [0.0030]*** | [0.0022]*** | [0.0027]*** | [0.0022]*** | [0.0029]*** | [0.0020]*** | [0.0022]*** |
| **3** | -0.0054 | -0.0103 | -0.0067 | -0.0071 | -0.0127 | -0.0141 | -0.0115 | -0.0134 |
| | [0.0025]* | [0.0024]*** | [0.0015]*** | [0.0020]*** | [0.0019]*** | [0.0026]*** | [0.0018]*** | [0.0021]*** |
| **4** | -0.005 | -0.0069 | -0.0054 | -0.0053 | -0.0124 | -0.0118 | -0.0103 | -0.0117 |
| | [0.0032] | [0.0021]** | [0.0019]** | [0.0033] | [0.0017]*** | [0.0023]*** | [0.0016]*** | [0.0021]*** |
| **5** | -0.0045 | -0.0069 | -0.0049 | -0.0037 | -0.0117 | -0.009 | -0.0089 | -0.0104 |
| | [0.0026] | [0.0018]*** | [0.0015]*** | [0.0029] | [0.0016]*** | [0.0022]*** | [0.0015]*** | [0.0020]*** |
| **6** | -0.0024 | -0.0052 | -0.0021 | 0.0002 | -0.0111 | -0.0081 | -0.0078 | -0.0089 |
| | [0.0031] | [0.0015]*** | [0.0022] | [0.0026] | [0.0017]*** | [0.0023]*** | [0.0016]*** | [0.0021]*** |
| **7** | -0.001 | -0.003 | -0.0009 | 0.0002 | -0.0106 | -0.0074 | -0.0074 | -0.0092 |
| | [0.0028] | [0.0014]* | [0.0020] | [0.0023] | [0.0017]*** | [0.0022]*** | [0.0016]*** | [0.0021]*** |
| **8** | 0.0016 | -0.0039 | 0.0003 | 0.0003 | -0.0096 | -0.0059 | -0.0065 | -0.0097 |
| | [0.0027] | [0.0019]* | [0.0015] | [0.0026] | [0.0018]*** | [0.0022]*** | [0.0016]*** | [0.0021]*** |
| **9** | 0.0054 | -0.0028 | 0.0032 | 0.002 | -0.0088 | -0.0046 | -0.0054 | -0.0104 |
| | [0.0025]* | [0.0015]* | [0.0018] | [0.0023] | [0.0020]*** | [0.0023]** | [0.0017]*** | [0.0021]*** |
| **10** | 0.0079 | -0.0026 | 0.0045 | 0.0057 | -0.0062 | -0.0038 | -0.0036 | -0.0073 |
| | [0.0026]** | [0.0011]** | [0.0023]* | [0.0029]* | [0.0022]*** | [0.0025] | [0.0017]** | [0.0020]*** |
| **Constant** | -5.0063 | -7.7747 | -3.3741 | 1.2771 | 9.2186 | 8.7422 | 8.8482 | 9.3224 |
| | [3.5595] | [4.2340]* | [1.4871]** | [2.9338] | [0.1125]*** | [0.1251]*** | [0.0782]*** | [0.0666]*** |
| **N** | 1150 | 841 | 1551 | 1110 | 1150 | 841 | 1551 | 1110 |
| **R-squared** | 0.97 | 0.97 | 0.97 | 0.97 | 0.99 | 0.99 | 0.99 | 0.99 |

Notes: Robust standard errors in brackets. See notes to Table 1 for information on regression specification. See also discussion and notes of Figure 5.

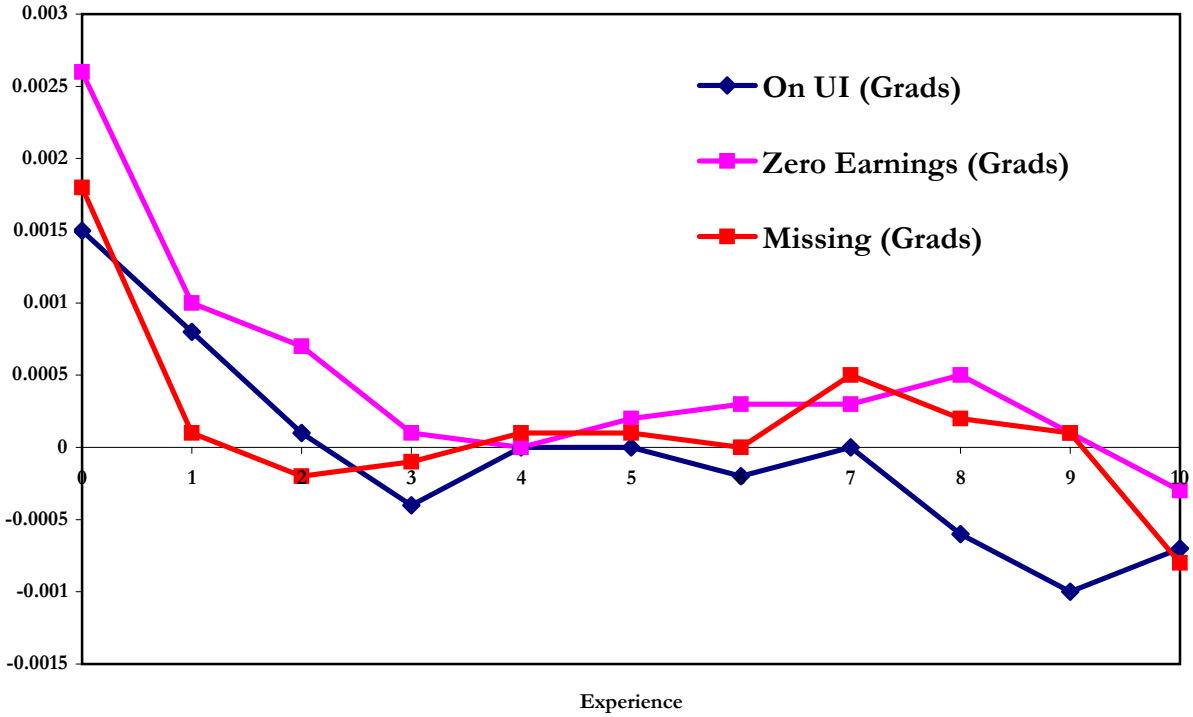
* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table C5: Effect of UR at Time of Predicted Graduation on Log Weekly Wages and Log Weeks, Canadian Census 1981,9186,1991,1996**

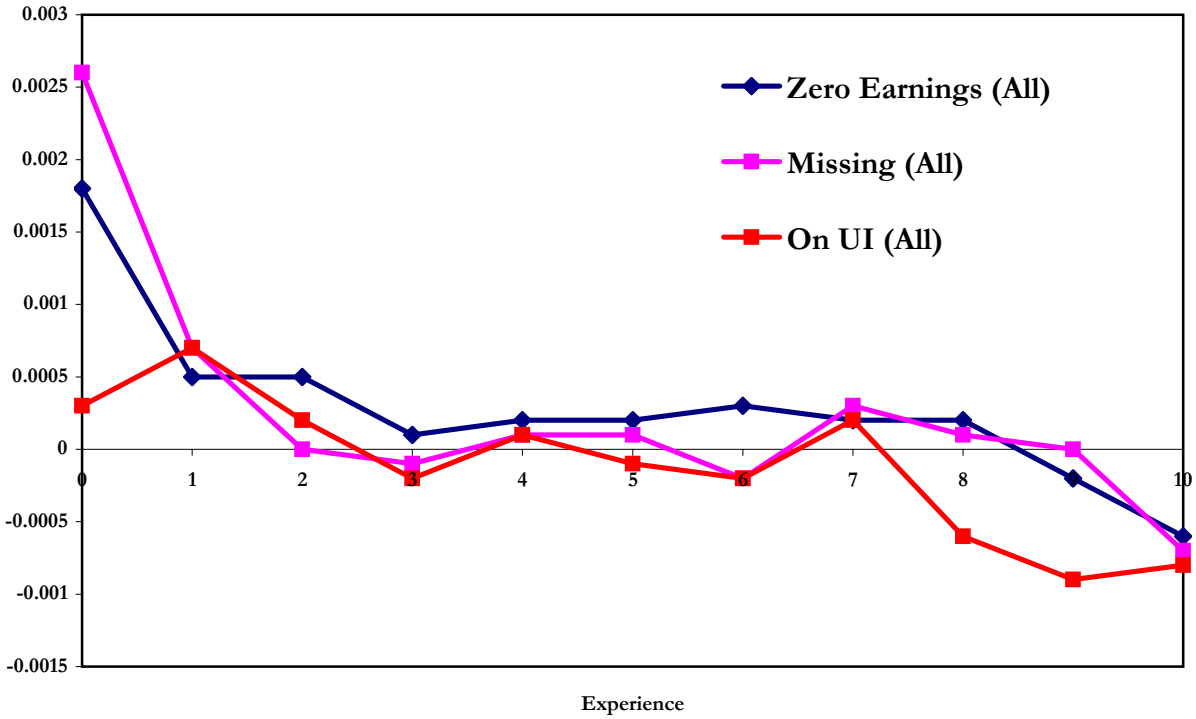
| | Without Current Year FE | | | With Current Year FE | | |
|---|---|---|---|---|---|---|
| **Exp. Year** | **Log Earn** | **Log Weekly Earn** | **Log Weeks** | **Log Earn** | **Log Weekly Earn** | **Log Weeks** |
| 0 | -0.013 | -0.009 | -0.004 | -0.011 | -0.002 | -0.010 |
| | (0.0084) | (0.0073) | (0.0026) | (0.0076) | (0.0074) | (0.0035) |
| 1 | -0.013 | -0.009 | -0.005 | -0.011 | -0.005 | -0.005 |
| | (0.0086) | (0.0048) | (0.0049) | (0.0095) | (0.0058) | (0.0057) |
| 2 | -0.012 | -0.006 | -0.006 | -0.012 | -0.005 | -0.007 |
| | (0.0060) | (0.0039) | (0.0031) | (0.0068) | (0.0037) | (0.0044) |
| 3 | -0.010 | -0.008 | -0.003 | -0.009 | -0.004 | -0.005 |
| | (0.0046) | (0.0033) | (0.0025) | (0.0054) | (0.0037) | (0.0029) |
| 4 | -0.012 | -0.010 | -0.002 | -0.014 | -0.008 | -0.006 |
| | (0.0046) | (0.0037) | (0.0020) | (0.0048) | (0.0036) | (0.0025) |
| 5 | -0.009 | -0.008 | -0.001 | -0.011 | -0.005 | -0.006 |
| | (0.0055) | (0.0042) | (0.0026) | (0.0047) | (0.0037) | (0.0029) |
| 6 | -0.007 | -0.007 | 0.000 | -0.012 | -0.006 | -0.005 |
| | (0.0061) | (0.0043) | (0.0038) | (0.0065) | (0.0038) | (0.0047) |
| 7 | -0.011 | -0.008 | -0.003 | -0.010 | -0.002 | -0.008 |
| | (0.0053) | (0.0040) | (0.0024) | (0.0062) | (0.0041) | (0.0034) |
| 8 | -0.005 | -0.008 | 0.003 | -0.003 | -0.003 | -0.001 |
| | (0.0048) | (0.0039) | (0.0026) | (0.0059) | (0.0044) | (0.0030) |
| 9 | -0.006 | -0.007 | 0.002 | -0.006 | -0.002 | -0.004 |
| | (0.0045) | (0.0033) | (0.0020) | (0.0050) | (0.0032) | (0.0024) |
| 10 | 0.002 | -0.001 | 0.002 | 0.006 | 0.008 | -0.002 |
| | (0.0052) | (0.0037) | (0.0023) | (0.0065) | (0.0045) | (0.0030) |

Notes: Replication of main estimates using Census data, see Sensitivity Appendix D.

**Appendix Figure D1 (A): Effect of Unemployment Rate at Time of Graduation on Zero Earnings, on UI, and Missing - National Models, Cohorts 1976-1995**



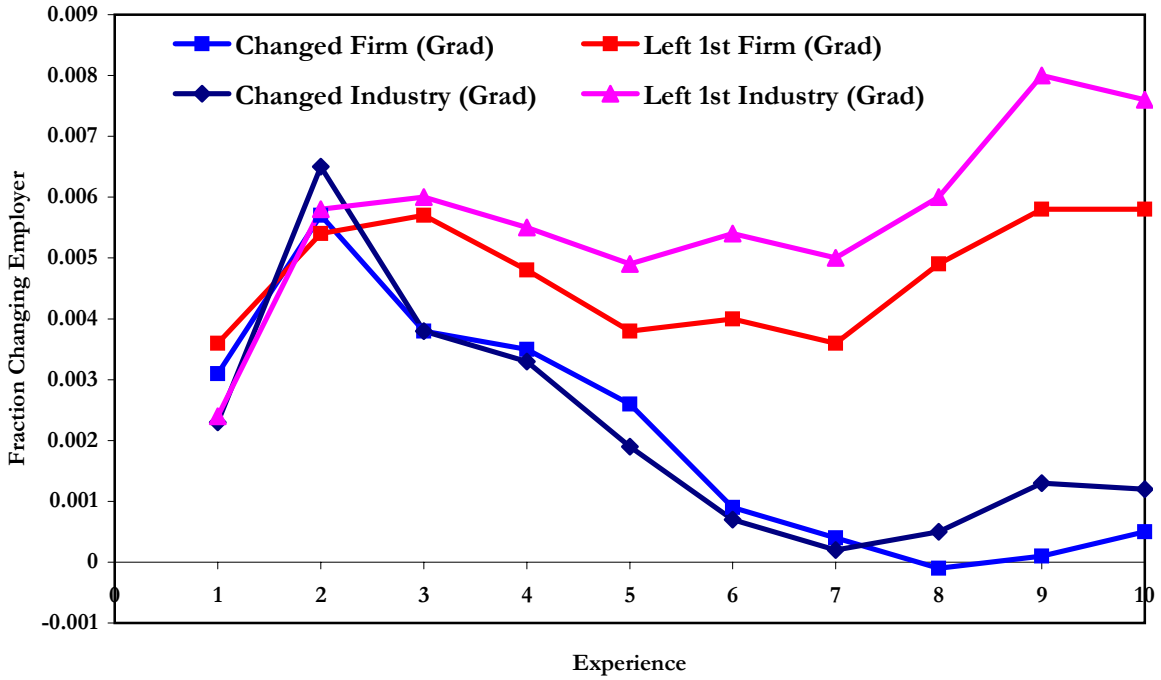

**Appendix Figure D1 (B): Effect of Unemployment Rate at Time of Graduation on Provincial Mobility - Regional Models, Full Sample, Cohorts 1976-1995**



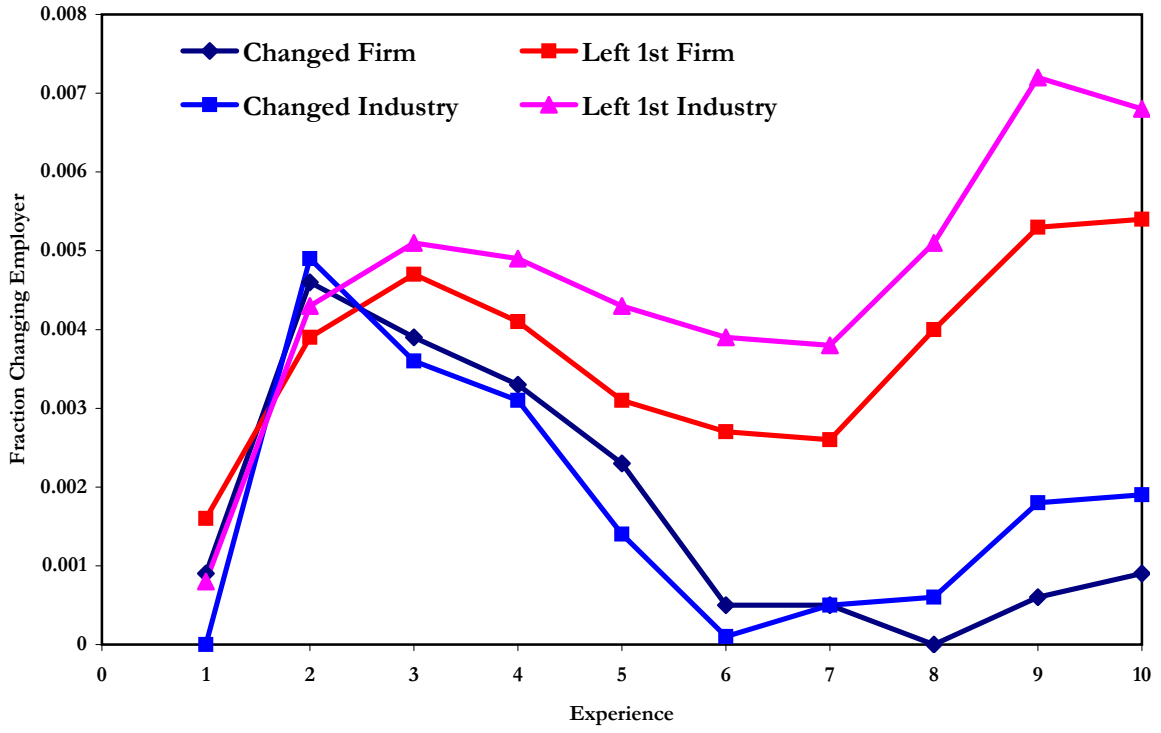

Notes: See text and notes to Figure 4.

**Appendix Figure D2: Effect of Unemployment Rate at Time of Graduation on Job and Insutry Mobility: National Models, Cohorts 1976-1995**

**Panel A: Graduate Sample**

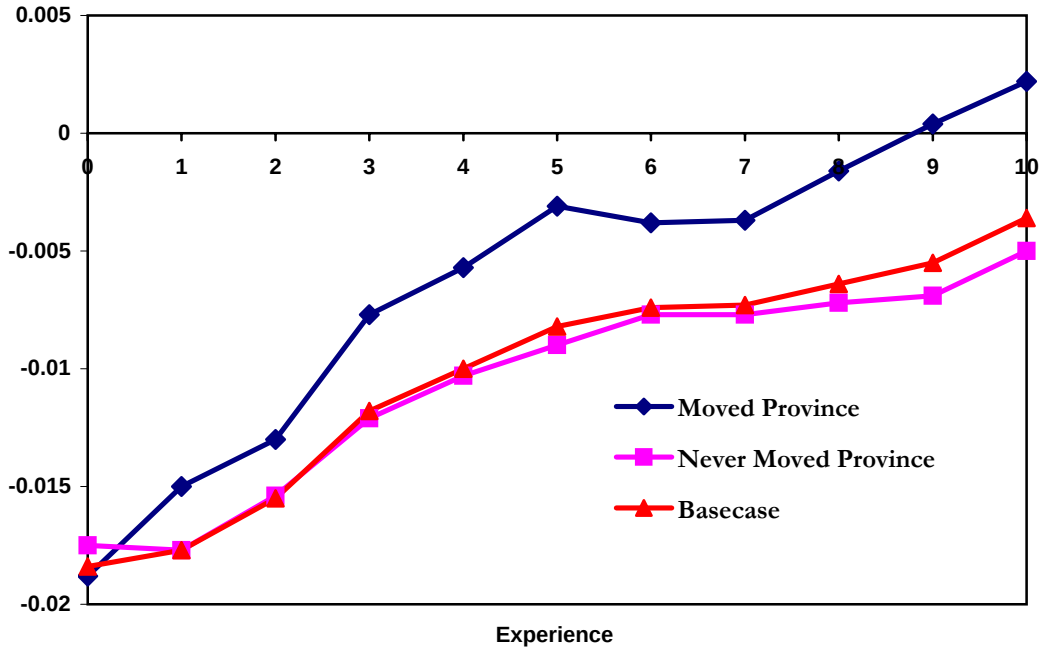



**Panel B: Full Sample of Workers**




Notes: See text and notes to Figure 4.

**Appendix Figure D3: Effects of Initial Unemployment Rates on Earnings For Workers Who Moved Province at Least Once and Those Who Never Moved**




Notes: See notes of Table 1 for regression specification.

**Appendix Table D1: Effect of Unemployment Rate at time of Graduation on Labor Force Participation (All Workers with Some College vs. Graduate Sample)**

| | Specification | | | | | |
|---|---|---|---|---|---|---|
| **Area** | **Regional** | | | **Regional** | | |
| **D>=0?** | **No** | | | **Yes** | | |
| **Outcome** | **Fraction Zero Earnings** | **Fraction Not in Sample** | **Fraction on UI** | **Fraction Zero Earnings** | **Fraction Not in Sample** | **Fraction on UI** |
| | **(1)** | **(2)** | **(3)** | **(5)** | **(6)** | **(7)** |
| **Experience Year** | | | | | | |
| **0** | 0.0003 | 0.0018 | 0.0002 | 0.0008 | 0.0014 | 0.0017 |
| | [0.0001]*** | [0.0006]*** | [0.0003] | [0.0001]*** | [0.0005]*** | [0.0003]*** |
| **1** | 0.0003 | 0.0005 | 0.0011 | 0.0003 | 0.0002 | 0.0011 |
| | [0.0001]*** | [0.0004] | [0.0002]*** | [0.0001]*** | [0.0003] | [0.0002]*** |
| **2** | 0.0003 | -0.0003 | 0.0011 | 0.0002 | -0.0001 | 0.0009 |
| | [0.0001]*** | [0.0003] | [0.0003]*** | [0.0001]** | [0.0003] | [0.0002]*** |
| **3** | 0 | -0.0003 | 0.0003 | -0.0001 | 0 | 0 |
| | [0.0001] | [0.0003] | [0.0003] | [0.0001] | [0.0003] | [0.0002] |
| **4** | 0 | -0.0005 | 0.0002 | 0 | 0.0001 | 0.0002 |
| | [0.0001] | [0.0003]* | [0.0002] | [0.0001] | [0.0002] | [0.0001] |
| **5** | -0.0001 | -0.0006 | -0.0003 | 0 | -0.0001 | -0.0001 |
| | [0.0001] | [0.0003]** | [0.0002]* | [0.0001] | [0.0003] | [0.0002] |
| **6** | 0 | -0.001 | -0.0004 | 0 | -0.0005 | -0.0002 |
| | [0.0001] | [0.0002]*** | [0.0002]** | [0.0001] | [0.0003]* | [0.0002] |
| **7** | 0 | -0.0007 | -0.0003 | 0 | -0.0002 | -0.0002 |
| | [0.0001] | [0.0002]*** | [0.0002]* | [0.0001] | [0.0002] | [0.0002] |
| **8** | -0.0001 | -0.0006 | -0.0007 | 0 | -0.0002 | -0.0005 |
| | [0.0001]** | [0.0003]** | [0.0002]*** | [0.0001] | [0.0003] | [0.0002]*** |
| **9** | -0.0003 | -0.0008 | -0.001 | -0.0002 | -0.0004 | -0.0007 |
| | [0.0001]*** | [0.0002]*** | [0.0002]*** | [0.0001]*** | [0.0002]* | [0.0002]*** |
| **10** | -0.0001 | -0.0011 | -0.001 | 0 | -0.0008 | -0.0005 |
| | [0.0001]** | [0.0003]*** | [0.0002]*** | [0.0001] | [0.0003]*** | [0.0002]*** |
| **Constant** | 0.0054 | 0.0334 | 0.0645 | -0.0032 | 0.0227 | 0.0162 |
| | [0.0022]** | [0.0121]*** | [0.0093]*** | [0.0025] | [0.0118]* | [0.0072]** |
| **N** | 14407 | 14407 | 14407 | 8679 | 8679 | 8679 |
| **$R^2$** | 0.16 | 0.35 | 0.31 | 0.2 | 0.39 | 0.34 |

Notes: Robust standard errors in brackets. See text and notes to Table 3 for information on regression specification.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table D2: Effect of Unemployment Rate at time of Graduation on Job and Industry Mobility (All Workers with Some College vs. Graduate Sample)**

| | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area** | **Regional** | | | | **Regional** | | | |
| **D>=0?** | **No** | | | | **Yes** | | | |
| **Outcome** | **Fraction Changed Firm** | **Fraction Changed Industry** | **Fraction Left First Firm** | **Fraction Left First Industry** | **Fraction Changed Firm** | **Fraction Changed Industry** | **Fraction Left First Firm** | **Fraction Left First Industry** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** |
| **Experience Year** | | | | | | | | |
| **0** | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - |
| **1** | 0.0013 | 0.0007 | 0.0014 | 0.0005 | 0.0029 | 0.0021 | 0.0038 | 0.0025 |
| | [0.0007]* | [0.0007] | [0.0009] | [0.0010] | [0.0008]*** | [0.0007]*** | [0.0010]*** | [0.0011]** |
| **2** | 0.0029 | 0.003 | 0.0029 | 0.0026 | 0.0031 | 0.0034 | 0.0046 | 0.0041 |
| | [0.0007]*** | [0.0007]*** | [0.0010]*** | [0.0010]** | [0.0007]*** | [0.0006]*** | [0.0011]*** | [0.0011]*** |
| **3** | 0.0022 | 0.0022 | 0.0035 | 0.0035 | 0.0021 | 0.0023 | 0.0049 | 0.0045 |
| | [0.0007]*** | [0.0006]*** | [0.0008]*** | [0.0009]*** | [0.0007]*** | [0.0006]*** | [0.0009]*** | [0.0009]*** |
| **4** | 0.0018 | 0.0015 | 0.0039 | 0.0037 | 0.0018 | 0.0015 | 0.0052 | 0.0046 |
| | [0.0007]** | [0.0007]** | [0.0008]*** | [0.0009]*** | [0.0006]*** | [0.0006]** | [0.0009]*** | [0.0009]*** |
| **5** | 0.0017 | 0.0014 | 0.0031 | 0.0032 | 0.0022 | 0.0019 | 0.0043 | 0.0039 |
| | [0.0007]** | [0.0006]** | [0.0009]*** | [0.0010]*** | [0.0005]*** | [0.0005]*** | [0.0010]*** | [0.0010]*** |
| **6** | 0.0009 | 0.0005 | 0.0029 | 0.003 | 0.0015 | 0.0011 | 0.0043 | 0.004 |
| | [0.0006] | [0.0006] | [0.0009]*** | [0.0009]*** | [0.0005]*** | [0.0005]** | [0.0010]*** | [0.0010]*** |
| **7** | 0.0012 | 0.0014 | 0.0027 | 0.0029 | 0.0018 | 0.002 | 0.0041 | 0.0039 |
| | [0.0007]* | [0.0007]** | [0.0009]*** | [0.0010]*** | [0.0006]*** | [0.0006]*** | [0.0011]*** | [0.0010]*** |
| **8** | 0.0012 | 0.0012 | 0.0029 | 0.0032 | 0.0018 | 0.002 | 0.0044 | 0.0042 |
| | [0.0009] | [0.0008] | [0.0010]*** | [0.0009]*** | [0.0008]** | [0.0007]*** | [0.0011]*** | [0.0010]*** |
| **9** | 0.0015 | 0.0016 | 0.0033 | 0.0039 | 0.0016 | 0.002 | 0.0047 | 0.0052 |
| | [0.0011] | [0.0010] | [0.0009]*** | [0.0009]*** | [0.0010] | [0.0009]** | [0.0010]*** | [0.0010]*** |
| **10** | 0.001 | 0.001 | 0.0036 | 0.0041 | 0.0013 | 0.0015 | 0.005 | 0.0055 |
| | [0.0011] | [0.0010] | [0.0009]*** | [0.0010]*** | [0.0011] | [0.0011] | [0.0010]*** | [0.0010]*** |
| **Constant** | 0.1485 | 0.1116 | 0.6686 | 0.5978 | 0.3407 | 0.3151 | 0.1391 | 0.523 |
| | [0.0269]*** | [0.0254]*** | [0.0357]*** | [0.0357]*** | [0.0184]*** | [0.0187]*** | [0.0428]*** | [0.0403]*** |
| **N** | 9629 | 9629 | 9611 | 9606 | 5871 | 5871 | 5863 | 5861 |
| **$R^2$** | 0.69 | 0.68 | 0.8 | 0.68 | 0.8 | 0.79 | 0.86 | 0.77 |

Notes: Robust standard errors in brackets. See text and notes to Table 5 for information on regression specification.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table D3: Effect of Unemployment Rate at time of Graduation on Labor Force Participation, National Model**

| | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area** | **National** | | | | **National** | | | |
| **D>=0?** | **No** | | | | **Yes** | | | |
| **Outcome** | **Fraction Zero Earnings** | **Fraction Not in Sample** | **Fraction on UI** | **Father's Income** | **Fraction Zero Earnings** | **Fraction Not in Sample** | **Fraction on UI** | **Father's Income** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** |
| **Experience Year** | | | | | | | | |
| **0** | 0.0018 | 0.0026 | 0.0003 | -0.0016 | 0.0026 | 0.0018 | 0.0015 | -0.0049 |
| | [0.0006]*** | [0.0006]*** | [0.0006] | [0.0038] | [0.0005]*** | [0.0005]*** | [0.0006]** | [0.0060] |
| **1** | 0.0005 | 0.0007 | 0.0007 | -0.003 | 0.001 | 0.0001 | 0.0008 | -0.0044 |
| | [0.0005] | [0.0003]** | [0.0003]** | [0.0042] | [0.0005]* | [0.0003] | [0.0003]*** | [0.0059] |
| **2** | 0.0005 | 0 | 0.0002 | -0.0047 | 0.0007 | -0.0002 | 0.0001 | -0.0058 |
| | [0.0004] | [0.0002] | [0.0003] | [0.0048] | [0.0004] | [0.0003] | [0.0003] | [0.0067] |
| **3** | 0.0001 | -0.0001 | -0.0002 | -0.0035 | 0.0001 | -0.0001 | -0.0004 | -0.0057 |
| | [0.0005] | [0.0002] | [0.0003] | [0.0050] | [0.0004] | [0.0003] | [0.0003] | [0.0069] |
| **4** | 0.0002 | 0.0001 | 0.0001 | -0.003 | 0 | 0.0001 | 0 | -0.0051 |
| | [0.0004] | [0.0003] | [0.0002] | [0.0049] | [0.0004] | [0.0004] | [0.0002] | [0.0070] |
| **5** | 0.0002 | 0.0001 | -0.0001 | -0.0028 | 0.0002 | 0.0001 | 0 | -0.0039 |
| | [0.0005] | [0.0003] | [0.0002] | [0.0047] | [0.0005] | [0.0003] | [0.0002] | [0.0070] |
| **6** | 0.0003 | -0.0002 | -0.0002 | -0.0026 | 0.0003 | 0 | -0.0002 | -0.0034 |
| | [0.0004] | [0.0002] | [0.0002] | [0.0047] | [0.0004] | [0.0003] | [0.0002] | [0.0069] |
| **7** | 0.0002 | 0.0003 | 0.0002 | -0.0032 | 0.0003 | 0.0005 | 0 | -0.004 |
| | [0.0005] | [0.0002] | [0.0003] | [0.0049] | [0.0004] | [0.0003]* | [0.0002] | [0.0072] |
| **8** | 0.0002 | 0.0001 | -0.0006 | -0.002 | 0.0005 | 0.0002 | -0.0006 | -0.0024 |
| | [0.0005] | [0.0003] | [0.0002]*** | [0.0051] | [0.0004] | [0.0003] | [0.0002]*** | [0.0073] |
| **9** | -0.0002 | 0 | -0.0009 | -0.001 | 0.0001 | 0.0001 | -0.001 | -0.001 |
| | [0.0005] | [0.0002] | [0.0002]*** | [0.0047] | [0.0004] | [0.0004] | [0.0002]*** | [0.0068] |
| **10** | -0.0006 | -0.0007 | -0.0008 | -0.0012 | -0.0003 | -0.0008 | -0.0007 | -0.0013 |
| | [0.0004] | [0.0002]*** | [0.0003]*** | [0.0051] | [0.0004] | [0.0002]*** | [0.0002]*** | [0.0076] |
| **Constant** | 0.1378 | 0.2133 | 0.0963 | 1.1904 | 0.1155 | 0.1942 | 0.0423 | 2.0907 |
| | [0.0148]*** | [0.0158]*** | [0.0139]*** | [0.3531]*** | [0.0139]*** | [0.0153]*** | [0.0134]*** | [0.5703]*** |
| **N** | 14989 | 14989 | 14989 | 11547 | 8989 | 8989 | 8989 | 6412 |
| **$R^2$** | 0.23 | 0.26 | 0.19 | 0.08 | 0.26 | 0.32 | 0.28 | 0.16 |

Notes: Robust standard errors in brackets. See text and notes to Table 1 for information on regression specification.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table D4: Effect of Unemployment Rate at time of Graduation on Job and Industry Mobility, National Model**

| | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area** | **National** | | | | **National** | | | |
| **D>=0?** | **No** | | | | **Yes** | | | |
| **Outcome** | **Fraction Changed Firm** | **Fraction Changed Industry** | **Fraction Left First Firm** | **Fraction Left First Industry** | **Fraction Changed Firm** | **Fraction Changed Industry** | **Fraction Left First Firm** | **Fraction Left First Industry** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** |
| **Experience Year** | | | | | | | | |
| **0** | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - |
| **1** | 0.0009 | 0 | 0.0016 | 0.0008 | 0.0031 | 0.0023 | 0.0036 | 0.0024 |
| | [0.0008] | [0.0007] | [0.0026] | [0.0021] | [0.0010]*** | [0.0009]** | [0.0027] | [0.0022] |
| **2** | 0.0046 | 0.0049 | 0.0039 | 0.0043 | 0.0057 | 0.0065 | 0.0054 | 0.0058 |
| | [0.0010]*** | [0.0010]*** | [0.0023] | [0.0021]* | [0.0011]*** | [0.0010]*** | [0.0026]* | [0.0023]** |
| **3** | 0.0039 | 0.0036 | 0.0047 | 0.0051 | 0.0038 | 0.0038 | 0.0057 | 0.006 |
| | [0.0009]*** | [0.0009]*** | [0.0017]** | [0.0016]*** | [0.0010]*** | [0.0008]*** | [0.0018]*** | [0.0017]*** |
| **4** | 0.0033 | 0.0031 | 0.0041 | 0.0049 | 0.0035 | 0.0033 | 0.0048 | 0.0055 |
| | [0.0011]** | [0.0011]** | [0.0012]*** | [0.0013]*** | [0.0009]*** | [0.0009]*** | [0.0013]*** | [0.0014]*** |
| **5** | 0.0023 | 0.0014 | 0.0031 | 0.0043 | 0.0026 | 0.0019 | 0.0038 | 0.0049 |
| | [0.0007]*** | [0.0008]* | [0.0013]** | [0.0016]** | [0.0006]*** | [0.0007]** | [0.0014]** | [0.0017]** |
| **6** | 0.0005 | 0.0001 | 0.0027 | 0.0039 | 0.0009 | 0.0007 | 0.004 | 0.0054 |
| | [0.0007] | [0.0006] | [0.0013]* | [0.0016]** | [0.0006] | [0.0005] | [0.0014]** | [0.0018]** |
| **7** | 0.0005 | 0.0005 | 0.0026 | 0.0038 | 0.0004 | 0.0002 | 0.0036 | 0.005 |
| | [0.0011] | [0.0011] | [0.0013]* | [0.0014]** | [0.0012] | [0.0012] | [0.0013]** | [0.0016]** |
| **8** | 0 | 0.0006 | 0.004 | 0.0051 | -0.0001 | 0.0005 | 0.0049 | 0.006 |
| | [0.0020] | [0.0022] | [0.0013]** | [0.0014]*** | [0.0015] | [0.0018] | [0.0012]*** | [0.0014]*** |
| **9** | 0.0006 | 0.0018 | 0.0053 | 0.0072 | 0.0001 | 0.0013 | 0.0058 | 0.008 |
| | [0.0025] | [0.0025] | [0.0018]** | [0.0019]*** | [0.0025] | [0.0023] | [0.0017]*** | [0.0017]*** |
| **10** | 0.0009 | 0.0019 | 0.0054 | 0.0068 | 0.0005 | 0.0012 | 0.0058 | 0.0076 |
| | [0.0021] | [0.0021] | [0.0013]*** | [0.0017]*** | [0.0018] | [0.0018] | [0.0013]*** | [0.0017]*** |
| **Constant** | -0.0756 | 0.0933 | 0.5615 | 0.4969 | -0.1821 | 0.0026 | 0.0905 | 0.3862 |
| | [0.0314]** | [0.0288]*** | [0.0902]*** | [0.0879]*** | [0.0358]*** | [0.0310] | [0.1250] | [0.0890]*** |
| **N** | 9854 | 9848 | 9836 | 9829 | 6025.0000 | 6023 | 6014 | 6012 |
| **$R^2$** | 0.74 | 0.74 | 0.83 | 0.72 | 0.8300 | 0.83 | 0.86 | 0.77 |

Notes: Robust standard errors in brackets. See text and notes to Table 1 for information on regression specification.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table D5: Average Wage Growth for Stayers and Movers Between Firms, Industries, and Provinces -- Regional Model, Cohorts 1982-1995**

| | | Wage Growth by Movers Status | | | | | |
|---|---|---|---|---|---|---|---|
| | Overall Earnings Growth | Gains of Job Movers | Gains of Job Stayers | Gains of Industry Movers | Gains of Industry Stayers | Gains of Province Movers | Gains of Province Stayers |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| **Experience Year** | **Panel A: All Workers** | | | | | | |
| **1** | 0.469 | 0.485 | 0.4588 | 0.4594 | 0.4589 | 0.5562 | 0.4667 |
| **2** | 0.2145 | 0.2707 | 0.1858 | 0.2861 | 0.1858 | 0.2828 | 0.2128 |
| **3** | 0.1834 | 0.2488 | 0.155 | 0.2736 | 0.1552 | 0.244 | 0.182 |
| **4** | 0.1542 | 0.2244 | 0.1272 | 0.2128 | 0.1269 | 0.1957 | 0.1533 |
| **5** | 0.1245 | 0.1922 | 0.1026 | 0.2202 | 0.1028 | 0.165 | 0.1238 |
| **6** | 0.0952 | 0.131 | 0.0853 | 0.1021 | 0.0854 | 0.1166 | 0.0948 |
| **7** | 0.0829 | 0.1216 | 0.0736 | 0.1049 | 0.0736 | 0.1089 | 0.0825 |
| **8** | 0.0646 | 0.0831 | 0.0606 | 0.0613 | 0.0606 | 0.0848 | 0.0643 |
| **9** | 0.0606 | 0.0847 | 0.0559 | 0.075 | 0.0559 | 0.0952 | 0.0602 |
| **10** | 0.0615 | 0.0962 | 0.0549 | 0.0744 | 0.0549 | 0.0823 | 0.0612 |
| **Experience Year** | **Panel B: Graduates** | | | | | | |
| **1** | 0.5571 | 0.5927 | 0.5363 | 0.5907 | 0.5364 | 0.6357 | 0.555 |
| **2** | 0.2186 | 0.2824 | 0.1908 | 0.2872 | 0.1907 | 0.278 | 0.2172 |
| **3** | 0.1614 | 0.2204 | 0.1395 | 0.2268 | 0.1395 | 0.2012 | 0.1606 |
| **4** | 0.128 | 0.1839 | 0.1099 | 0.1627 | 0.1096 | 0.1277 | 0.128 |
| **5** | 0.1051 | 0.1571 | 0.0907 | 0.1536 | 0.0908 | 0.1226 | 0.1048 |
| **6** | 0.0858 | 0.1107 | 0.0797 | 0.0744 | 0.0798 | 0.0788 | 0.0859 |
| **7** | 0.0769 | 0.1003 | 0.0719 | 0.0511 | 0.0716 | 0.0765 | 0.0769 |
| **8** | 0.0587 | 0.0716 | 0.0561 | 0.0444 | 0.0563 | 0.0714 | 0.0585 |
| **9** | 0.0578 | 0.0774 | 0.0542 | 0.0072 | 0.0541 | 0.0561 | 0.0578 |
| **10** | 0.0578 | 0.0762 | 0.0545 | 0.03 | 0.0543 | 0.0775 | 0.0575 |

Notes: See Oreopoulos et al. (2006) for discussion.

**Appendix Table D6: Effect of Unemployment Rate at time of Graduation on Gains from Job, Industry, and Regional Mobility -- Regional Model for All Workers, Cohorts 1982-1995**

| | | Marginal Effect on Wage Growth by Movers Status | | | | | |
|---|---|---|---|---|---|---|---|
| | Effect on Overall Earnings Growth | Effect on Gains of Job Movers | Effect on Gains of Job Stayers | Effect on Gains of Industry Movers | Effect on Gains of Industry Stayers | Effect on Gains of Province Movers | Effect on Gains of Province Stayers |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| **Experience Year** | | | | | | | |
| **1** | -0.0017 | 0.0011 | -0.0039 | 0.0065 | -0.0039 | 0.0115 | -0.0024 |
| | [0.0019] | [0.0027] | [0.0018]** | [0.0058] | [0.0018]** | [0.0070] | [0.0020] |
| **2** | 0.0047 | 0.0062 | 0.0034 | 0.0071 | 0.0033 | 0.0006 | 0.0047 |
| | [0.0010]*** | [0.0015]*** | [0.0011]*** | [0.0050] | [0.0010]*** | [0.0055] | [0.0010]*** |
| **3** | 0.0063 | 0.0089 | 0.0049 | 0.0153 | 0.0049 | 0.0042 | 0.0063 |
| | [0.0007]*** | [0.0015]*** | [0.0007]*** | [0.0056]*** | [0.0007]*** | [0.0053] | [0.0007]*** |
| **4** | 0.0044 | 0.006 | 0.0037 | -0.0007 | 0.0036 | -0.0076 | 0.0047 |
| | [0.0007]*** | [0.0018]*** | [0.0005]*** | [0.0061] | [0.0005]*** | [0.0058] | [0.0007]*** |
| **5** | 0.0039 | 0.007 | 0.0029 | 0.0054 | 0.0029 | -0.0037 | 0.0042 |
| | [0.0007]*** | [0.0022]*** | [0.0006]*** | [0.0054] | [0.0006]*** | [0.0054] | [0.0007]*** |
| **6** | 0.0028 | 0.0057 | 0.0021 | 0.0051 | 0.002 | -0.0181 | 0.0033 |
| | [0.0007]*** | [0.0016]*** | [0.0007]*** | [0.0056] | [0.0007]*** | [0.0058]*** | [0.0007]*** |
| **7** | 0.0026 | 0.0036 | 0.0023 | 0.0062 | 0.0022 | 0.0006 | 0.0028 |
| | [0.0008]*** | [0.0023] | [0.0006]*** | [0.0068] | [0.0006]*** | [0.0066] | [0.0008]*** |
| **8** | 0.0044 | 0.007 | 0.0035 | 0.0047 | 0.0034 | -0.0054 | 0.0046 |
| | [0.0008]*** | [0.0020]*** | [0.0006]*** | [0.0066] | [0.0006]*** | [0.0069] | [0.0008]*** |
| **9** | 0.0025 | -0.0003 | 0.0025 | -0.0095 | 0.0025 | -0.0053 | 0.0027 |
| | [0.0007]*** | [0.0023] | [0.0006]*** | [0.0066] | [0.0005]*** | [0.0092] | [0.0008]*** |
| **10** | 0.004 | 0.0052 | 0.0034 | -0.0038 | 0.0035 | -0.0052 | 0.0042 |
| | [0.0009]*** | [0.0026]** | [0.0007]*** | [0.0076] | [0.0007]*** | [0.0070] | [0.0009]*** |
| **Constant** | [0.0380]*** | [0.0512] | [0.0175]*** | [0.1588] | [0.0373]*** | [0.2047] | [0.0198]*** |
| | 39648 | 23240 | 16408 | 10654 | 18084 | 8587 | 31061 |
| **N** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **R-squared** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Notes: Robust standard errors in brackets. See Oreopoulos et al. (2006) for a discussion.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table E1: Effect of Unemployment Rate at time of Graduation on Firm Size and Firm Wages (All Workers with Some College vs. Graduate Sample)**

| | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area** | **Regional** | | | | **Regional** | | | |
| **D>=0?** | **No** | | | | **Yes** | | | |
| **Outcome** | **Log Firm Size** | **Fraction Firm Size > 1000** | **Average Median Firm Wage** | **Average Log Firm Payroll** | **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** | -0.0051 | -0.0012 | -0.0107 | -0.0135 | -0.008 | -0.0016 | -0.0097 | -0.0169 |
| | [0.0051] | [0.0008] | [0.0013]*** | [0.0058]** | [0.0050] | [0.0008]* | [0.0014]*** | [0.0058]*** |
| **1** | -0.0084 | -0.0016 | -0.0105 | -0.0186 | -0.0115 | -0.002 | -0.0096 | -0.0224 |
| | [0.0052] | [0.0008]** | [0.0011]*** | [0.0057]*** | [0.0049]** | [0.0009]** | [0.0011]*** | [0.0055]*** |
| **2** | -0.0043 | -0.0013 | -0.0074 | -0.0118 | -0.0088 | -0.002 | -0.0073 | -0.0173 |
| | [0.0050] | [0.0008]* | [0.0011]*** | [0.0055]** | [0.0050]* | [0.0008]** | [0.0011]*** | [0.0056]*** |
| **3** | 0.0013 | -0.0004 | -0.0057 | -0.0047 | -0.0034 | -0.0012 | -0.0057 | -0.0107 |
| | [0.0047] | [0.0008] | [0.0010]*** | [0.0051] | [0.0047] | [0.0008] | [0.0010]*** | [0.0052]** |
| **4** | 0.0025 | -0.0003 | -0.004 | -0.0015 | -0.0022 | -0.0009 | -0.0044 | -0.008 |
| | [0.0048] | [0.0008] | [0.0010]*** | [0.0052] | [0.0048] | [0.0008] | [0.0011]*** | [0.0054] |
| **5** | 0.0061 | 0 | -0.0032 | 0.0034 | 0.0025 | -0.0003 | -0.0039 | -0.0023 |
| | [0.0048] | [0.0008] | [0.0010]*** | [0.0053] | [0.0051] | [0.0009] | [0.0012]*** | [0.0057] |
| **6** | 0.0048 | -0.0002 | -0.0039 | 0.0011 | 0.0014 | -0.0005 | -0.0049 | -0.0046 |
| | [0.0047] | [0.0008] | [0.0011]*** | [0.0052] | [0.0050] | [0.0009] | [0.0012]*** | [0.0056] |
| **7** | 0.005 | -0.0002 | -0.0039 | 0.0014 | 0.0013 | -0.0007 | -0.005 | -0.0047 |
| | [0.0050] | [0.0008] | [0.0011]*** | [0.0055] | [0.0054] | [0.0009] | [0.0012]*** | [0.0060] |
| **8** | 0.008 | 0.0002 | -0.0029 | 0.0055 | 0.0029 | -0.0003 | -0.0044 | -0.0022 |
| | [0.0051] | [0.0008] | [0.0011]*** | [0.0056] | [0.0054] | [0.0009] | [0.0011]*** | [0.0060] |
| **9** | 0.0095 | 0.0004 | -0.002 | 0.0075 | 0.0044 | 0.0001 | -0.0035 | 0.0002 |
| | [0.0051]* | [0.0008] | [0.0011]* | [0.0057] | [0.0055] | [0.0009] | [0.0011]*** | [0.0063] |
| **10** | 0.0122 | 0.001 | -0.0002 | 0.0119 | 0.0048 | 0.0002 | -0.002 | 0.0021 |
| | [0.0057]** | [0.0009] | [0.0013] | [0.0063]* | [0.0068] | [0.0010] | [0.0015] | [0.0077] |
| **Constant** | 7.5036 | 0.6255 | 0.702 | 6.4307 | 8.1745 | 0.719 | 0.8069 | 7.2971 |
| | [0.1883]*** | [0.0280]*** | [0.0500]*** | [0.2252]*** | [0.1953]*** | [0.0283]*** | [0.0368]*** | [0.2203]*** |
| **N** | 13978 | 13978 | 13978 | 13978 | 8435 | 8435 | 8435 | 8435 |
| **$R^2$** | 0.36 | 0.32 | 0.53 | 0.4 | 0.53 | 0.47 | 0.75 | 0.6 |

Notes: Robust standard errors in brackets. See text and notes to Table 5 for information on regression specification.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table E2: Effect of Unemployment Rate at time of Graduation on Firm Size and Firm Wages - National Sample with Linear Cohort Trends**

| | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area** | **National** | | | | **National** | | | |
| **D>=0?** | **No** | | | | **Yes** | | | |
| **Outcome** | **Log Firm Size** | **Fraction Firm Size > 1000** | **Average Median Firm Wage** | **Average Log Firm Payroll** | **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** | -0.0283 | -0.0045 | -0.014 | -0.0382 | -0.0428 | -0.006 | -0.0143 | -0.0543 |
| | [0.0088]*** | [0.0012]*** | [0.0043]*** | [0.0095]*** | [0.0088]*** | [0.0012]*** | [0.0043]*** | [0.0099]*** |
| **1** | -0.0333 | -0.0049 | -0.011 | -0.0432 | -0.0438 | -0.0059 | -0.0112 | -0.0549 |
| | [0.0052]*** | [0.0008]*** | [0.0037]*** | [0.0070]*** | [0.0070]*** | [0.0010]*** | [0.0035]*** | [0.0083]*** |
| **2** | -0.0347 | -0.0054 | -0.0075 | -0.0431 | -0.042 | -0.0061 | -0.0074 | -0.0508 |
| | [0.0058]*** | [0.0009]*** | [0.0026]*** | [0.0073]*** | [0.0072]*** | [0.0010]*** | [0.0027]** | [0.0086]*** |
| **3** | -0.0295 | -0.0045 | -0.0066 | -0.0377 | -0.0336 | -0.005 | -0.0057 | -0.041 |
| | [0.0063]*** | [0.0009]*** | [0.0017]*** | [0.0069]*** | [0.0072]*** | [0.0010]*** | [0.0020]** | [0.0079]*** |
| **4** | -0.0266 | -0.0043 | -0.0046 | -0.0323 | -0.0267 | -0.0042 | -0.0035 | -0.032 |
| | [0.0052]*** | [0.0008]*** | [0.0016]*** | [0.0060]*** | [0.0062]*** | [0.0008]*** | [0.0020] | [0.0073]*** |
| **5** | -0.0239 | -0.0039 | -0.006 | -0.0306 | -0.0238 | -0.0035 | -0.0046 | -0.0297 |
| | [0.0058]*** | [0.0009]*** | [0.0021]*** | [0.0071]*** | [0.0058]*** | [0.0010]*** | [0.0022]* | [0.0072]*** |
| **6** | -0.0271 | -0.0042 | -0.0074 | -0.0353 | -0.0267 | -0.0037 | -0.0061 | -0.0345 |
| | [0.0050]*** | [0.0008]*** | [0.0023]*** | [0.0062]*** | [0.0048]*** | [0.0008]*** | [0.0022]** | [0.0059]*** |
| **7** | -0.0199 | -0.0029 | -0.0064 | -0.0264 | -0.0237 | -0.0035 | -0.0062 | -0.0311 |
| | [0.0050]*** | [0.0008]*** | [0.0027]** | [0.0066]*** | [0.0048]*** | [0.0007]*** | [0.0025]** | [0.0064]*** |
| **8** | -0.0115 | -0.0013 | -0.004 | -0.0147 | -0.0226 | -0.0027 | -0.0051 | -0.0282 |
| | [0.0057]* | [0.0009] | [0.0031] | [0.0073]* | [0.0055]*** | [0.0008]*** | [0.0029]* | [0.0072]*** |
| **9** | -0.003 | 0.0002 | 0.0001 | -0.0028 | -0.0183 | -0.0016 | -0.0015 | -0.0205 |
| | [0.0080] | [0.0012] | [0.0031] | [0.0096] | [0.0076]** | [0.0012] | [0.0029] | [0.0091]** |
| **10** | 0.0028 | 0.0016 | 0.0049 | 0.007 | -0.0116 | 0 | 0.0031 | -0.0096 |
| | [0.0071] | [0.0011] | [0.0030] | [0.0092] | [0.0080] | [0.0012] | [0.0024] | [0.0096] |
| **Constant** | 12.0757 | 1.2584 | 1.8382 | 11.9304 | 13.1274 | 1.445 | 1.9796 | 13.2333 |
| | [0.3681]*** | [0.0570]*** | [0.1541]*** | [0.4772]*** | [0.2838]*** | [0.0460]*** | [0.1542]*** | [0.3754]*** |
| **N** | 13978 | 13978 | 13978 | 13978 | 8435 | 8435 | 8435 | 8435 |
| **$R^2$** | 0.29 | 0.25 | 0.45 | 0.35 | 0.42 | 0.38 | 0.64 | 0.51 |

Notes: Robust standard errors in brackets. See text and notes to Table 1 for information on regression specification.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table E3: Effect of Unemployment Rate at time of Graduation on Firm and Industry Wages (2-Digit), Graduate Sample**

| Outcome | Specification | | | | |
|---|---|---|---|---|---|
| | Average Median Firm Wage | Average Median Firm Wage Controlling for Region | Average Median Firm Wage Controlling for Experience | Average Industry Wage | Average Industry Wage Controlling for Experience |
| | (1) | (2) | (3) | (4) | (5) |
| **Experience Year** | | | | | |
| **0** | -0.0097 | -0.0087 | -0.009 | -0.0028 | -0.0027 |
| | [0.0014]*** | [0.0015]*** | [0.0010]*** | [0.0005]*** | [0.0005]*** |
| **1** | -0.0096 | -0.0089 | -0.0082 | -0.0025 | -0.0024 |
| | [0.0011]*** | [0.0012]*** | [0.0009]*** | [0.0005]*** | [0.0005]*** |
| **2** | -0.0073 | -0.007 | -0.006 | -0.0019 | -0.0018 |
| | [0.0011]*** | [0.0011]*** | [0.0008]*** | [0.0005]*** | [0.0005]*** |
| **3** | -0.0057 | -0.0057 | -0.005 | -0.0014 | -0.0013 |
| | [0.0010]*** | [0.0011]*** | [0.0007]*** | [0.0004]*** | [0.0004]*** |
| **4** | -0.0044 | -0.0044 | -0.0041 | -0.0009 | -0.0009 |
| | [0.0011]*** | [0.0011]*** | [0.0008]*** | [0.0004]** | [0.0004]** |
| **5** | -0.0039 | -0.004 | -0.0037 | -0.0011 | -0.0011 |
| | [0.0012]*** | [0.0012]*** | [0.0008]*** | [0.0005]** | [0.0004]** |
| **6** | -0.0049 | -0.005 | -0.0043 | -0.0015 | -0.0014 |
| | [0.0012]*** | [0.0012]*** | [0.0008]*** | [0.0005]*** | [0.0004]*** |
| **7** | -0.005 | -0.0052 | -0.0043 | -0.0013 | -0.0013 |
| | [0.0012]*** | [0.0012]*** | [0.0008]*** | [0.0005]*** | [0.0004]*** |
| **8** | -0.0044 | -0.0045 | -0.0043 | -0.0009 | -0.0009 |
| | [0.0011]*** | [0.0012]*** | [0.0008]*** | [0.0005]** | [0.0005]** |
| **9** | -0.0035 | -0.0036 | -0.0034 | -0.0009 | -0.0008 |
| | [0.0011]*** | [0.0011]*** | [0.0009]*** | [0.0005]* | [0.0005]* |
| **10** | -0.002 | -0.0022 | -0.0027 | -0.0004 | -0.0004 |
| | [0.0015] | [0.0015] | [0.0009]*** | [0.0005] | [0.0005] |
| **Constant** | 0.8069 | 1.1159 | 0.0244 | 9.1073 | 0.0053 |
| | [0.0368]*** | [0.0407]*** | [0.0284] | [0.0160]*** | [0.0149] |
| **N** | 8435 | 8512 | 8507 | 8479 | 8479 |
| **$R^2$** | 0.75 | 0.75 | 0.61 | 0.49 | 0.5 |

Notes: Robust standard errors in brackets. See text and notes to Table 5 for information on regression specification.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table F1: Effect of Unemployment Rate at time of Graduation on Log Real Earnings Controlling for Fixed Effects for First Industry or First Firm and by Size of Average Median Firm Wage and Average Log Firm Payroll**

| | Specification | | | | | |
|---|---|---|---|---|---|---|
| | Fixed Effects for First Firm/ Industry | | By Average Median Firm Wage | | By Average Log Firm Payroll | |
| | | | Main Effect | Difference | Main Effect | Difference |
| | Firm | Industry | <75th Percentile | >=75th Percentile | <75th Percentile | >=75th Percentile |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Experience Year** | | | | | | |
| **0** | -0.0091 | -0.0091 | -0.0146 | -0.0021 | -0.0157 | -0.0025 |
| | [0.0033]*** | [0.0033]*** | [0.0028]*** | [0.0022] | [0.0028]*** | [0.0020] |
| **1** | -0.0111 | -0.0111 | -0.0159 | -0.0036 | -0.0159 | -0.0038 |
| | [0.0028]*** | [0.0028]*** | [0.0026]*** | [0.0023] | [0.0024]*** | [0.0021]* |
| **2** | -0.009 | -0.009 | -0.0134 | -0.0053 | -0.0136 | -0.0058 |
| | [0.0027]*** | [0.0027]*** | [0.0024]*** | [0.0022]** | [0.0024]*** | [0.0021]*** |
| **3** | -0.0069 | -0.0069 | -0.0109 | -0.0051 | -0.0101 | -0.0068 |
| | [0.0025]*** | [0.0025]*** | [0.0025]*** | [0.0023]** | [0.0023]*** | [0.0023]*** |
| **4** | -0.0051 | -0.0051 | -0.0096 | -0.0039 | -0.0096 | -0.0044 |
| | [0.0027]* | [0.0027]* | [0.0020]*** | [0.0019]** | [0.0021]*** | [0.0018]** |
| **5** | -0.0032 | -0.0032 | -0.0082 | -0.0026 | -0.0088 | -0.0026 |
| | [0.0024] | [0.0024] | [0.0018]*** | [0.0016]* | [0.0020]*** | [0.0017] |
| **6** | -0.0031 | -0.0031 | -0.0067 | -0.0043 | -0.007 | -0.0041 |
| | [0.0025] | [0.0025] | [0.0021]*** | [0.0017]*** | [0.0020]*** | [0.0017]** |
| **7** | -0.0027 | -0.0027 | -0.0052 | -0.0058 | -0.0069 | -0.0039 |
| | [0.0027] | [0.0027] | [0.0019]*** | [0.0016]*** | [0.0019]*** | [0.0014]*** |
| **8** | -0.0005 | -0.0005 | -0.005 | -0.0033 | -0.0073 | -0.0006 |
| | [0.0023] | [0.0023] | [0.0020]** | [0.0018]* | [0.0021]*** | [0.0016] |
| **9** | -0.0013 | -0.0013 | -0.0036 | -0.006 | -0.0061 | -0.0013 |
| | [0.0027] | [0.0027] | [0.0023] | [0.0017]*** | [0.0022]*** | [0.0020] |
| **10** | 0.0028 | 0.0028 | -0.0011 | -0.0049 | -0.0022 | -0.0034 |
| | [0.0030] | [0.0030] | [0.0026] | [0.0016]*** | [0.0025] | [0.0021] |
| **Constant** | 15.3696 | 15.3696 | 8.9546 | -- | 8.8768 | -- |
| | [.] | [.] | [0.0908]*** | -- | [0.0664]*** | -- |
| **N** | 418600 | 418600 | 12700 | -- | 14614 | -- |
| **R-squared** | 0.8 | 0.8 | 0.93 | -- | 0.93 | -- |

Note: First two columns indicate models with firm or industry fixed effects. The remainign columns display coefficients from two interacted regression models, respectively. Each columns shows the unemployment rate and experience interactions from regressing log annual earnings on the youth unemployment rate in the province of first residence, interacted with experience years 0 to 10, plus province of first residence fixed effects, experience fixed effects, and year of graduation fixed effects. One, two, and three asterix indicates statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively. See text for more details.

**Appendix Table F2: Effect of Unemployment Rate at time of Graduation on Log Real Earnings Controlling for Fixed Effects for First Industry or First Firm**

| | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **National/Regional** | **National** | **National** | **Regional** | **Regional** | **National** | **National** | **Regional** | **Regional** |
| **Trend** | **Linear** | **Linear** | **NA** | **NA** | **Linear** | **Linear** | **NA** | **NA** |
| **D>=0?** | **No** | **No** | **No** | **No** | **Yes** | **Yes** | **Yes** | **Yes** |
| **Fixed Effects for First Firm/ Industry** | **Firm** | **Industry** | **Firm** | **Industry** | **Firm** | **Industry** | **Firm** | **Industry** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** |
| **Experience Year** | | | | | | | | |
| **0** | -0.0067 | -0.0141 | -0.0079 | -0.0119 | -0.0077 | -0.0077 | -0.0091 | -0.0091 |
| | [0.0046] | [0.0030]*** | [0.0033]** | [0.0026]*** | [0.0048] | [0.0048] | [0.0033]*** | [0.0033]*** |
| **1** | -0.0058 | -0.013 | -0.0111 | -0.0144 | -0.0061 | -0.0061 | -0.0111 | -0.0111 |
| | [0.0049] | [0.0037]*** | [0.0029]*** | [0.0023]*** | [0.0046] | [0.0046] | [0.0028]*** | [0.0028]*** |
| **2** | -0.0035 | -0.0091 | -0.0093 | -0.0128 | -0.0036 | -0.0036 | -0.009 | -0.009 |
| | [0.0040] | [0.0033]** | [0.0030]*** | [0.0021]*** | [0.0034] | [0.0034] | [0.0027]*** | [0.0027]*** |
| **3** | -0.0005 | -0.0047 | -0.0056 | -0.0087 | -0.001 | -0.001 | -0.0069 | -0.0069 |
| | [0.0026] | [0.0024]* | [0.0028]** | [0.0021]*** | [0.0023] | [0.0023] | [0.0025]*** | [0.0025]*** |
| **4** | -0.0006 | -0.0027 | -0.0035 | -0.0066 | -0.0001 | -0.0001 | -0.0051 | -0.0051 |
| | [0.0035] | [0.0028] | [0.0027] | [0.0020]*** | [0.0032] | [0.0032] | [0.0027]* | [0.0027]* |
| **5** | -0.0021 | -0.0039 | -0.0019 | -0.0056 | -0.0004 | -0.0004 | -0.0032 | -0.0032 |
| | [0.0038] | [0.0028] | [0.0023] | [0.0019]*** | [0.0031] | [0.0031] | [0.0024] | [0.0024] |
| **6** | 0 | -0.0022 | -0.0011 | -0.0051 | 0.0006 | 0.0006 | -0.0031 | -0.0031 |
| | [0.0047] | [0.0031] | [0.0027] | [0.0022]** | [0.0045] | [0.0045] | [0.0025] | [0.0025] |
| **7** | -0.0011 | -0.0027 | -0.0015 | -0.0051 | 0.0011 | 0.0011 | -0.0027 | -0.0027 |
| | [0.0047] | [0.0031] | [0.0029] | [0.0023]** | [0.0041] | [0.0041] | [0.0027] | [0.0027] |
| **8** | 0.001 | -0.0003 | 0.0005 | -0.0036 | 0.0024 | 0.0024 | -0.0005 | -0.0005 |
| | [0.0041] | [0.0031] | [0.0026] | [0.0021]* | [0.0025] | [0.0025] | [0.0023] | [0.0023] |
| **9** | 0.0032 | 0.0013 | 0.0001 | -0.0036 | 0.0035 | 0.0035 | -0.0013 | -0.0013 |
| | [0.0044] | [0.0029] | [0.0028] | [0.0022]* | [0.0028] | [0.0028] | [0.0027] | [0.0027] |
| **10** | 0.0068 | 0.0041 | 0.0038 | -0.0014 | 0.0075 | 0.0075 | 0.0028 | 0.0028 |
| | [0.0035]* | [0.0023]* | [0.0031] | [0.0023] | [0.0025]** | [0.0025]** | [0.0030] | [0.0030] |
| **Constant** | 6.8467 | 7.6874 | | 10.1806 | 13.8693 | 13.8693 | 15.3696 | 15.3696 |
| | [.] | [0.1990]*** | | [0.0825]*** | [5.4863e+11] | [5.4863e+11] | [.] | [.] |
| **N** | 596931 | 60212 | 596931 | 60212 | 418600 | 418600 | 418600 | 418600 |
| **R-squared** | 0.79 | 0.85 | 0.8 | 0.86 | 0.8 | 0.8 | 0.8 | 0.8 |

Notes: Robust standard errors in brackets. Basic regression models described in text and notes to Table 1 with firm or industry fixed effects.

* significant at 10%; ** significant at 5%; *** significant at 1%

**Appendix Table F3: Effect of Unemployment Rate at time of Graduation by Initial Firm Type - Regional Sample with D>=0**

| | Firm Size | | Firm Size | | Average Median Firm Wage | | Average Log Firm Payroll | |
|---|---|---|---|---|---|---|---|---|
| | Level <1000 | Difference >=1000 | Level <5000 | Difference >=5000 | Level <75th Percentile | Difference >=75th Percentile | Level <75th Percentile | Difference >=75th Percentile |
| | (3) | (4) | (1) | (2) | (5) | (6) | (7) | (8) |
| **Experience Year** | | | | | | | | |
| **0** | -0.0168 | -0.0025 | -0.0174 | -0.0028 | -0.0146 | -0.0021 | -0.0157 | -0.0025 |
| | [0.0025]*** | [0.0020] | [0.0024]*** | [0.0024] | [0.0028]*** | [0.0022] | [0.0028]*** | [0.0020] |
| **1** | -0.0154 | -0.0038 | -0.0162 | -0.0036 | -0.0159 | -0.0036 | -0.0159 | -0.0038 |
| | [0.0024]*** | [0.0021]* | [0.0021]*** | [0.0023] | [0.0026]*** | [0.0023] | [0.0024]*** | [0.0021]* |
| **2** | -0.0119 | -0.0058 | -0.013 | -0.0055 | -0.0134 | -0.0053 | -0.0136 | -0.0058 |
| | [0.0023]*** | [0.0021]*** | [0.0021]*** | [0.0019]*** | [0.0024]*** | [0.0022]** | [0.0024]*** | [0.0021]*** |
| **3** | -0.0074 | -0.0068 | -0.0091 | -0.0055 | -0.0109 | -0.0051 | -0.0101 | -0.0068 |
| | [0.0025]*** | [0.0023]*** | [0.0020]*** | [0.0017]*** | [0.0025]*** | [0.0023]** | [0.0023]*** | [0.0023]*** |
| **4** | -0.0072 | -0.0044 | -0.0082 | -0.0036 | -0.0096 | -0.0039 | -0.0096 | -0.0044 |
| | [0.0020]*** | [0.0018]** | [0.0018]*** | [0.0015]** | [0.0020]*** | [0.0019]** | [0.0021]*** | [0.0018]** |
| **5** | -0.0065 | -0.0026 | -0.007 | -0.0022 | -0.0082 | -0.0026 | -0.0088 | -0.0026 |
| | [0.0021]*** | [0.0017] | [0.0019]*** | [0.0017] | [0.0018]*** | [0.0016]* | [0.0020]*** | [0.0017] |
| **6** | -0.0046 | -0.0041 | -0.006 | -0.0025 | -0.0067 | -0.0043 | -0.007 | -0.0041 |
| | [0.0020]** | [0.0017]** | [0.0018]*** | [0.0017] | [0.0021]*** | [0.0017]*** | [0.0020]*** | [0.0017]** |
| **7** | -0.0046 | -0.0039 | -0.006 | -0.0024 | -0.0052 | -0.0058 | -0.0069 | -0.0039 |
| | [0.0018]** | [0.0014]*** | [0.0017]*** | [0.0016] | [0.0019]*** | [0.0016]*** | [0.0019]*** | [0.0014]*** |
| **8** | -0.006 | -0.0006 | -0.0063 | -0.0002 | -0.005 | -0.0033 | -0.0073 | -0.0006 |
| | [0.0020]*** | [0.0016] | [0.0018]*** | [0.0017] | [0.0020]** | [0.0018]* | [0.0021]*** | [0.0016] |
| **9** | -0.0046 | -0.0013 | -0.0049 | -0.0011 | -0.0036 | -0.006 | -0.0061 | -0.0013 |
| | [0.0023]* | [0.0020] | [0.0020]** | [0.0019] | [0.0023] | [0.0017]*** | [0.0022]*** | [0.0020] |
| **10** | -0.0012 | -0.0034 | -0.0008 | -0.005 | -0.0011 | -0.0049 | -0.0022 | -0.0034 |
| | [0.0025] | [0.0021] | [0.0022] | [0.0020]** | [0.0026] | [0.0016]*** | [0.0025] | [0.0021] |
| **Constant** | 8.8768 | | 8.943 | | 8.9546 | | 8.8768 | |
| | [0.0664]*** | | [0.0664]*** | | [0.0908]*** | | [0.0664]*** | |
| **N** | 14614 | | 14569 | | 12700 | | 14614 | |
| **$R^2$** | 0.93 | | 0.93 | | 0.93 | | 0.93 | |

Note: Columns indicate the sample selected on for each regression. Each columns shows the unemployment rate and experience interactions from regressing log annual earnings on the youth unemployment rate in the province of first residence, interacted with experience years 0 to 10, plus province of first residence fixed effects, experience fixed effects, and year of graduation fixed effects. One, two, and three asterix indicates statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively. See text for more details.

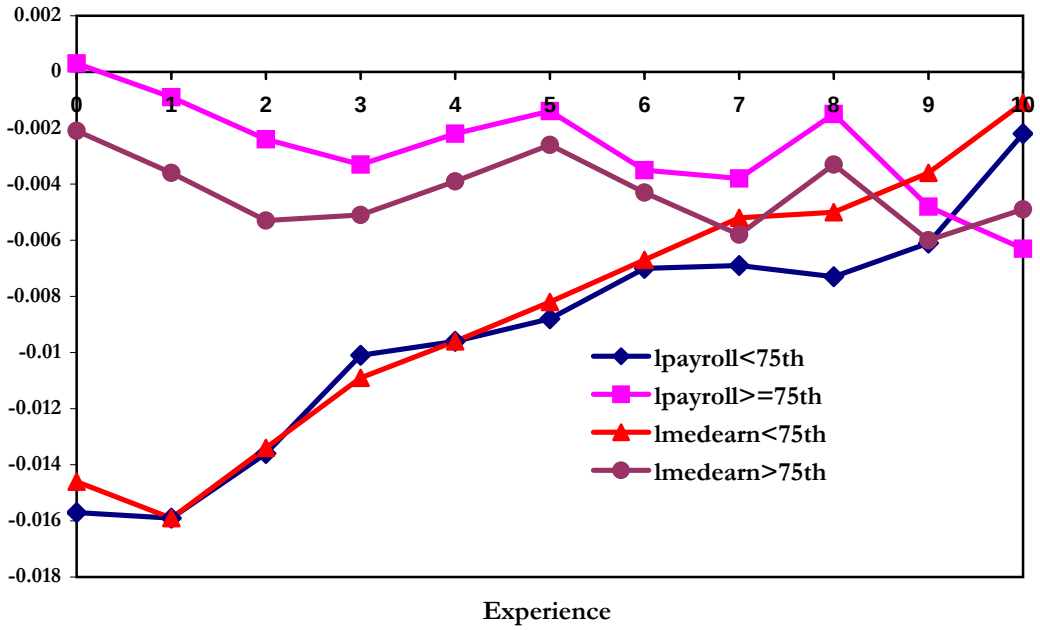
**Appendix Table F4: Effect of Unemployment Rate at time of Graduation by Average Industry Turnover Rate- Regional Sample with D>=0**

| | Average Turnover Rate at 2-Digit Industry Level, Controlling for Year Effects | |
|---|---|---|
| | **Bottom Quintile** | **Top Quintile** |
| | **(1)** | **(2)** |
| **Experience Year** | | |
| **0** | -0.0165 | -0.0206 |
| | (0.003) | (0.004) |
| **1** | -0.0176 | -0.0208 |
| | (0.003) | (0.004) |
| **2** | -0.0149 | -0.0161 |
| | (0.003) | (0.003) |
| **3** | -0.0132 | -0.0118 |
| | (0.002) | (0.003) |
| **4** | -0.0110 | -0.0091 |
| | (0.002) | (0.003) |
| **5** | -0.0102 | -0.0067 |
| | (0.002) | (0.003) |
| **6** | -0.0100 | -0.0049 |
| | (0.002) | (0.003) |
| **7** | -0.0103 | -0.0050 |
| | (0.003) | (0.003) |
| **8** | -0.0090 | -0.0052 |
| | (0.002) | (0.003) |
| **9** | -0.0097 | -0.0014 |
| | (0.002) | (0.003) |
| **10** | -0.0085 | -0.0021 |
| | (0.002) | (0.003) |

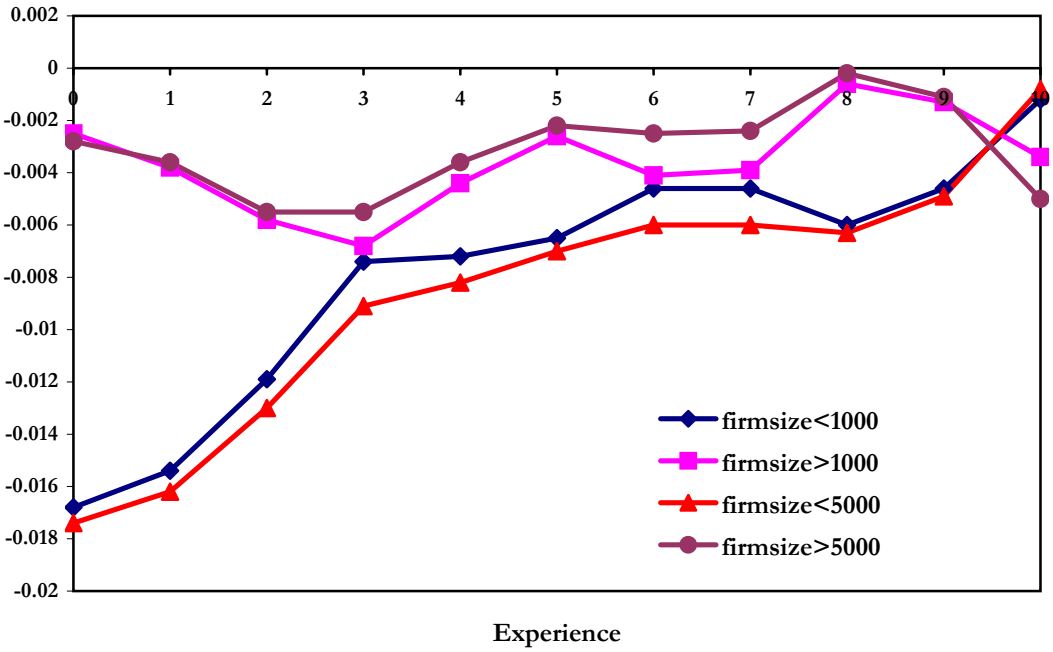
Note: Columns indicate the sample selected on for each regression. Each columns shows the unemployment rate and experience interactions from regressing log annual earnings on the youth unemployment rate in the province of first residence, interacted with experience years 0 to 10, plus province of residence fixed effects, experience fixed effects, and year of graduation fixed effects. See text for more details.

**Appendix Figure F1: Effects of Initial Unemployment Rates on Wages by Initial Firm Type**

**Panel A: Losses and Reversion by Payroll and Median Earning**

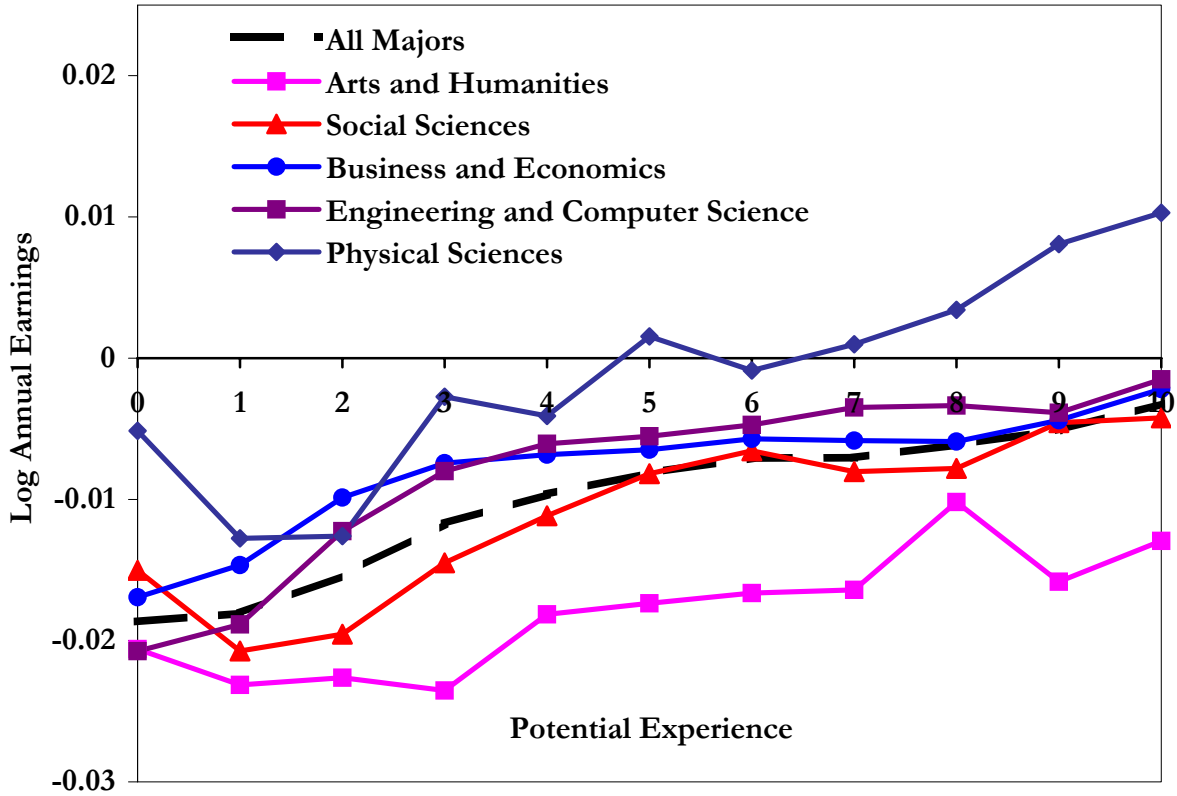



**Panel B: Losses and Reversion by Firm Size**




Notes: See notes in Appendix Table F3.

**Appendix Figure G1: Effect of Graduating in Recession on Annual Earnings by Major of Study (Graduates Only)**




Notes: See notes of Table 1 and text for regression specification.

**Appendix Table G1: Heterogeneity in Initial Loss and Reversion for Workers from Top, Middle, and Bottom Colleges [Classified by Average Wage of Graduates]**

| Outcome Variable | | All Graduates | Position in Average Annual Earnings by Colleges | | |
|---|---|---|---|---|---|
| | | | Bottom Third | Middle Third | Top Third |
| **Annual Earnings** | **Drop** | -0.0183 | -0.0212 | -0.0202 | -0.0165 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Slope** | 0.0020 | 0.0015 | 0.0017 | 0.0024 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | 0.0015 | 0.0011 | 0.0013 | 0.0018 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Average Firm Median Log Earnings** | **Drop** | -0.0094 | -0.0097 | -0.0140 | -0.0092 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Slope** | 0.0010 | 0.0007 | 0.0010 | 0.0012 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | 0.0007 | 0.0003 | 0.0006 | 0.0009 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Average Firm Employment** | **Drop** | -0.0104 | 0.0347 | -0.0177 | -0.0245 |
| | | (0.0000) | (0.0003) | (0.0001) | (0.0000) |
| | **Slope** | 0.0021 | 0.0019 | 0.0020 | 0.0034 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | 0.0016 | 0.0001 | 0.0020 | 0.0028 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Fraction Changed Employer** | **Jump** | 0.0032 | 0.0023 | 0.0021 | 0.0061 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Slope** | 0.0002 | -0.0004 | 0.0007 | 0.0002 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | 0.0001 | 0.0000 | 0.0004 | -0.0001 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Fraction Left 1st Employer** | **Drop** | 0.0030 | -0.0018 | 0.0027 | 0.0067 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Slope** | -0.0002 | 0.0004 | 0.0001 | -0.0009 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | -0.0001 | 0.0004 | 0.0000 | -0.0006 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Fraction Zero Earnings** | **Drop** | 0.0013 | 0.0016 | 0.0012 | 0.0012 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Slope** | -0.0003 | -0.0002 | -0.0002 | -0.0003 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | -0.0002 | -0.0001 | -0.0001 | -0.0002 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

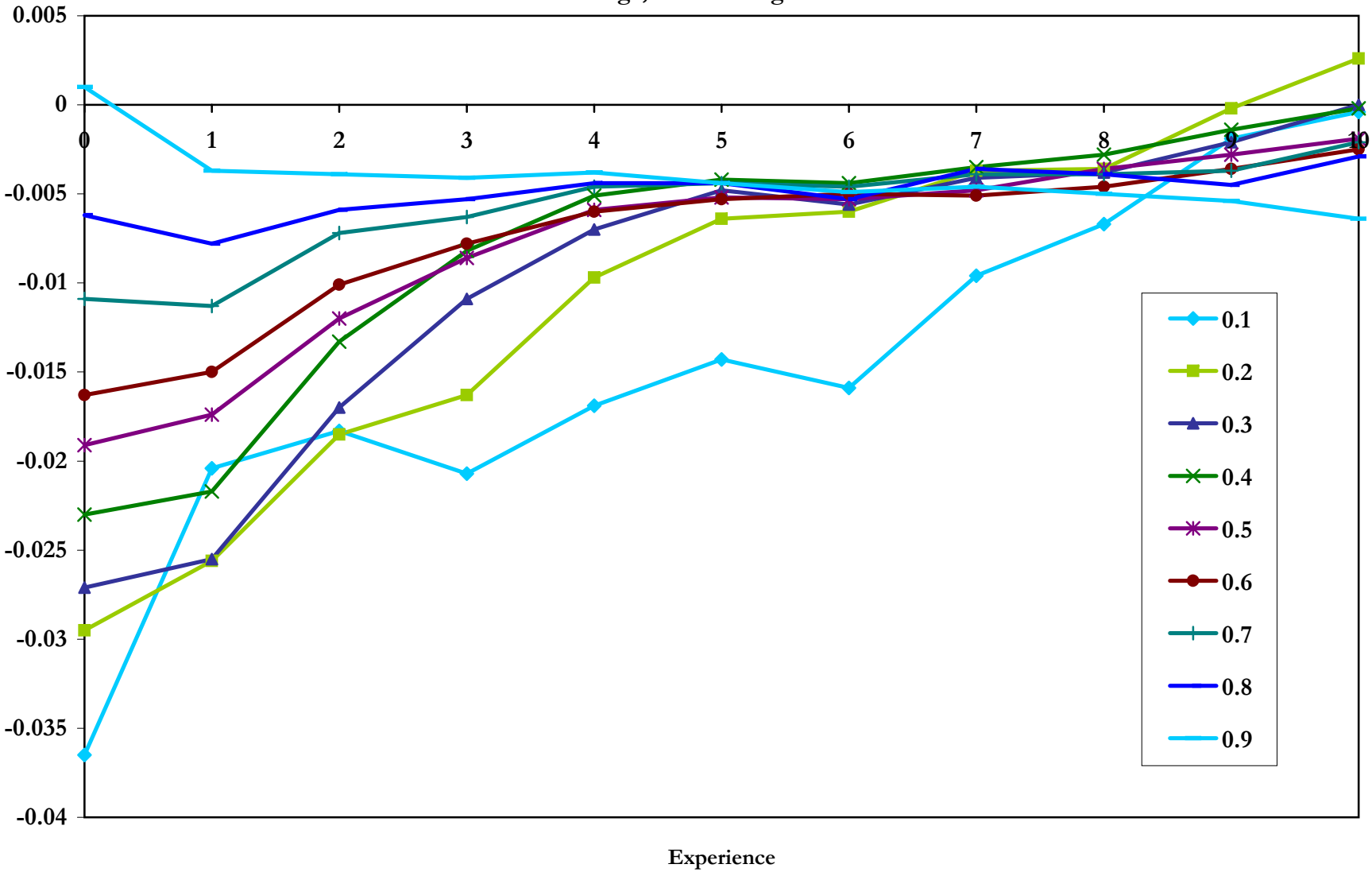
Notes: Coefficients from separate regression models. The initial loss (DROP) is the effect of unemployment at graduation (UR) at experience zero and one, the first phase of the catch up (SLOPE) is the coefficient on the interaction of UR with linear experience for experience years two to six, and the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

**Appendix Table G2: Heterogeneity in Initial Loss and Reversion by Major of Study**

| Outcome Variable | | All Graduates | Classification of Major | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Arts and Humanities | Social Sciences | Other | Physical Sciences | Teachers | Business and Economics | Engineering and Computer Science | Health Sciences |
| **Fraction in Sample** | | | 10.09 | 13.86 | 13.6 | 10.06 | 3.55 | 26.34 | 21.37 | 1.13 |
| **Average Log Annual Earnings** | | | 9.51 | 9.69 | 9.78 | 9.9 | 9.94 | 9.96 | 10.19 | 10.25 |
| **Annual Earnings** | **Drop** | -0.0183 | -0.0228 | -0.0194 | -0.0182 | -0.0106 | -0.0218 | -0.0146 | -0.0180 | -0.0098 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0001) |
| | **Slope** | 0.0020 | 0.0009 | 0.0020 | 0.0019 | 0.0019 | 0.0026 | 0.0017 | 0.0025 | -0.0003 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | 0.0015 | 0.0010 | 0.0015 | 0.0017 | 0.0019 | 0.0022 | 0.0012 | 0.0018 | 0.0001 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Average Firm Median Log Earnings** | **Drop** | -0.0093 | -0.0085 | -0.0064 | -0.0099 | -0.0112 | -0.0146 | -0.0062 | -0.0086 | 0.0014 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0001) |
| | **Slope** | 0.0010 | 0.0002 | 0.0010 | 0.0007 | 0.0014 | 0.0009 | 0.0008 | 0.0016 | -0.0004 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | 0.0007 | 0.0001 | 0.0008 | 0.0005 | 0.0008 | 0.0004 | 0.0006 | 0.0010 | -0.0002 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Fraction Left 1st Employer** | **Drop** | 0.0030 | -0.0015 | -0.0007 | 0.0026 | 0.0031 | 0.0093 | 0.0021 | 0.0079 | -0.0022 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Slope** | -0.0002 | 0.0009 | 0.0006 | -0.0001 | -0.0003 | -0.0007 | -0.0001 | -0.0014 | 0.0000 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | -0.0001 | 0.0003 | 0.0003 | 0.0000 | -0.0001 | -0.0003 | -0.0001 | -0.0009 | 0.0002 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Fraction Zero Earnings** | **Drop** | 0.0013 | 0.0018 | 0.0011 | 0.0013 | 0.0017 | 0.0008 | 0.0004 | 0.0019 | 0.0074 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Slope** | -0.0003 | 0.0001 | -0.0002 | -0.0002 | -0.0003 | -0.0001 | -0.0003 | -0.0005 | 0.0001 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | **Fade** | -0.0002 | -0.0001 | -0.0001 | -0.0001 | -0.0002 | -0.0001 | -0.0001 | -0.0003 | -0.0002 |
| | | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (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.

**Appendix Figure G2: Effect of Unemployment Rate at Graduation on Deciles of Distribution of Annual Real Earnings, Male College Graduates**



**Appendix G (Part 2): Quantile Regressions**

We also examined whether the negative effects from graduating in a recession differ for college graduates over different parts of the income distribution using quantile regression. The main results consist of OLS coefficient estimates for the effects of the initial entry unemployment rate on log annual earnings. These coefficients indicate the expected change in the average log wage from a one point increase in the initial unemployment rate over different experience levels. In comparison, Appendix Figure G1 shows the expected change in the log wage at each decile along the earnings distribution from a one point increase in the initial unemployment rate, also over different experience levels. These coefficients come from estimating the same regression model as before, but using quantile regressions for each decile instead of ordinary least squares.

The pattern in Appendix Figure G1 clearly reveals that differences in unemployment conditions at time of entry into the labor market affect the bottom part of the earnings distribution more than the top part. The catch-up process occurs everywhere so that after 10 years in the labor market, the earnings distribution looks the same regardless of initial economic conditions. But those in the lower part of the distribution suffer larger and longer earnings losses. At the 10th percentile in the earnings distribution, for example, a 5 percentage point increase in the initial unemployment rate (about a two standard deviation increase) decreases earnings by about 18 percent in the first year in the labor market. Five years later, earnings are still 7.5 percent lower. This gap eventually fades to zero, but not until the tenth year. Each higher earnings decile is less affected by initial unemployment conditions. The 90th percentile in the earnings distribution one year out is only about 2.5 percent lower from a 5 percentage point increase in the initial unemployment rate. While individuals in the upper part of the income distribution appear partially protected by the influences of the initial unemployment rate in the first five years, this does not translate to greater protection six to ten years out. The catch-up process occurs most strongly over the lower deciles. By the sixth year, the lingering effects from the initial unemployment rate on log earnings are about the same for all deciles except the lowest, and they fade to about zero by the tenth year.

**Appendix Table H1: Effect of Unemployment Rate on Duration of College -- National, Regional, and Predicted**

| | All Workers | | | Workers D>=0 | | |
|---|---|---|---|---|---|---|
| | Fraction D>=0 | Fraction D not equal 0 | Fraction D outside -1,1 | Fraction D >0 | Fraction D >1 | Fraction D >2 |
| **Average** | 0.67 | 0.68 | 0.36 | 0.36 | 0.14 | 0.06 |
| **Panel A: National, All Workers** | | | | | | |
| **Unemployment Rate** | 0.0007 | -0.0031 | -0.0028 | -0.0032 | -0.0022 | 0.0001 |
| | [0.0041] | [0.0018]* | [0.0022] | [0.0038] | [0.0027] | [0.0013] |
| **N** | 1514 | 1514 | 1514 | 957 | 957 | 957 |
| **$R^2$** | 0.01 | 0 | 0 | 0.01 | 0.01 | 0 |
| **Panel B: Regional, All Workers** | | | | | | |
| **Unemployment Rate** | -0.0022 | 0.0057 | 0.0046 | 0.0063 | 0.005 | 0.0027 |
| | [0.0028] | [0.0022]** | [0.0023]* | [0.0032]* | [0.0023]** | [0.0011]** |
| **N** | 1514 | 1514 | 1514 | 957 | 957 | 957 |
| **$R^2$** | 0.06 | 0.02 | 0.04 | 0.04 | 0.03 | 0.02 |
| **Panel C: Regional, Predicted UR, All Workers** | | | | | | |
| **Unemployment Rate** | -0.0021 | 0.0024 | 0.0003 | 0.0029 | -0.0007 | -0.0009 |
| | [0.0130] | [0.0063] | [0.0087] | [0.0045] | [0.0018] | [0.0019] |
| **N** | 1489 | 1489 | 1489 | 932 | 932 | 932 |
| **$R^2$** | 0.12 | 0.04 | 0.09 | 0.6 | 0.7 | 0.59 |

**Panel D: Distribution of Actual and Predicted Durations and Deviations in Years**

| Years | Actual Duration | Predicted Duration | Difference Between Actual and Predicted (D) | |
|---|---|---|---|---|
| **1** | 0.18 | 0.05 | **-3<=** | 0.10 |
| **2** | 0.13 | 0.01 | **-2** | 0.12 |
| **3** | 0.19 | 0.29 | **-1** | 0.11 |
| **4** | 0.30 | 0.60 | **0** | 0.32 |
| **5** | 0.17 | 0.05 | **1** | 0.22 |
| **6** | 0.04 | 0.00 | **2** | 0.08 |
| **7** | 0.01 | 0.00 | **>=3** | 0.06 |

**Robust standard errors in brackets**

*** significant at 10%; ** significant at 5%; *** significant at 1%**

**Appendix Table H2: Distribution of Years of College Among All Entrants and in Graduate Sample**

| | Entire Sample (Some College) | | Graduates (Actual ≥ Predicted Year) | |
|---|---|---|---|---|
| **Years of College** | **N** | **Percent** | **N** | **Percent** |
| **1** | 30,420 | 17.03 | 818 | 0.69 |
| **2** | 21,922 | 12.27 | 3,474 | 2.92 |
| **3** | 34,745 | 19.45 | 23,953 | 20.13 |
| **4** | 53,803 | 30.12 | 52,973 | 44.53 |
| **5** | 30,172 | 16.89 | 30,160 | 25.35 |
| **6** | 6,200 | 3.47 | 6,197 | 5.21 |
| **7** | 1,391 | 0.78 | 1,388 | 1.17 |
| **Total Exiting College** | 178,653 | 100 | 118,963 | 100 |

**Appendix Table H3: Effect of Unemployment Rate on Duration of College -- National, Regional, and Predicted**

| | Years Until BA | Fraction Above Grade | Fraction < 4 Years | Fraction > 4 Years | In Graduate Sample | Difference (D) |
|---|---|---|---|---|---|---|
| **Panel A: National, All Workers** | | | | | | |
| **Unemployment Rate** | 0.007 | -0.0019 | -0.0018 | 0.001 | 0.0012 | -0.0006 |
| | [0.0138] | [0.0039] | [0.0039] | [0.0025] | [0.0043] | [0.0157] |
| **N** | 1591 | 1591 | 1591 | 1591 | 1591 | 1591 |
| **$R^2$** | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.02 |
| **Panel B: Regional, All Workers** | | | | | | |
| **Unemployment Rate** | 0.0072 | 0.0046 | 0.0003 | 0.0041 | -0.0032 | 0.0034 |
| | [0.0074] | [0.0028] | [0.0024] | [0.0020]** | [0.0028] | [0.0108] |
| **N** | 1591 | 1591 | 1591 | 1591 | 1591 | 1591 |
| **$R^2$** | 0.08 | 0.05 | 0.06 | 0.09 | 0.09 | 0.06 |
| **Panel C: Regional, Predicted UR, All Workers** | | | | | | |
| **Unemployment Rate** | 0.0001 | -0.0003 | 0.0019 | 0.0025 | -0.0048 | -0.0042 |
| | [0.0410] | [0.0101] | [0.0115] | [0.0081] | [0.0112] | [0.0523] |
| **N** | 1566 | 1566 | 1566 | 1566 | 1566 | 1566 |
| **$R^2$** | 0.14 | 0.07 | 0.15 | 0.1 | 0.16 | 0.11 |
| **Panel D: National, D>=0** | | | | | | |
| **Unemployment Rate** | 0.0062 | -0.0025 | -0.0012 | 0.0017 | 0.0001 | -0.0052 |
| | [0.0063] | [0.0043] | [0.0010] | [0.0025] | [0.0014] | [0.0082] |
| **N** | 955 | 955 | 955 | 955 | 955 | 955 |
| **$R^2$** | 0.01 | 0.02 | 0.04 | 0.01 | 0 | 0.01 |
| **Panel E: Regional, D>=0** | | | | | | |
| **Unemployment Rate** | 0.011 | 0.0083 | -0.0002 | 0.0061 | -0.0007 | 0.0157 |
| | [0.0052]** | [0.0035]** | [0.0009] | [0.0027]** | [0.0015] | [0.0065]** |
| **N** | 955 | 955 | 955 | 955 | 955 | 955 |
| **$R^2$** | 0.22 | 0.04 | 0.27 | 0.15 | 0.38 | 0.04 |
| **Panel F: Regional, Predicted UR, D>=0** | | | | | | |
| **Unemployment Rate** | 0.006 | 0.0024 | -0.0001 | 0.0042 | -0.0002 | 0 |
| | [0.0042] | [0.0038] | [0.0008] | [0.0026] | [0.0016] | [0.0000]*** |
| **N** | 930 | 930 | 930 | 930 | 930 | 930 |
| **$R^2$** | 0.83 | 0.64 | 0.46 | 0.71 | 0.54 | 1 |

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. The dependent variable is indicated in the column heading. The national model regresses the dependent variable on the youth unemployment rate in the country at the year of college exit, plus province of residence 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, plus province of residence fixed effects, and year of graduation fixed effects. One, two, and three asterix indicates statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively. See text for more details.

**Appendix Table H4: Effect of Unemployment Rate at Time of Predicted Graduation on Log Real Earnings by Potential Experience (Reduced Form) and Instrumental Variable Estimates, Regional Model**

| | Specification | | | |
|---|---|---|---|---|
| **Model** | **Reduced Form** | | **Instrumental Variables** | |
| **D>=0?** | **No** | **Yes** | **No** | **Yes** |
| | **(1)** | **(2)** | **(3)** | **(4)** |
| **First Stage Coefficient** | --- | --- | 0.8841 | 0.8984 |
| | --- | --- | [0.0502]*** | [0.0391]*** |
| **Experience Year** | | | | |
| **0** | -0.0119 | -0.0134 | -0.0162 | -0.0186 |
| | [0.0023]*** | [0.0023]*** | [0.0030]*** | [0.0034]*** |
| **1** | -0.0154 | -0.0134 | -0.0215 | -0.0179 |
| | [0.0030]*** | [0.0024]*** | [0.0041]*** | [0.0033]*** |
| **2** | -0.0145 | -0.0114 | -0.0204 | -0.0147 |
| | [0.0030]*** | [0.0021]*** | [0.0042]*** | [0.0028]*** |
| **3** | -0.0117 | -0.0086 | -0.0165 | -0.0106 |
| | [0.0027]*** | [0.0019]*** | [0.0038]*** | [0.0024]*** |
| **4** | -0.0093 | -0.0072 | -0.013 | -0.0086 |
| | [0.0025]*** | [0.0019]*** | [0.0035]*** | [0.0023]*** |
| **5** | -0.0068 | -0.0059 | -0.0093 | -0.0069 |
| | [0.0024]*** | [0.0017]*** | [0.0034]*** | [0.0021]*** |
| **6** | -0.0054 | -0.0045 | -0.0072 | -0.0053 |
| | [0.0027]** | [0.0019]** | [0.0038]* | [0.0024]** |
| **7** | -0.0059 | -0.0046 | -0.0079 | -0.0058 |
| | [0.0026]** | [0.0018]** | [0.0036]** | [0.0023]** |
| **8** | -0.0053 | -0.0045 | -0.0073 | -0.0061 |
| | [0.0024]** | [0.0018]** | [0.0034]** | [0.0023]*** |
| **9** | -0.0046 | -0.0041 | -0.0065 | -0.0056 |
| | [0.0024]* | [0.0020]** | [0.0034]* | [0.0024]** |
| **10** | -0.0027 | -0.003 | -0.0043 | -0.0044 |
| | [0.0025] | [0.0020] | [0.0034] | [0.0024]* |
| **Constant** | 6.9933 | 8.7117 | 7.0555 | 8.7857 |
| | [0.1012]*** | [0.0668]*** | [0.0981]*** | [0.1075]*** |
| **N** | 14223 | 8495 | 14223 | 8495 |
| **R-squared** | 0.92 | 0.95 | 0.92 | 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. The reduced form model regresses log annual earnings on the predicted youth unemployment rate in the province of first residence when D=0, interacted with experience years 0 to 10, plus province of residence fixed effects, experience fixed effects, and year of graduation fixed effects. The instrumental variable model regresses log annual earnings on the instrumented 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. One, two, and three asterix indicates statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively. See text for more details.

**Appendix Table I1: Accounting for Sources of Catch-Up After Early Unemployment Exposure at the Cell-Level, Graduates Only**

| | Based on Year-State-Cohort Cells | | | | Based on Year-State-Cohort-Skill Group Cells | | | |
|---|---|---|---|---|---|---|---|---|
| Exp. Year | Basic Model | With UR History | With Firm Quality | With Firm Quality and UR History | Basic Model | With UR History | With Firm Quality | With Firm Quality and UR History |
| 1 | -0.0177 [0.0026]*** | -0.016 [0.0027]*** | -0.0107 [0.0023]*** | -0.0085 [0.0023]*** | -0.0177 [0.0026]*** | -0.0162 [0.0027]*** | -0.0089 [0.0021]*** | -0.0078 [0.0022]*** |
| 2 | -0.0181 [0.0021]*** | -0.017 [0.0024]*** | -0.0092 [0.0017]*** | -0.0083 [0.0019]*** | -0.0181 [0.0021]*** | -0.0171 [0.0024]*** | -0.0059 [0.0016]*** | -0.0057 [0.0018]*** |
| 3 | -0.0169 [0.0019]*** | -0.0155 [0.0024]*** | -0.0095 [0.0015]*** | -0.0083 [0.0021]*** | -0.0168 [0.0018]*** | -0.0157 [0.0024]*** | -0.0069 [0.0014]*** | -0.0066 [0.0020]*** |
| 4 | -0.0134 [0.0017]*** | -0.0111 [0.0022]*** | -0.0083 [0.0015]*** | -0.0065 [0.0019]*** | -0.0134 [0.0017]*** | -0.0112 [0.0022]*** | -0.0062 [0.0014]*** | -0.0048 [0.0019]** |
| 5 | -0.0113 [0.0016]*** | -0.0077 [0.0022]*** | -0.0074 [0.0013]*** | -0.0043 [0.0019]** | -0.0113 [0.0015]*** | -0.008 [0.0022]*** | -0.006 [0.0014]*** | -0.0033 [0.0018]* |
| 6 | -0.0095 [0.0015]*** | -0.006 [0.0024]** | -0.0068 [0.0013]*** | -0.0026 [0.0019] | -0.0095 [0.0014]*** | -0.0063 [0.0024]*** | -0.0053 [0.0013]*** | -0.0016 [0.0017] |
| 7 | -0.0087 [0.0016]*** | -0.0028 [0.0029] | -0.0052 [0.0013]*** | 0.0007 [0.0019] | -0.0087 [0.0016]*** | -0.0036 [0.0028] | -0.0033 [0.0013]*** | 0.0017 [0.0017] |
| 8 | -0.0085 [0.0017]*** | -0.0034 [0.0030] | -0.0044 [0.0013]*** | 0 [0.0022] | -0.0085 [0.0017]*** | -0.0041 [0.0029] | -0.0024 [0.0012]** | 0.0009 [0.0020] |
| 9 | -0.0075 [0.0017]*** | -0.0028 [0.0028] | -0.0034 [0.0013]** | -0.0012 [0.0021] | -0.0075 [0.0017]*** | -0.0035 [0.0027] | -0.0013 [0.0012] | -0.0007 [0.0019] |
| 10 | -0.0062 [0.0018]*** | -0.0015 [0.0028] | -0.0027 [0.0014]* | -0.0017 [0.0023] | -0.0062 [0.0017]*** | -0.002 [0.0027] | -0.001 [0.0012] | -0.0014 [0.0021] |

Notes: Regressions in columns 1 to 4 at level of graduation cohort, state of first residence, state of current residence, and calendar year. Columns 5 to 8 add interaction with predicted earnings at time of graduation. All regressions include dummies for graduation cohort, state of residence at graduation, state of current residence, calendar year, and experience. Where appropriate, we also include skill-group dummies. The analysis is replicated by skill-group in the Appendix. All regressions weighted by cell size. Standard errors clustered at cohort-state of first residence level.

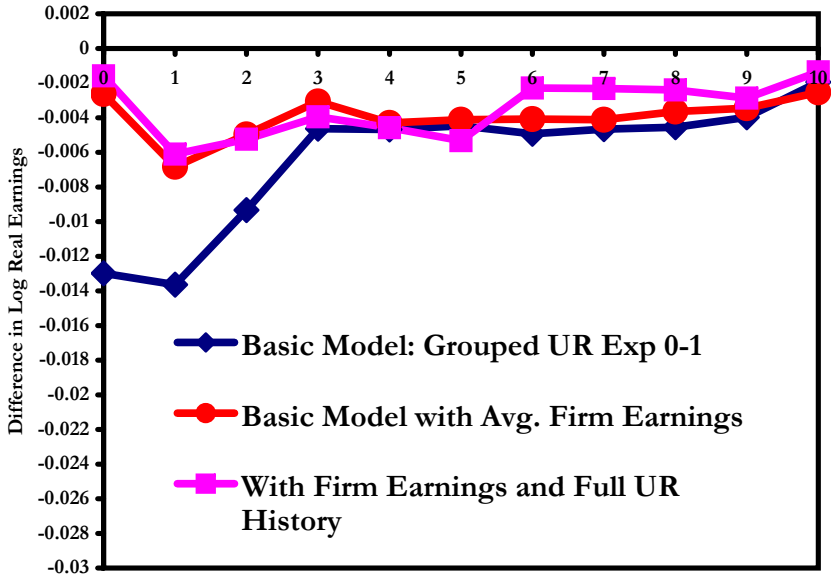
**Appendix Table I2: Accounting for Sources of Catch-Up After Early Unemployment Exposure At the Cell Level, Separately By Skill Group, Graduates Only**

| | Top 20% Predicted Earnings | | | | Middle 20% Predicted Earnings | | | | Bottom 20% Predicted Earnings | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp. Year | Basic Model | With UR History | With Firm Quality | With Firm Quality and UR History | Basic Model | With UR History | With Firm Quality | With Firm Quality and UR History | Basic Model | With UR History | With Firm Quality | With Firm Quality and UR History |
| 1 | -0.013 | -0.011 | -0.0026 | -0.0016 | -0.0209 | -0.0194 | -0.0126 | -0.0111 | -0.0228 | -0.0252 | -0.0179 | -0.0209 |
| | [0.0039]*** | [0.0039]*** | [0.0042] | [0.0042] | [0.0040]** | [0.0041]** | [0.0036]** | [0.0038]*** | [0.0065]** | [0.0072]** | [0.0056]** | [0.0064]*** |
| 2 | -0.0136 | -0.012 | -0.0068 | -0.0061 | -0.0267 | -0.0261 | -0.0133 | -0.0129 | -0.0295 | -0.0324 | -0.0234 | -0.0269 |
| | [0.0025]*** | [0.0026]*** | [0.0028]** | [0.0029]** | [0.0038]** | [0.0038]** | [0.0033]** | [0.0034]*** | [0.0064]** | [0.0067]** | [0.0052]** | [0.0056]*** |
| 3 | -0.0093 | -0.009 | -0.005 | -0.0052 | -0.0245 | -0.0224 | -0.0162 | -0.0148 | -0.0256 | -0.0313 | -0.0193 | -0.0255 |
| | [0.0022]*** | [0.0029]*** | [0.0021]** | [0.0029]* | [0.0032]** | [0.0039]** | [0.0030]** | [0.0037]*** | [0.0056]** | [0.0060]** | [0.0044]** | [0.0052]*** |
| 4 | -0.0046 | -0.005 | -0.0031 | -0.0039 | -0.0191 | -0.016 | -0.0128 | -0.0107 | -0.021 | -0.0247 | -0.0169 | -0.0192 |
| | [0.0019]** | [0.0025]* | [0.0020] | [0.0025] | [0.0030]** | [0.0036]** | [0.0027]** | [0.0031]*** | [0.0055]** | [0.0054]** | [0.0045]** | [0.0043]*** |
| 5 | -0.0047 | -0.005 | -0.0043 | -0.0046 | -0.0171 | -0.0124 | -0.013 | -0.0081 | -0.0142 | -0.0184 | -0.0104 | -0.0126 |
| | [0.0020]** | [0.0028]* | [0.0019]** | [0.0025]* | [0.0025]** | [0.0033]** | [0.0024]** | [0.0030]*** | [0.0054]** | [0.0064]** | [0.0047]** | [0.0055]** |
| 6 | -0.0045 | -0.005 | -0.0041 | -0.0053 | -0.0132 | -0.0085 | -0.0102 | -0.004 | -0.0134 | -0.0195 | -0.0077 | -0.0128 |
| | [0.0019]** | [0.0027]* | [0.0018]** | [0.0026]** | [0.0025]** | [0.0033]** | [0.0023]** | [0.0029] | [0.0050]** | [0.0054]** | [0.0040]* | [0.0046]*** |
| 7 | -0.0049 | -0.002 | -0.0041 | -0.0023 | -0.0114 | -0.0044 | -0.0077 | 0.0002 | -0.0128 | -0.0175 | -0.0057 | -0.0078 |
| | [0.0019]*** | [0.0032] | [0.0017]** | [0.0030] | [0.0027]** | [0.0038] | [0.0024]** | [0.0031] | [0.0056]** | [0.0068]** | [0.0047] | [0.0059] |
| 8 | -0.0047 | -0.001 | -0.0041 | -0.0023 | -0.0113 | -0.0045 | -0.0075 | -0.0007 | -0.0121 | -0.0127 | -0.0076 | -0.0052 |
| | [0.0020]** | [0.0035] | [0.0018]** | [0.0034] | [0.0030]** | [0.0045] | [0.0024]** | [0.0035] | [0.0055]** | [0.0068]* | [0.0045]* | [0.0059] |
| 9 | -0.0046 | 0.000 | -0.0036 | -0.0024 | -0.0099 | -0.0037 | -0.0051 | -0.0001 | -0.0107 | -0.0121 | -0.0049 | -0.0042 |
| | [0.0021]** | [0.0033] | [0.0019]* | [0.0031] | [0.0029]** | [0.0040] | [0.0024]** | [0.0034] | [0.0054]* | [0.0068]* | [0.0044] | [0.0057] |
| 10 | -0.004 | 0.000 | -0.0034 | -0.0029 | -0.0064 | -0.0022 | -0.0021 | 0.0005 | -0.018 | -0.0175 | -0.0109 | -0.0109 |
| | [0.0021]* | [0.0032] | [0.0019]* | [0.0033] | [0.0031]** | [0.0039] | [0.0025] | [0.0032] | [0.0069]** | [0.0068]** | [0.0057]* | [0.0060]* |

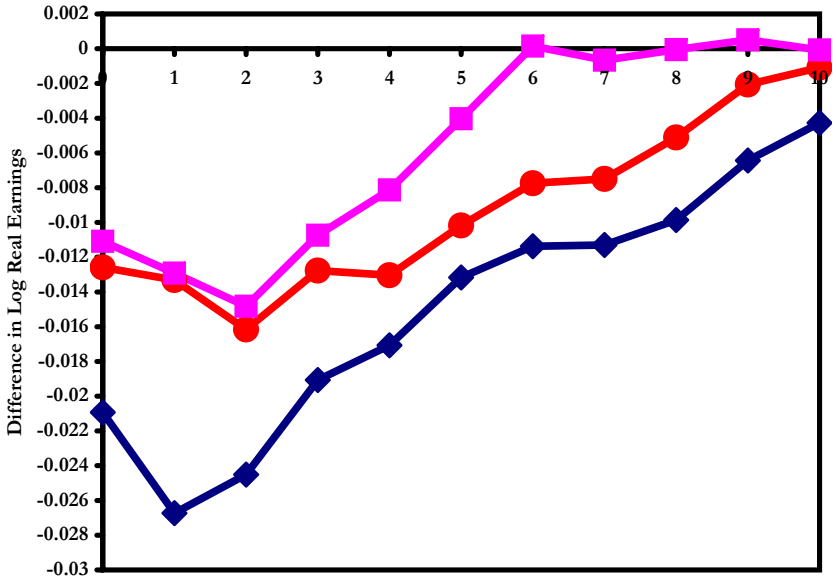
Notes: Regression at level of graduation cohort, state of first residence, and calendar year. All regressions weighted by cell size. Standard errors clustered at cohort-state of first residence level. See notes to Appendix Table I1 and text.

**Appendix Figure I1: Sources of Catch-Up After Early Unemployment Exposure by Skill-Group, Cell Level Models**

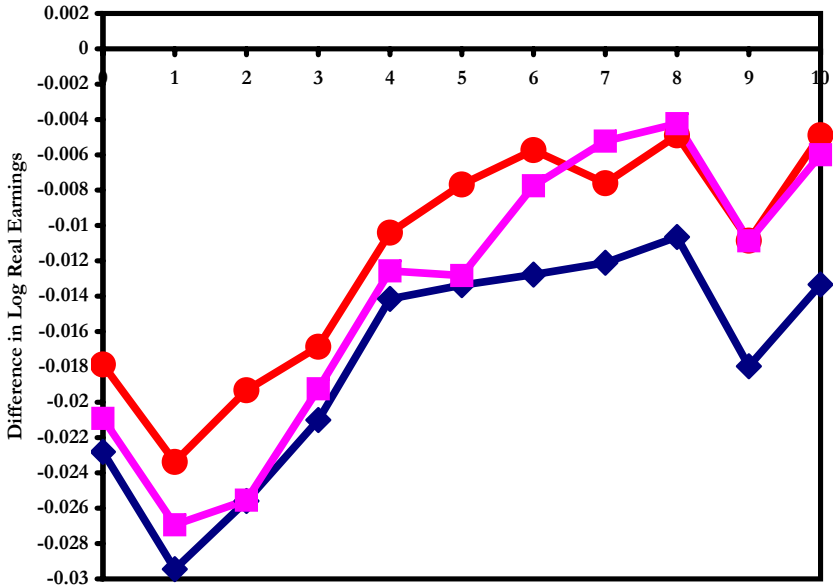
**Panel A: Top 20% of Predicted Earnings at Graduation**




**Panel B: Middle 20% of Predicted Earnings at Graduation**

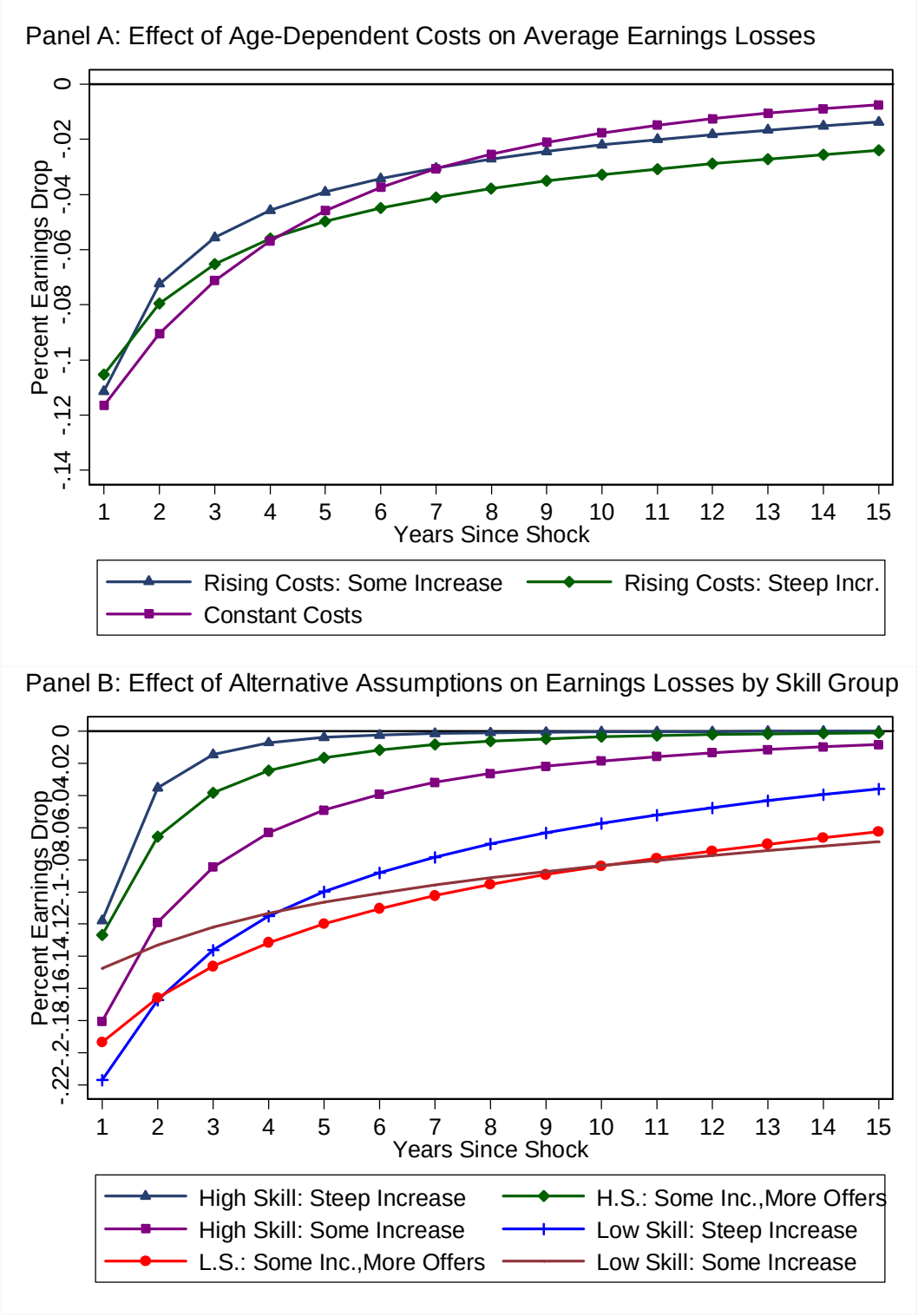



**Panel C: Bottom 20% of Predicted Earnings at Graduation**




Notes: See notes of Figure 8 and discussion in text.

**Appendix Figure J1: Simulation of Predicted Effect of Decline in Initial Hiring Rate at Good Firms on Earnings in our Model of Endogenous Job Search**




Notes: See discussion in Sensitivity Appendix E.