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# The Impact of Firing Costs on Wages Across Various Educational Categories

Jhon Jair Gonzalez Pulgarin\*

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## Abstract

This paper presents an analysis of how firing costs impact the wages. The analysis exploits the changes of the employment-at-will introduced in different states from 1977 to 1997 in the United States, to evaluate how these increases in firing costs affected the wages of individuals with varying levels of education. A quasi-experimental approach reveals negative effects of these reforms at both the top and bottom of the wage-education distribution, indicating a polarized impact. The calibration of a standard search and matching highlights the crucial role of the probability of match-specific productivity changes in explaining the strong negative effect of firing costs on wages at both ends of the wage distribution.

**Keywords:** firing costs, employment-at-will, employment protection, difference-in-difference, search and matching.

**JEL Classification:** D04, J01, J08

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# 1 Introduction

The United States saw a well-documented rise in firing costs during the period 1977-1997 (Autor, 2003). This raises the question of whether the macroeconomic wage dynamics and the evolution of firing costs are related. This study aims to analyze this relationship by exploring whether increasing firing costs affects the wage growth of individuals with varying educational backgrounds during 1977 and 1997 for the United States. The motivation for examining the effects of firing costs on the wage-educational distribution is rooted in both empirical and theoretical considerations. Empirical data highlights the importance of considering variations in wage growth among educational categories across different states. From a theoretical standpoint, the differentiated impact can be attributed to potential changes in labor market conditions resulting from increased firing costs. These costs can potentially amplify the effects of search frictions on employment and wages. For instance, firms would lower their dismissal threshold if employment protection regulations are increasing, even more in a context of falling job separation rates across educational levels as estimated in Cairó and Cajner (2018). This results in reduced average job productivity and, consequently, lower wages. Additionally, the proportion of firms affected by idiosyncratic shocks may be higher for the least educated workers compared to other educational categories, because of the deteriorating labor market conditions for individuals with lower levels of education. Therefore, the combination of decreasing dismissal thresholds and variations in arrival probabilities of idiosyncratic shocks across different educational groups, motivates the empirical and theoretical assessment of this paper.

To address this question, the paper employs both empirical and theoretical evaluations, using panel data and search-matching models. The panel data is compiled from diverse sources, including the Current Population Survey, surveys from the Bureau of Economic Analysis, the Employment Survey of the Bureau of Labor Statistics, and data from Autor (2003). This dataset provides comprehensive state-level information, including wage data for different educational categories, states with exceptions to employment-at-will policies, GDP figures, employment statistics, and other relevant factors. These data enable the estimation of the average treatment effect associated with the implementation of these regulations on the wages of individuals with varying educational backgrounds, through a difference-in-difference approach with staggered treatment. The estimation leverages the methodology outlined by Roth et al. (2022), Callaway and Sant'Anna (2021), and Sun and Abraham

(2021). From a theoretical perspective, this paper examines the impact of firing costs on wages, considering a segmented labor market characterized by endogenous job finding probabilities and endogenous job destruction, in alignment with the works of [Mortensen and Pissarides \(1994\)](#), [Pissarides \(2000\)](#), [Kugler and Saint-Paul \(2004\)](#). This theoretical framework is calibrated using data from [Cairó and Cajner \(2018\)](#).

This paper establishes the existence of a theoretical and empirical negative impact of increasing firing costs on the wages of individuals who are high school dropouts or have education levels greater than college attainment: a polarized effect. Empirically, the Average Treatment Effect of rising firing costs shows a negative effect on wages within selected states. It is important to note that due to data limitations, the econometric regressions could not be executed using information covering the entire United States territory. Furthermore, the extent of these effects varies depending on the level of education. Notably, the estimations reveal a strong negative effect for individuals with greater than a college educational background and for high school dropouts. The theoretical model shows that firing costs have a detrimental impact on equilibrium wages for incumbent workers. When the model is calibrated, the results suggest a negative effect of increasing employment protection regulation on the tails of the wage-educational distribution. This effect is more pronounced for individuals who are high school dropouts or have education levels greater than college attainment, in comparison to other education categories. The extent of these results might potentially be explained by simultaneous declines in dismissal thresholds and varying arrival probabilities of idiosyncratic shocks.

**Related Literature** When it comes to the impact of dismissal costs on employment, economic theory doesn't offer clear-cut predictions. However, it does shed light on the efficiency of hiring and firing practices. For instance, [Autor et al. \(2007\)](#) argues that under certain circumstances, firing costs can increase a firm's adjustment costs, which, in turn, may negatively affect worker flows. [Blanchard and Tirole \(2008\)](#) find that higher firing taxes can lead to increased wages, as worker bargaining power strengthens. In [Pissarides \(2000\)](#) the outside wage increases by a fraction of the hiring subsidy, conversely, the outside wage decreases by a fraction of the firing tax, as the firm becomes liable to the tax if the worker accepts the job. The inside wage was unaffected by the hiring subsidy but increased with firing taxes since the firm should pay the tax if the worker doesn't agree to continue the job match. [Bentolila and Bertola \(1990\)](#) emphasize the critical role of economic

uncertainty and dynamics in shaping a firm's policies regarding firing and hiring. They highlight that the impact of firing costs is contingent on the economic environment. During the 1980s, for instance, firing costs held relatively significant importance in Germany, the UK, and France. This significance was particularly notable following the first oil shock, where a simultaneous decline in demand and productivity growth rates, coupled with increased volatility, shaped the economic landscape.

Empirical findings of employment protection are also mixed. Lazear (1990) find that any optimal contract can undo the effects of severance payments<sup>1</sup>. Furthermore, severance payments lowers the number of jobs in the economy, reduces the size of the labor force, and increase the unemployment rate. Acemoglu and Angrist (2001) find a decline in relative employment of disabled individuals aged between 21 and 39, with no effects on wages. Firings also appear to be high in states that implemented more ADA-related discrimination charges. Autor et al. (2007) find a decline in total factor productivity in states adopting the Covenant of Good Faith and Fair Dealing exceptions. Additionally, Kugler and Saint-Paul (2004) find that unemployed job seekers face reduced probabilities of finding employment compared to the employed due to a combination of increased employment protection and adverse selection.

According to Doepke and Gaetani (2020), employment protection plays a crucial role in explaining the college wage premium. It affects the incentives for firms and workers to invest in productive relationships. German firms, in contrast to those in the United States, create job positions that allow low-skilled workers to learn on the job, accumulate skills, increase productivity, and consequently, raise their wages. Cervini-Plá et al. (2014) focus on the impacts of reducing payroll taxes and firing costs in Spain, using a matching model that assesses the effects on entry wages for new entrants and incumbents. Cervini-Plá et al. (2014) find unclear effects of payroll taxes on wages and, in line with the results discussed here, negative effects of firing costs on the entry-level wages. Their evaluation of the Spanish reform relies on standard difference-in-difference estimations, comparing individuals affected by the reform (young and old workers) with those in their prime working age. The econometric estimations suggest that reduced firing costs and payroll taxes led to increased wages for new entrants and incumbents.

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<sup>1</sup>Any mandatory governmental transfer from agent A to agent B, can be compensated by a voluntary transfer of the same amount from B to A.

## 2 Data for Measuring the Effect of the Firing Costs on Wages

The panel data used in this study is an aggregation of individual state-level observations from the IPUMS-administered version of the Current Population Survey of the United States. It includes information on Gross Domestic Product and employment from the Bureau of Economic Analysis, as well as data on unemployment and various characteristics obtained from surveys conducted by the Bureau of Labor Statistics. The identification of states that have adopted regulations related to employment-at-will is based on observations extracted from [Autor \(2003\)](#). The dataset covers the period from 1977 to 1997, with the District of Columbia excluded due to data availability issues. For the preferred estimation, specific states have not been included (additional details can be found in the appendix [B](#)).

**Wages** The central variable in this analysis is "wages," which is based on the `INCWAGE` data from the CPS (IPUMS version). It provides information about the nominal total pre-tax wage and salary income received as an employee for the previous calendar year. The survey question related to this variable has undergone slight changes over different samples (for more details, refer to appendix [B](#)).

**Education** This paper constructs and analyzes five educational variables using the `educ` data from the CPS (IPUMS version) and `higrade`. Workers are classified into five different groups: 1. High school dropout (individuals with 0 to 12 years of education, unfinished). 2. High school diploma holder (individuals with 12 years of education or holding a high school diploma). 3. Individuals with some college education (those who completed one, two, or three years of college or did not finish four years of college). 4. College-educated workers (individuals with a college degree or four years of college education). And 5. Those with greater than college educational levels (those with a master's or PhD degree or more than four years of college education).

**Exceptions to the Employment-at-will** [Autor \(2003\)](#) extensively documented the evolution of state exceptions to employment-at-will from 1950 to 1997. This dataset allows the identification of when different states adopted exceptions to employment-at-will, including implied contract, 'good faith,' and public policy provisions <sup>2</sup>. Employment-at-will policy allows employers to discharge or

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<sup>2</sup>additional graphical illustrations can be found in appendix [A](#) and graph [6](#)

retain employees at will, with or without cause, without being inherently unlawful. The employment-at-will policy states "discharge or retain employees at will for good cause or for no cause, or even for bad cause without thereby being guilty of an unlawful act per se."<sup>3</sup> According to [Kugler and Saint-Paul \(2004\)](#) the adopted exceptions to the employment-at-will in the United States can be classified into three categories: the implied contract, the public policy and the 'good faith' exception. The implied contract exception suggests that there exist implied contractual provisions that limits the ability of the employers to fire workers. The public policy exceptions restricts the employers' ability to terminate contracts of workers that are reluctant to commit actions against to or protected by public policy. Finally, the 'good faith' exception limits employers from terminating contractual relationships that look for avoiding the payment of pensions and bonuses. According to [Kugler and Saint-Paul \(2004\)](#), the 'good faith' exception is the tightest regulation as it imposes that a dismissal should be based on causes.

### 3 Econometric Strategy

#### 3.1 Average Treatment Effect in Staggered Settings

There is heterogeneity in time as the number of states that implement the reform increases over time. The differences across states is relevant as they are different. Therefore, a simple and direct, while controversial (see e.g. [Callaway and Sant'Anna \(2021\)](#), [Sun and Abraham \(2021\)](#), [Roth et al. \(2022\)](#)) method to evaluate the effect of the reform, the adoption of the exceptions to the employment-at-will, is to estimate two ways fixed effects (TWFE) models, that include time and state effects. However, this is only valid if the parallel trends and the no anticipation assumption are satisfied, and further, if there is no heterogeneity in treatment effects across time or units. In that case, the population coefficient of the TWFE coincides with the Average Treatment Effect of the difference-in-difference estimation [Roth et al. \(2022\)](#). However, the nature of the treatment associated with the implementation of the exceptions to the employment-at-will is staggered in time, and therefore, the standard two ways fixed effects yields wrong estimates for the average treatment

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<sup>3</sup>(Payne v. Western & Atlantic Railroad, 1884, Tennessee Supreme Court, 82 Tenn. 507 (1884), 519–20, 1884 WL 469 at \*6 (Sep. term 1884).), as cited in [Kugler and Saint-Paul \(2004\)](#).

effect<sup>4</sup>. Recent research findings have developed alternative estimators when there is heterogeneity in treatment across units or time, or when the nature of treatment is staggered. The estimator used in this paper have been obtained from the application of the method of [Callaway and Sant’Anna \(2021\)](#) because the design of the experiment is the closest to the setting presented in this paper. Furthermore, it allows to choose the comparison group: the never treated or the not-yet treated.

Based on [Roth et al. \(2022\)](#) and [Callaway and Sant’Anna \(2021\)](#), and under extended versions of the parallel and no anticipation assumption<sup>5</sup>, the following estimation is carried out:

$$\widehat{ATT}(g, t) = \mathbb{E}[W_{it} - W_{i,g-1} | G_i = g] - \mathbb{E}[W_{it} - W_{i,g-1} | G_i \in \mathcal{G}]$$

The expression before can be estimated as:

$$\widehat{ATT}(g, t) = \frac{1}{N_g} \sum_{i:G_i=g} [W_{it} - W_{i,g-1}] - \frac{1}{N_{\mathcal{G}}} \sum_{i:G_i \in \mathcal{G}} [W_{it} - W_{i,g-1}] \quad (1)$$

Where  $W_{it}$  represents the wages of workers belonging to the different groups of education. Consider  $G_i = \min\{t : D_{it} = 1\}$  the earliest period at which unit  $i$  has received treatment. If the unit never receives treatment during the sample,  $G = \infty$ . Treatment is an absorbing state, which implies that once the unit is treated, it remains treated, for all  $t \geq G_i$ , hence  $R_{it} = t - G_i + 1$  the time relative to treatment, so that  $R_{it} = 1$  is the first treated period for unit  $i$ . The expression (1) is a generalization of the standard difference in difference estimator [Roth et al. \(2022\)](#).

The equation (1) can be interpreted as comparison between the expected change in the dependent variable for cohort  $g$  between periods  $g - 1$  and  $t$  to that for a control group not-yet/never treated at period  $t$ . [Callaway and Sant’Anna \(2021\)](#) consider two options for  $\mathcal{G}$ . The first is to use the never treated units ( $\mathcal{G} = \{\infty\}$ ) and the second uses the not yet treated units ( $\mathcal{G} = \{g' : g' > t\}$ ). in this

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<sup>4</sup>[Roth et al. \(2022\)](#) discusses the issue, in particular, the estimated parameter of a TWFE estimation does not correspond with a causal parameter. In fact, the estimation of  $\beta_{TWFE}$  corresponds to to a potentially non convex weighted average of the difference-in-difference estimator, that can be negative and reverse the sign of the causal effect.

<sup>5</sup>Two Important remarks: 1. The parallel trends assumption, in its strongest version, assumes that the dependent variable would have evolved *parallel* in case the treatment has not occurred. 2. The no anticipation assumption establishes that the treatment of an untreated unit today does not depend on when it will happen in the future.



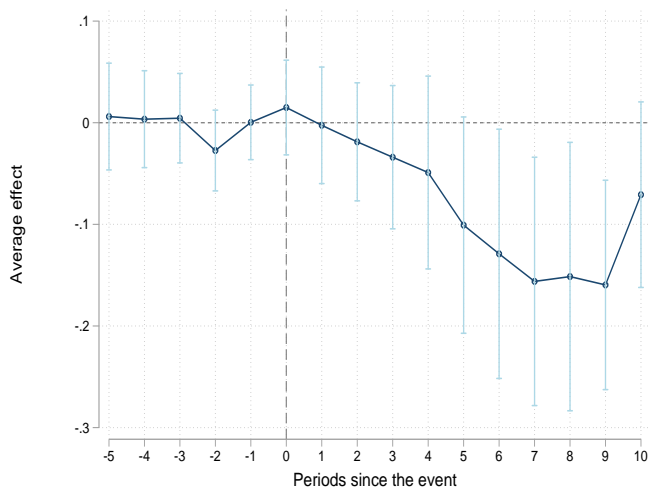
paper, the not-yet-treated approach is privileged as the number of never treated states is very low.

### 3.2 Implementation

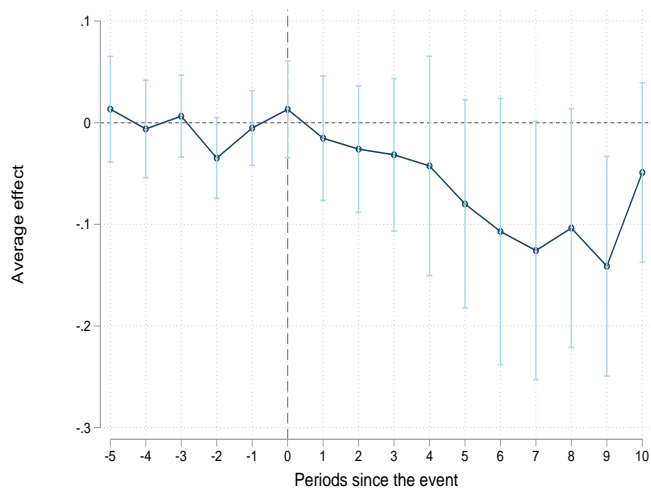
This section presents the primary results of the previously discussed econometric strategy. States are classified into three categories: 'treated,' 'never treated,' and 'not yet treated.' 'Treated' states implemented at least one of the most common exceptions to the employment-at-will policy within a specific year between 1977 and 1997. 'Never treated' states, including Florida, Georgia, Louisiana, and Rhode Island, did not enact any employment-at-will regulations during that period. It's important to note that states transition from 'not yet treated' to 'treated' upon implementing these regulations.

The estimation of the expression (1) initially uses the 'not-yet treated' group for comparison, which is later compared to estimates from the 'never treated' units. These estimations are performed without covariates since they must be measured before the implementation of the reform, and the variables in the sample do not meet this condition. The process includes estimating the Average Treatment Effect of employment reforms on wages across five educational categories. Subsequently, event study plots are presented comparing the treatment's effect before and after the reform implementation. The main results are presented in table 1 (further estimates are presented in the appendix C).

Table 1 presents average treatment effect estimates (simple weighted average, weighted only by group size) for wages across different educational categories, including high school dropouts, high school graduates, individuals with some college, college graduates, and those with education beyond college. In column 2, the estimates are based on the 'not yet treated' group as the comparison, assuming unconditional parallel trends without covariates. Column 3, on the other hand, uses the 'never treated' group as the comparison under unconditional parallel trends without covariates. These estimates correspond to the expression (1). The results reveal a statistically significant negative average treatment effect on wages for high school dropouts and individuals with education beyond college, indicating that increases in employment protection, specifically the tightening of employment-at-will regulations, negatively impact wages. In particular, adopting one of the exceptions to the employment-at-will implies a reduction of 8.82% of average wages at the state level (column 2). To put it in perspective, if real wages for high school dropouts averaged \$6,906.096



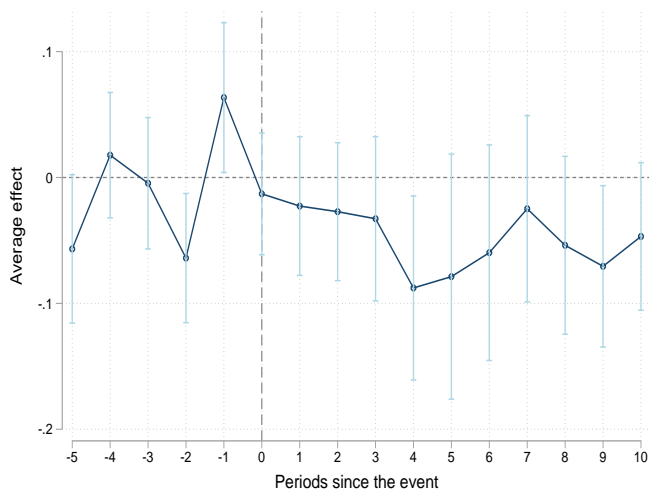
(a) Not Yet Treated



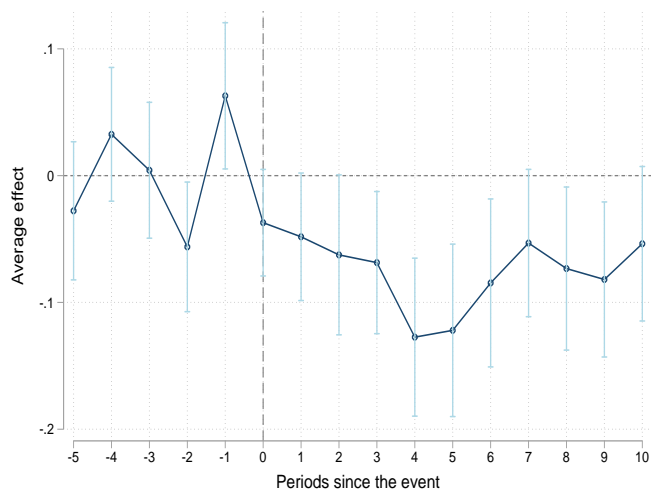
(b) Never Treated

Figure 1: **Average Treatment Effect, Wages High School Dropout**

Panels (a) and (b) present the effects of the employment protection prior and posterior to the implementation of the reform. The comparison group used in the panel (a) is the not yet treated units, while in panel (b) the comparison is made with never treated units. The estimation uses the method of Callaway and Sant'Anna (2021).



(a) Not Yet Treated



(b) Never Treated

Figure 2: **Average Treatment Effect, Wages Greater than College**

Panels (a) and (b) present the effects of the employment protection prior and posterior to the implementation of the reform. The comparison group used in the panel (a) is the not yet treated units, while in panel (b) the comparison is made with never treated units. The estimation uses the method of Callaway and Sant'Anna (2021).

in 1990 at the state level, the adoption of one of the exceptions to employment-at-will led to an average loss of \$608 at the state level compared with states that have not implemented the reform but will do so later. Regarding individuals with education beyond college, their average wages were \$45,231.24 in 1990; hence, the reduction would be 5.46% (column 2) or \$2,470 after increased employment protection compared to states that have not yet implemented the reform. Estimates in column 3 provide similar results but are compared to never-treated states. Interestingly, the effects are more pronounced for high school dropouts than for individuals with education beyond college. This suggests that the rise in firing costs in the United States from 1977 to 1997 resulted in polarized and negative effects on the wage-educational distribution, reducing wage inequalities at the extremes but increasing them in the middle.

The event study graphs for high school dropouts and individuals with education beyond college are presented in Figures 1 and 2, respectively. These graphs indicate no significant effects before the reform, but they do reveal some negative effects following the implementation of exceptions to the employment-at-will. In particular, after nine periods of implementing the reforms, states will expect to see average wages of high school dropouts to reduce more than 10% (panel (a) of figure 1). For individuals with educational levels beyond college, wages are expected to fall around 9% after four periods of implementing the reform (panel (a) of figure 2).

Average Treatment Effect (Sample Weighted Average)		
	Unconditional Parallel Trends (without covariates. Not yet as comparison)	Unconditional Parallel Trends (without covariates. Never treated as comparison)
High School Dropout Wages	-0.0882238 (0.014)	-0.0770335 (0.038)
High School Wages	-0.0159317 (0.496)	-0.0138913 (0.593)
Some College Wages	-0.0321528 (0.341)	-0.0257788 (0.478)
College Wages	-0.0246264 (0.501)	-0.0407847 (0.268)
Greater than College Wages	-0.054616 (0.029)	-0.0742299 (0.002)

Table 1: **Effect of the Firing Costs on Wages of Different Educational Categories**

### 3.3 Discussion

This section discusses the main assumptions of the econometric method outlined in [Callaway and Sant'Anna \(2021\)](#) and the obtained results. The first assumption concerns the absorbing state of treated units, with the additional requirement that no unit is treated in the first period. This assumption is mostly met by the subset of the sample used in this paper, as all states remained treated after the implementation of the treatment. However, due to data limitations, it was not possible to consider states with regulatory changes before 1960, as wage time series data only starts after 1966.

The second assumption outlined in [Callaway and Sant'Anna \(2021\)](#) pertains to random sampling, which is largely met by the subsample. The third assumption concerns limited treatment anticipation, meaning that units might anticipate but not perfectly predict the treatment. In the context of exceptions to employment-at-will, states may anticipate the policy's adoption, but the precise timing of such adoption is uncertain due to political considerations.

In the context of the parallel trends assumption, [Callaway and Sant'Anna \(2021\)](#) discuss two versions depending on the choice of the comparison group: 'not yet treated' or 'never treated' units. This assumption is more flexible than the standard parallel trends requirement as it should only hold conditionally on covariates that influence the trends of outcomes over time when their distribution differs across groups. If the number of 'never treated' units is very low, it's advisable to use the 'not yet treated' as comparison group, although this comes with some limitations. In the absence of treatment anticipation, using 'never treated' units does not impose restrictions on observed pre-treatment trends, unlike the 'not yet treated' group. Not restricting pre-trends implies that outcomes might not have evolved in parallel prior to treatment implementation, but trends could align in later periods. In this paper, the 'not yet treated' units is privileged and the unconditional parallel trends assumption should therefore hold, which is partially met since at least one pre-trend is significant. Finally, [Callaway and Sant'Anna \(2021\)](#) notes that the generalized propensity score should be uniformly bounded away from 1.

It's important to note the potential issue of endogeneity, given that the reform has known effects on employment, as discussed in [Autor \(2003\)](#) and [Kugler and Saint-Paul \(2004\)](#). Economic agents may anticipate these effects and relocate to states with less stringent labor regulations.

## 4 The Model

### 4.1 Description of the Model

The model is based on [Pissarides \(2000\)](#) and [Kugler and Saint-Paul \(2004\)](#) extended to account different types of workers, the model includes wage bargaining à la Nash and endogenous job destruction. Workers are differentiated by their level of education and corresponding level of productivity,  $\eta$ , which can be high school dropout (*HSD*), high school (*HS*), some college (*SC*), college (*COL*) and greater than college (*GCOL*). Corresponding productivity levels have an increasing profile coherent with their level of education, hence the lowest productivity level belongs to individuals classified in the high school dropout group. On the other hand, firms can freely enter the market by creating vacancies. After the position is created, the firm entails a cost  $C$  of keeping a position unfilled. During hiring, workers arrive to vacant jobs at initially exogenous rate  $f$ . Before the match, firms do not know either the type of the workers nor their past labor history; the firms only observe the applicant's level of education and can direct the search to a specific market. After hiring, the firms observe the productivity of the worker. When a match is formed, production starts and the output of the firm per unit of time is  $m + \eta$ ,  $m$  is match-specific component and  $\eta$  is worker specific. The firm observes total  $m + \eta$  and will prefer to hire workers with high  $\eta$  to ensure itself against a possible  $m$  low, hence keeping the workers and avoiding to pay firing costs<sup>6</sup>.

Initially, when the match is formed, the match specific component equals  $\bar{m}$ , however, the firm can be hit by a shock that arrives with probability  $\gamma$ , and it changes the productivity of the match.  $G(m)$  with support  $[\underline{m}, \bar{m}]$  is an uniform cumulative distribution function, from which the new productivity is drawn.

### The Nash Sharing Rule: Initial or Outside Wages

In the presence of firing costs, two types of wages exist: inside wages and outside wages. Inside wages are defined for incumbent workers, for whom firing costs are operative. Wages are set to maximize the Nash rule.  $\beta$  is therefore the bargaining power of the worker with  $\beta \in (0, 1)$ . For the

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<sup>6</sup>Firing costs are considered in this framework as administrative costs incurred once the firm fires a workers and he/she starts litigation. The amount of these costs are completely exogenous to the model and represented by an unique parameter  $F$ . We are aware that if costs are pure transfers, there are no have effects on employment ([Mortensen \(1978\)](#) and [Lazear \(1990\)](#) discussed by ([Acemoglu and Angrist, 2001](#))).

outside wage, the surplus is:

$$S_0 = (E(\bar{m}, \eta) - U(\eta))^\beta (J(\bar{m}, \eta) - V)^{1-\beta}$$

For **inside** wages, there is the need to take into account the firing costs in the Nash rule:

$$S = (E(m, \eta) - U(\eta))^\beta (J(m, \eta) - V + F)^{1-\beta}$$

Over the next subsections the expressions for  $E(m, \eta)$ ,  $J(m, \eta)$ ,  $V$ , and  $U(\eta)$  are defined.

### The Value Function of Being Employed

$$rE(m, \eta) = w(m, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} E(x, \eta) g(x) dx + G(m_c(\eta)) U(\eta) - E(m, \eta) \right]$$

Individuals with a job earn a wage  $w(m, \eta)$  which is the result of a Nash bargaining.  $m_c$  is the threshold productivity under which a worker is fired. The expression in square brackets is the capital gain or loss from being hit by a shock or in other words the worker with productivity  $\eta$  and match specific component  $m$  enjoys expected return  $E(m, \eta)$  which he has to give up when the shock arrives. If the new productivity  $m \notin [m_c, \bar{m}]$ , the worker is fired and joins the pool of unemployment with an expected return  $U(\eta)$ .

### The Value Functions of Being Unemployed

$$rU(\eta) = b + f \left[ E(\bar{m}, \eta) - U(\eta) \right]$$

Where  $b$  represents the unemployment benefits, and the expression in brackets is the expected capital gain from a change of state employed and unemployed.  $f$  is the probability of moving into employment.

## The Value Functions for the Firm

The firm fires the worker if  $J(m, \eta) < -F$ . The dismissal threshold is represented by  $J(m_c(\eta), \eta) + F = 0$ . This is the reservation productivity equation. The value function of an occupied job is

$$rJ(m, \eta) = m + \eta - w(m, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} J(x, \eta) g(x) dx - G(m_c(\eta))F - J(m, \eta) \right]$$

When the firm creates a new job, it starts at the maximum productivity level,  $m = \bar{m}$ . Idiosyncratic productivity shocks might arrive at rate  $\gamma > 0$  and are drawn from the distribution  $G(m)$ .

## The Value of a Vacancy

$$rV = -C + a(J(\bar{m}, \eta) - V)$$

All jobs are created at maximum idiosyncratic productivity  $m = \bar{m}$ . The firms will continue opening vacancies until the profits from vacancies equals zero.  $a$  represents the rate of workers arrival to vacant jobs.

## Optimal Wages

Each time an idiosyncratic shock arrives wages are negotiated. The inside and outside equilibrium wages are defined below. The complete solution of the model is presented in the appendix [D](#).

The **Inside wage**

$$w(m, \eta) = \beta(m + \eta + rF) + (1 - \beta)b + \beta f(1 - \beta) \left[ \frac{\bar{m} - m_c}{r + \gamma} - F \right]$$

The **Outside wage**

$$w_0(\bar{m}, \eta) = \beta(\bar{m} + \eta - \gamma F) + (1 - \beta)b + f\beta(1 - \beta) \left[ \frac{\bar{m} - m_c}{r + \gamma} - F \right]$$

In a general equilibrium context, wages depend on the match-specific component ( $m$ ), the individual component ( $\eta$ ), labor market tightness (when job-finding probabilities are endogenous), and firing costs. The wage equations are close to those presented in [Pissarides \(2000\)](#), with the key distinction being the inclusion of the worker-specific component ( $\eta$ ).

## 4.2 Effects of the Firing Costs

This section discusses the main findings regarding the effect of the firing costs on wages. It seems evident to focus on inside wages, as the firing costs are operative for incumbent workers as in [Pissarides \(2000\)](#).

### 4.2.1 Exogenous Meeting Rates

With exogenous meeting rates the effect of the firing costs can be found by differentiating the inside wage equation:

$$\frac{dw(m, \eta)}{dF} = -\beta f \frac{1 - \beta}{r + \gamma} \frac{dm_c}{dF} + \beta(r - (1 - \beta)f) \quad (2)$$

The above expressions leaves explicitly the need of computing the effect of the firing costs on the dismissal threshold  $m_c(\eta)$ . This leads to the first important result of this paper, summarized in [proposition 1](#).

**Proposition 1.** *Considering exogenous meeting rates, the effect of the firing costs on the dismissal threshold is negative  $\frac{dm_c}{dF} < 0$ .*

The [proposition 1](#) shows that increasing employment protection leads the firms to lower the dismissal threshold hence retaining workers that otherwise would be fired. The derivation of this result can be found in the [appendix D.1.1](#). The effect on the dismissal threshold allows the computation of the expression [\(2\)](#), yielding the second result of this paper.



**Proposition 2.** *Considering exogenous meeting rates,  $f$ , the effect of the firing costs on wages is determined by a single expression:  $1 - (\gamma + r)$ . For  $(\gamma + r)$  sufficiently low, the effect of increasing firing costs on wages is positive.*

The expression of proposition 2 is derived in the appendix D.1.1. It appears reasonable to assume that the share of firms hit by idiosyncratic shocks and interest rates are low enough for this term 2 to hold. In the calibrated model,  $r$  is close to zero, therefore, the parameter  $\gamma$  will play a key role in determining the final effect of the firing costs on the wage distribution.

When exogenous meeting rates are considered, the analysis may not fully capture all dynamics of labor markets. Next section introduces endogenous job finding probabilities.

#### 4.2.2 Endogenous Meeting Rates

In the presence of endogenous meeting rates, there is a matching technology that defines the meetings between unemployed workers and vacancies, denoted  $H(u, v)$ . There is as well an indicator of the tightness of the labor market, defined as the ratio between unemployed and vacancies,  $\theta$ . The job finding rate,  $f$ , is now  $\theta q(\theta)$ :

$$\begin{aligned} q(\theta) &= \frac{H(u, v)}{v} = H\left(\frac{1}{\theta}, 1\right) \\ f &= \theta q(\theta) \end{aligned}$$

After defining the new conditions of the labor market, it is possible to determine the effect of the firing costs on wages as follows:

$$\frac{dw(m, \eta)}{dF} = \underbrace{-\beta (1 - \beta)\theta q(\theta) \frac{1}{r + \gamma} \frac{dm_c}{dF} + \beta(r - (1 - \beta)\theta q(\theta))}_{\text{Expression (2)}} + \underbrace{\beta(\theta q'(\theta) + q(\theta)) \frac{c}{q(\theta)} \frac{d\theta}{dF}}_{\text{New term}} \quad (3)$$

Expression (3) can be decomposed into two terms. The first one is similar to the effect of the firing costs on wages when job finding probabilities are exogenous. The new term, highlighted in red, is the additional effect stemming from the impact of the firing costs on the market tightness

(see appendix D.1.2 for further details). With endogenous meeting rates, the total effect of the firing costs on wages thus depends on the effect of these costs on labor market tightness  $\theta$  and the dismissal threshold  $m_c$ .

The system of two equations derived from the differentiation of the job creation and the job destruction condition, allows to determine the effects of the firing costs on the dismissal threshold ( $m_c$ ) and the market tightness ( $\theta$ ). From these computations, the following proposition, 3, is derived.

**Proposition 3.** *Consider endogenous meeting rates, hence  $\frac{dm_c}{dF} < 0$  and  $\frac{d\theta}{dF} < 0$*

Proposition 3 expands upon proposition 1 by considering endogenous meeting rates (see appendix D.1.3 for further details). In this context, an increase in firing costs can lead to a decrease in the labor market tightness ( $\theta$ ) because it may reduce the number of unemployed. Simultaneously, the productivity threshold ( $m_c$ ) decreases with increased firing costs, causing firms to retain workers they previously intended to let go. The effect of the firing costs on the dismissal threshold has varied depending on whether the job finding rates are endogenous or exogenous. In the first case,  $\frac{dm_c}{dF}$  can be represented as follows:

$$\frac{dm_c}{dF} = -\frac{\left(r + \beta f \frac{1}{\varepsilon_{q|\theta}}\right) (r + \gamma)}{\left(r + \gamma G(m_c(\eta)) + \beta f \frac{1}{\varepsilon_{q|\theta}}\right)} \quad (4)$$

Where  $\varepsilon = |q'(\theta) \frac{\theta}{q(\theta)}|$ . The expression (4) is quite similar to the effect of the firing costs on  $m_c$  with exogenous meeting rates (presented below),

$$\frac{dm_c}{dF} = -\frac{(r + \beta f)(r + \gamma)}{r + \beta f + \gamma G(m_c(\eta))} \quad (5)$$

The derivation of 4 is available in Appendix F. Expressions (4) and (5) are equivalent only if  $\varepsilon_{q|\theta} = 1$ ; however, in general, they differ. In the calibration of the general equilibrium model, job finding probabilities ( $\theta q(\theta)$ ) and job separation rates ( $\gamma G(m_c)$ ) are set following the approach of Cairó and Cajner (2018), who demonstrate decreasing rates with an increasing level of education. Given interest rates near zero, the direction of the effect of firing costs on  $m_c$  will be largely

determined by the fraction of firms affected by an idiosyncratic shock ( $\gamma$ ).

These findings lead to the derivation of expression (3), which finally can be presented as:

$$\frac{dw}{dF} = \beta \left( \frac{r\varepsilon_{q|\theta}(r + \gamma G(m_c(\eta))) - q(\theta)\theta((1 - \beta)\gamma G(m_c) - r\beta)}{\varepsilon_{q|\theta}(r + \gamma G(m_c(\eta))) + \beta q(\theta)\theta} \right) >? \quad (6)$$

The expression (6) is derived in Appendix E. In a general equilibrium framework, the sign of the effects of the firing costs ( $F$ ) on wages is undetermined. However, this effect depends on how the firing costs influence the labor market tightness ( $\theta$ ) and the dismissal threshold ( $m_c$ ). The impact on market tightness is negative, as indicated by the derivative computed in Appendix D.1.3 ( $d\theta/dF$ ), which, in turn, affects job-finding probabilities, that appear to be negatively affected by regulations on employment protection (as discussed in Kugler and Saint-Paul (2004)). Specifically, if job-finding probabilities decrease after an increase in employment protection, workers may have fewer outside options and accept lower wages<sup>7</sup>. Furthermore, if employment protection reduces the dismissal threshold,  $m_c$ , average productivity may decrease, potentially depressing wages.

This theoretical model seeks to understand the factors influencing the relationship between wages and firing costs. Variations in job-finding probability and the dismissal threshold emerge as potential factors, which at the same time, are to a large extent, determined by  $\gamma$ .

The share of the firms being hit by an idiosyncratic shock,  $\gamma$ , might be of relevant importance. Specifically, if a substantial number of firms in the labor market anticipate that their productivity will be impacted by this shock, thereby reducing the overall productivity of workers, it may lead to a decline in wages. Additionally, such firms might exhibit increased hesitancy in hiring new workers, consequently reducing job finding probabilities even further. Therefore, in a setting with increased employment protection, the effects of  $\gamma$  might be amplified.

Given the problems to easily find the direction of the effects of the firing costs on wages, the identification implies the calibration of the general equilibrium model and the subsequently introduction of variations in the firing costs.

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<sup>7</sup>The derivative is  $q(\theta) + \theta q'(\theta)$ , with  $q'(\theta) < 0$ , so if firing costs rise, the effect final on the productivity will depend on the gap between  $q(\theta)$  and  $\theta q'(\theta) < 0$

## 5 Calibration of the General Equilibrium Model

The estimation strategy employed in this paper assumes that firing costs are a fraction of the inside wage, denoted as  $F = \Psi w(m_c, \eta)$ <sup>8</sup>. The distribution for new productivity drawn after a shock arrival,  $G(m)$ , is assumed to be uniform, with support in the interval  $[0, \bar{m}]$ . Therefore, the model parameters consist of  $\{\bar{m}, \eta, \Psi, r, \gamma, \alpha, \beta, b, c, A\}$ , while the unknowns are  $\{m_c, f, q(\theta), \theta, u\}$ .

Considering the estimates of the job finding probability,  $f = \theta q(\theta)$ , and the job separation rate,  $\delta = \gamma \frac{m_c}{\bar{m}}$ , for each sub-market of education categories identified by [Cairó and Cajner \(2018\)](#) in the United States labor market<sup>9</sup>, the system of equations reduces to a problem with two variables:  $F$  and  $\bar{m}$ , from which the other unknowns are derived. Achieving equilibrium in different educational segments of the market requires ensuring that the transformed job destruction equals the transformed inside wage equation. The expressions for these conditions are presented below. Further details can be found in [Appendix G](#).

### Job Destruction Condition:

$$\left( \phi + \frac{\gamma}{r + \gamma} \frac{(1 - \phi)^2}{2} - f\beta \frac{1 - \phi}{r + \gamma} \right) \bar{m} + (r + f\beta)F = -\eta + b$$

### Inside Wage Equation:

$$\left( \beta\phi + (1 - \beta)f\beta \frac{1 - \phi}{r + \gamma} \right) \bar{m} + \left( -\frac{1}{\Psi} + \beta r - (1 - \beta)f\beta \right) F = -\beta\eta - (1 - \beta)b$$

### 5.1 Benchmark Calibration

The model calibration relies on the parameter values presented in [table 2](#). The results are depicted in [figures 3 and 4](#). These figures present numerical values of variables given variations in the parameter  $\Psi$  of the firing costs. In particular, it portrays the elasticities with respect to variations in firing costs in function of  $\Psi$  for the average wages, the market tightness,  $\theta$ , and the dismissal threshold,

<sup>8</sup>Alternatively, one can use average wages:  $F = \Psi w\left(\frac{m_c + \bar{m}}{2}, \eta\right)$ .

<sup>9</sup>[Cairó and Cajner \(2018\)](#) presents estimates of the job finding probability and job separation rates for high school dropouts, high school graduates, individuals with some college, and college graduates. For the 'greater than college' category, the estimation is based on trends, implying that job finding and job destruction rates for this educational category are extrapolations.

$m_c$ . Furthermore, it also presents numerical values of market equilibrium given variation of  $\Psi$  for the  $\theta$ ,  $m_c$ , the upper bound of the idiosyncratic productivity distribution  $\bar{m}$ , the wages evaluated at the dismissal threshold  $w_c = w(m_c(\eta), \eta)$ , and the average wage  $w_m = w\left(\frac{m_c + \bar{m}}{2}\right)$ . Figure 3 presents results for the benchmark economy, while figure 4 shows the estimates adjusted to match empirical observations of the United States economy and discussed in the next section.

In the benchmark scenario, the parameter values, shown in table 2, are as follows: the interest rate fixed at 0.00333 corresponds to a 4% annual rate. The parameter  $\alpha$  of the matching technology is set to 0.5; and satisfying the Hosios condition,  $\beta = 1 - \alpha = 0.5$ , the wage bargaining power of the workers. The cost of creating a vacancy,  $c$ , is set to 0.1 and the unemployment benefits  $b$  are set to 0.3. The share of the firms hit by an idiosyncratic shock ( $\gamma$ ), is 0.1. It is important to remark the unavailability of information to estimate adequately  $\gamma$ .  $\Psi$ , a fraction of the wages, is set between (0.1, 1). Following Cairó and Cajner (2018), job-finding and job-separation rates decrease as the education levels increase. On the other hand, the profile of individual productivities increases with educational levels, with specific values set as follows:  $\eta$  is 1.2 for greater than college, 1.1 for college, 0.7 for some college, 0.5 for high school, and 0.4 for high school dropout.

The elasticities and the equilibrium values presented in figure 3, representing the benchmark scenario, align with theoretical predictions. Notably, the elasticity of the average wages decreases with variations in firing costs across different educational categories, with a significant effect observed for high school dropouts. In accordance with proposition 3, the elasticities of the dismissal threshold ( $m_c$ ) and labor market tightness ( $\theta$ ) in response to firing cost variations are negative. Wages evaluated at the dismissal threshold and the average productivity reflect increasing worker productivity levels ( $\eta$ ) across different educational categories.

## 5.2 Matching the United States Labor Market

Starting with the benchmark calibration, the parameters are subsequently adjusted to match the characteristics of the United States labor market, specifically the estimations presented in the econometrics section of this paper. It appears to be that if  $\gamma$  has a convex shape across various educational levels for the U.S. labor market exhibits ( $\gamma$  is high for high school dropouts and for individuals with education levels beyond college), then the estimated theoretical effects of firing costs are close to the empirical estimates. However, compared to the empirical findings, the model might underestimate

<b>Parameter</b>	<b>Benchmark</b>	<b>US economy</b>
$\Psi$ : share of firing costs	(0.1, 1)	(0.1, 1)
$b$ : unemployment benefits	0.3	0.3
$\underline{m}$ : Lowest productivity level (uniform)	0	0
$c$ : cost of posting	0.1	0.1
$r$ : interest rate	0.00333	0.00333
$\alpha$ : parameter matching function	0.5	0.5
$\beta = 1 - \alpha$	0.5	0.5
<b>Greater than college (GCOL)</b>		
$\delta$ : job separation	0.01	0.01
$\eta$ : labor productivity	1.2	1.2
$\theta q(\theta)$ : Job finding probability	0.405	0.405
$\gamma$ : idiosyncratic shocks	0.1	0.15
<b>College (COL)</b>		
$\delta$ : job separation	0.0108	0.0108
$\eta$ : labor productivity	1.1	1.1
$\theta q(\theta)$ : Job finding probability	0.4105	0.4105
$\gamma$ : idiosyncratic shocks	0.1	0.02
<b>Some College (SC)</b>		
$\delta$ : job separation	0.0203	0.0203
$\eta$ : labor productivity	0.7	0.7
$\theta q(\theta)$ : Job finding probability	0.4434	0.4434
$\gamma$ : idiosyncratic shocks	0.1	0.03
<b>High School (HS)</b>		
$\delta$ : job separation	0.0244	0.0244
$\eta$ : labor productivity	0.5	0.5
$\theta q(\theta)$ : Job finding probability	0.4318	0.4318
$\gamma$ : idiosyncratic shocks	0.1	0.04
<b>High School Dropout (HSD)</b>		
$\delta$ : job separation	0.0437	0.0437
$\eta$ : labor productivity	0.4	0.4
$\theta q(\theta)$ : Job finding probability	0.4523	0.4523
$\gamma$ : idiosyncratic shocks	0.1	0.1

Table 2: **Parameters. Variation in Firing Costs**

the effects of firing costs on wages. Figure 4 illustrates the evolution of the elasticity of the average wages concerning variations in the parameter  $\Psi$ . The negative slope is stronger for high school and individuals with education levels beyond college, while being less significant for other educational categories. For high school dropouts, average wages are expected to decrease by a maximum of 4%, which differs in magnitude from the previously presented empirical estimates. The marked and negative slopes can be attributed to the substantial decline in the dismissal threshold for individuals with greater than college education and the sharp decrease in labor market tightness for high school dropouts.

The higher probability to be hit by an idiosyncratic shock for greater than college and high school dropout, provides an explanation for the observed negative effects of higher employment protection on the wages of high school dropouts and individuals with education levels beyond college. In contrast, there are no discernible effects on the middle of the wage-educational distribution, resulting in a polarized effect. The increase in employment protection leads to a decrease in labor market tightness, which, in turn, might lower job-finding probabilities. This reduction in job-finding probabilities limits the outside options for workers, consequently impacting their wages negatively. Additionally, higher firing costs contribute to a reduction in the dismissal threshold, average labor productivity, and, in turn, wages.

These results are consistent with previous research findings, notably [Cervini-Plá et al. \(2014\)](#). They find a positive effect of reduced firing costs on wages for the groups directly affected by the reform in the Spanish labor market. [Cervini-Plá et al. \(2014\)](#) focus on the effects of reductions in payroll taxes and firing costs in Spain using a matching model that centers on the effects on entry wages of new entrants and incumbents. They find unclear effects of payroll taxes on wages and, similar to the results discussed here, negative effects of firing costs on new entry wages: firms can translate part of the firing costs to new jobs, lowering the implicit bargaining power of the workers. For incumbent workers, increasing firing costs also reduced their wages, since they expect a lower match surplus when moving to another job. [Cervini-Plá et al. \(2014\)](#) use as well standard difference-in-difference estimations that compare individuals affected by the reform (young and old workers) with those in the prime working age, their econometric estimations suggest that reduced firing costs and payroll taxes increased wages for new entrants and incumbents.

The effects discussed in this paper are also in line with [Doepke and Gaetani \(2020\)](#), who find a

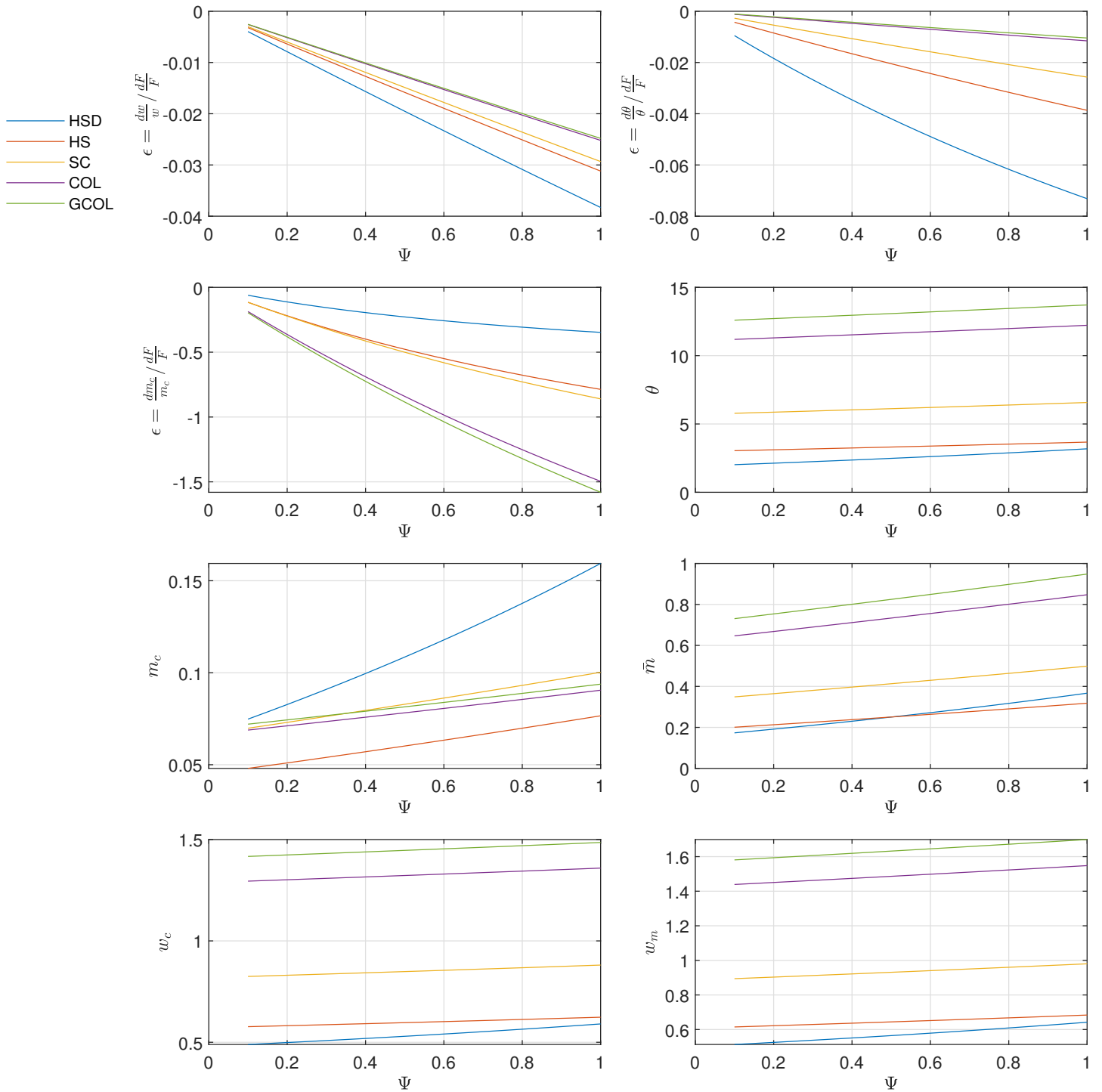


Figure 3: **Benchmark calibration**



negative effect of firing costs on wages, albeit with a distinct approach. [Doepke and Gaetani \(2020\)](#) argue that employment protection is relevant in explaining the college wage premium because it affects the incentives of firms and workers to invest in the productive relationships. However, unlike the model presented in this paper, their framework implies on-the-job skill accumulation, which drives income inequalities among workers: firms can create jobs that allow for skill accumulation or low-quality jobs where workers remain stagnant. Their analysis might illustrate the differences in trends of wage college premium between the the United States and Germany. The underlying mechanism is as follows: the decrease in investment on specific human capital among less educated workers leads to a reduction in average human capital, lowering wages, and consequently, increasing the college wage premium.

## 6 Concluding Remarks

Wages in the United States have shown divergent trends alongside an increasing employment protection over recent decades. The econometric analysis outlined here, using a difference-in-difference approach with staggered timing, uncovers a negative impact of state policy reforms on the wages of high school dropouts and individuals with education levels beyond college. However, there are no significant effects on wages for other educational categories: a polarized effect. Specifically, wages of high school dropouts and those with greater than college education, significant declined in states with stricter employment protection regulations, suggesting that without these regulations, the college wage premium might be even higher.

Future versions of this paper should include covariates, such as the political leaning of each state, which remains relatively constant over shorter periods. This would help address potential issues arising from the unconditional parallel trends assumption. Additionally, given the limited number of observations, conducting a county-level analysis could be worthwhile.

In terms of the theoretical framework, this study highlights several novel findings that have received limited attention in existing literature, in particular, the negative effect of increased employment protection on labor market tightness and the dismissal threshold. These factors appear to be the driving forces behind the negative impact of firing costs on wages for individuals at the lower and upper ends of the wage-educational distribution. Moreover, the U.S. labor market exhibits a

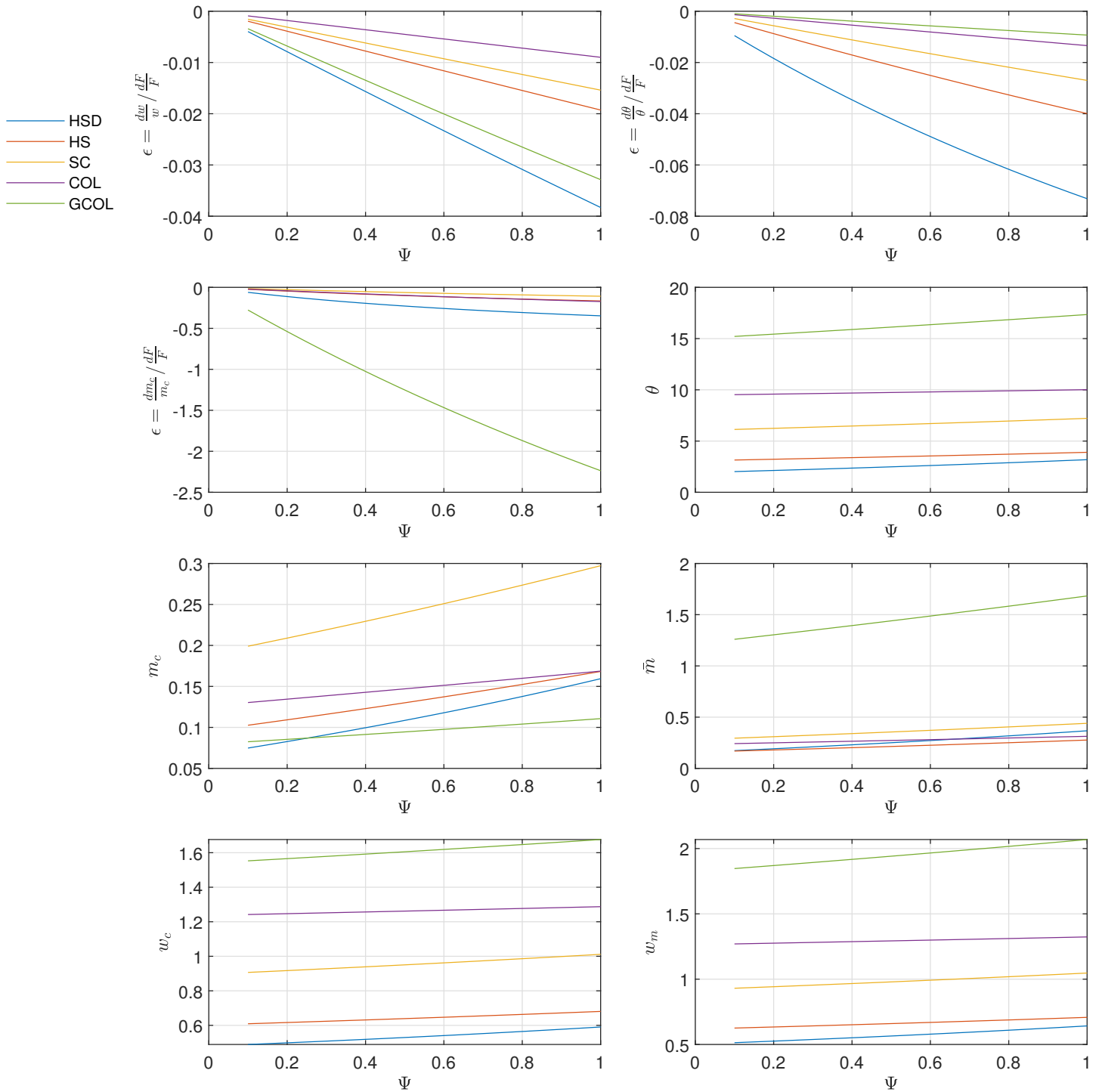


Figure 4: The United States Labor Market

convex profile for the share of firms affected by idiosyncratic shocks across different education levels. Therefore, a combination of idiosyncratic shocks, worker-productivity levels, labor market tightness, dismissal thresholds, job finding and job separations rates, explain why the adoption of exceptions to the employment-at-will appear to negatively affect the tails of the wage-educational distribution.

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## A Wages and Employment Protection

Taking into account the granular decomposition of the variable education, the figure 5 present the evolution of the college wage premium and wages for a detailed classification of the education. Furthermore, while the figure 5 present similar patterns to the ones presented in [Acemoglu and Autor \(2011\)](#), values do not entirely match because of differences in the methodology and data used

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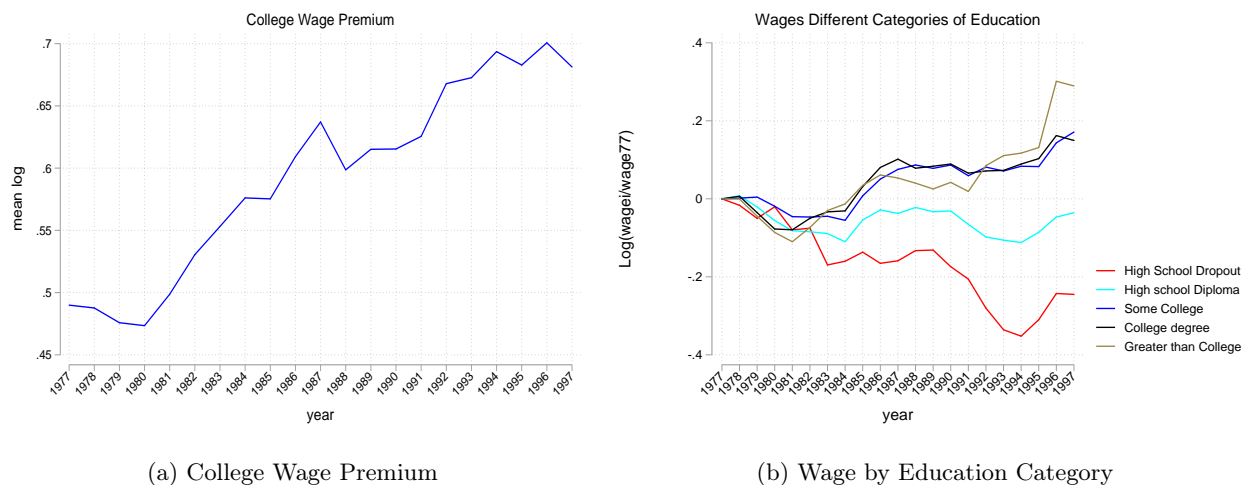


Figure 5: **College Decomposition and Wage Decomposition**

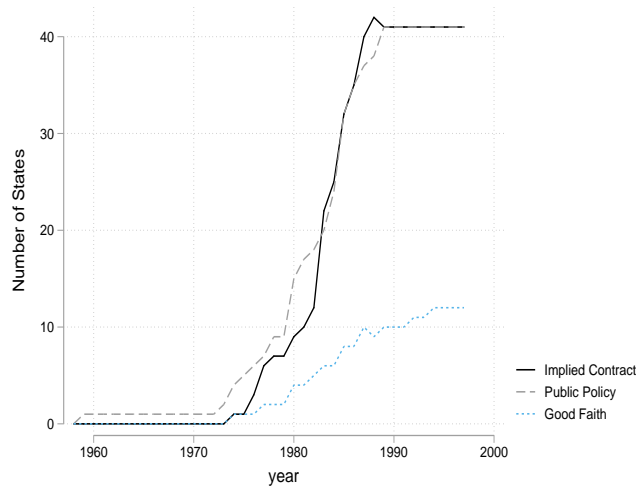
The graphs depict information based on similar computations done by [Acemoglu and Autor \(2011\)](#) but using a restricted data sample. Panel (a) and (b) are computed using the entire territory of the United States. The college wage premium was computed as the ratio of the wages of individuals with a bachelor degree or four years of college degree over individuals with a high school diploma or 12 years of education.

The increase of the college wage premium is consistent with research findings (see e.g. [Goldin and Margo \(1992\)](#), [Katz and Murphy \(1992\)](#), [Katz and Autor \(1999\)](#), [Acemoglu and Autor \(2011\)](#)). Further, the most simple model of technical progress in the lines of ([Acemoglu and Autor, 2011](#)), predicts a strong correlation between productivity, driven by increases in technology adoption, and real wage dynamics.

Firing costs raised in the United States during 1977-1997 due to the state enactments of laws, thereby constraining firms' optimal firing decisions. Starting in 1972, the majority of states began implementing exceptions to the employment-at-will policy. Figure (6) illustrates the number of

<sup>10</sup>[Acemoglu and Autor \(2011\)](#) measured the wage premium as the "adjusted log college/high school weekly wage premium in the US labor market ... .. for full-time, full-year workers." use more observations for a larger period of time, and the normalization of the variables is done with respect to the 1963 year, here is with respect to 1973.

states adopting these exceptions over time. Specifically, the solid black line represents the adoption of the implied contract exception, the dotted blue line signifies states adopting the public policy exception, and the dotted gray line corresponds to the number of states adopting the good faith exception<sup>11</sup>. The graph indicates a rising trend in states regulating the employment-at-will doctrine, which consequently affects firms' optimal firing decisions.



(a) Number of States Adopting Exceptions

## Figure 6: Adoption of Exceptions to the Employment-at-will

The graphs were computed using data provided by Autor (2003). (a) The slope of each line corresponds to the number of states adopting the respective reform, e.g. around 10 states implemented the implied contract exception in 1980.

## B Further Details of the Data Set

### B.1 Five Educational Categories

**Wages** The panel is based on data from the Current Population Survey, particularly, individual-level information encompassing wages, educational attainment, household residence, and other pertinent demographic characteristics. The variable *wages*, central in this analysis and used through the paper, is based on *INCWAGE* of the CPS (IPUMS version), which provides information on the nominal total pre-tax wage and salary income, received as employee for the previous calendar year. The question in the survey related to this variable, has slightly changed over the samples. In partic-

<sup>11</sup>Panel a of this graph is also presented in Autor (2003)

ular, for the years 1962-1968, people surveyed were asked to respond how much they earned in wages and salary. Between 1969-1979, the interviewers asked about wages or salary before any deductions. Thereafter, respondents included overtime pay, tips, bonuses, and commissions from their primary employer, and money received from other employers. This might represent an overestimation of the latter trends, which is not corrected in the current analysis. In terms of comparability, for the censuses waves of 1960 and 1970 and for the CPS survey between 1962-1979, individuals that participated in the survey were 14+ years old. The 1980, 1990 and 2000 censuses, the lower age was 16, while age 15 for the CPS beginning 1980. The variables denoting wage information for the different educational categories reflect the average wage within each group for a specific state in a given year. To ensure accurate comparisons, nominal values are adjusted for inflation using the CPI index retrieved from the IMF website.

**Education** This paper construct and provides analysis on five educational variables, in particular, using the variable `educ` of the CPS (IPUMS version), and `higrade`, workers were classified into five different groups: *i* high school dropout. This category was defined as an individual with years of education ranging from 0 to 12 (unfinished). *ii* an individual with 12 years of education or certifying holding the high school diploma, was classified as a high school diploma holder. *iii* Individuals with some college education are those that completed one, two or three years of college or those that did not finish four years of college. *iv* A college educated worker is an individual that certifies holding the college degree or has completed four years of college education. *v* Finally, those individuals certifying a master or a PhD, or completing more than 4 years of college education, were classified as holding greater than college educational level. It is important to remark that because of data availability is not possible to check in all the cases, if the individual holds the particular diploma.

### B.1.1 States Included in the Sample

The final data set is a strongly balanced panel with particular states that meet certain characteristics, in particular, the final states considered in the analysis are those presented in the table 3. Some states were not considered in the final sample because it was not possible to obtain information on wages prior to the beginning of the implementation of the exceptions for every state. To establish a comparison between states that adopted the exceptions with those that did not over the differ-

ent decades, information on wages should be before the year of the implementation of the reform. District of Columbia was not considered either because it does not have available information on adopted exceptions to the employment-at-will.

States considered	First year	States considered	First year
West Virginia	1978	Nebraska	1983
Arkansas	1980	Nevada	1983
Connecticut	1980	South Dakota	1983
Montana	1980	Virginia	1983
New Jersey	1980	North Dakota	1984
New Mexico	1980	Texas	1984
Wisconsin	1980	Iowa	1985
Kansas	1981	North Carolina	1985
Maryland	1981	South Carolina	1985
Tennessee	1981	Vermont	1985
Hawaii	1982	Wyoming	1985
New York	1982	Utah	1986
Ohio	1982	Alabama	1987
Alaska	1983	Mississippi	1987
Arizona	1983	Delaware	1992
Colorado	1983	Florida	0
Kentucky	1983	Georgia	0
Minnesota	1983	Louisiana	0
Missouri	1983	Rhode Island	0

Table 3: **States Considered in the Sample and First Year of Implementation of the Reforms**

The final panel considered in the empirical section of this paper, that serves as an illustration of the effects of the firing costs on wages, can be summarized in the next table 4.



Survey year	Frequency	Percent	Survey year	Frequency	Percent
1977	38	4.76	1988	38	4.76
1978	38	4.76	1989	38	4.76
1979	38	4.76	1990	38	4.76
1980	38	4.76	1991	38	4.76
1981	38	4.76	1992	38	4.76
1982	38	4.76	1993	38	4.76
1983	38	4.76	1994	38	4.76
1984	38	4.76	1995	38	4.76
1985	38	4.76	1996	38	4.76
1986	38	4.76	1997	38	4.76
1987	38	4.76	<b>Total</b>	<b>798</b>	<b>100</b>

Table 4: **Distribution of the Observations by Year**

## C Complete Estimates

Unconditional Parallel Trends (without covariates. Not yet as comparison)											
	Partially Aggregation of the Parameters										Aggregated Parameter
Simple Weighted Average											-0.0882238 (0.014)
Group-Specific Effects	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	-0.3451157	-0.0948199	-0.0448734	-0.0755454	-0.038531	-0.1461078	-0.1281563	-0.1121024	-0.0286139	-0.2934989	-0.0898949
	0	(0.935)	(0.058)	(0.19)	(0.688)	(0.037)	(0.301)	(0.024)	(0.051)	0	(0.004)
Unconditional Parallel Trends (without covariates. Never treated as comparison)											
	Partially Aggregation of the Parameters										Aggregated Parameter
Simple Weighted Average											-0.0770335 (0.038)
Group-Specific Effects	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	-0.3442755	-0.089353	-0.048383	-0.0530072	-0.0206341	-0.1401262	-0.1135065	-0.1037717	-0.0153071	-0.2934989	-0.0784287
	0	(0.057)	(0.342)	(0.551)	(0.747)	(0.002)	(0.015)	(0.149)	(0.771)	0	(0.020)

Table 5: High School Dropout Wages Aggregated Treatment Effects Estimates

Unconditional Parallel Trends (without covariates. Not yet as comparison)											
	Partially Aggregation of the Parameters										Aggregated Parameter
Simple Weighted Average											-0.0159317 (0.496)
Group-Specific Effects	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	-0.185928	-0.0028143	-0.04037	-0.0644322	-0.008811	-0.019861	0.0349364	0.0250069	0.0390874	-0.0840252	-0.013271
	0	(0.954)	(0.006)	(0.011)	(0.771)	(0.652)	(0.298)	(0.015)	(0.659)	0	(0.527)
Unconditional Parallel Trends (without covariates. Never treated as comparison)											
	Partially Aggregation of the Parameters										Aggregated Parameter
Simple Weighted Average											-0.0138913 (0.593)
Group-Specific Effects	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	-0.1950205	0.0065667	-0.0505405	-0.0684348	-0.004599	-0.0141721	0.0353487	0.030545	0.0407151	-0.0840252	-0.0112408
	0	(0.907)	0	(0.03)	(0.887)	(0.772)	(0.315)	(0.001)	(0.647)	0	(0.629)

Table 6: High School Wages Aggregated Treatment Effects Estimates

Unconditional Parallel Trends (without covariates. Not yet as comparison)											
	Partially Aggregation of the Parameters										Aggregated Parameter
Simple Weighted Average											-0.0321528 (0.341)
Group-Specific Effects	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	-0.1620597	-0.0170282	-0.0637595	-0.047706	-0.045784	-0.1350985	0.0797272	-0.0053679	0.0148047	-0.094875	-0.0293724
	0	(0.66)	(0.202)	(0.305)	(0.318)	(0.001)	(0.133)	(0.85)	(0.781)	0	(0.352)
Unconditional Parallel Trends (without covariates. Never treated as comparison)											
	Partially Aggregation of the Parameters										Aggregated Parameter
Simple Weighted Average											-0.0257788 (0.478)
Group-Specific Effects	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	-0.1836681	0.0027898	-0.059593	-0.0531167	-0.0448593	-0.1417716	0.0985685	0.0231681	0.0180238	-0.094875	-0.0229415
	0	(0.95)	(0.257)	(0.317)	(0.37)	(0.003)	(0.094)	(0.28)	(0.735)	0	(0.499)

Table 7: Some College Wages Aggregated Treatment Effects Estimates

Unconditional Parallel Trends (without covariates. Not yet as comparison)											
	Partially Aggregation of the Parameters										Aggregated Parameter
Simple Weighted Average											-0.0246264 (0.501)
Group-Specific Effects	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	-0.156009	-0.0447818	0.0095987	-0.0472113	-0.0320007	-0.0599452	0.0104617	0.1440697	-0.0755059	0.4840993	-0.0131756
	0	(0.268)	(0.864)	(0.39)	(0.545)	(0.279)	(0.881)	0	(0.095)	0	(0.679)
Unconditional Parallel Trends (without covariates. Never treated as comparison)											
	Partially Aggregation of the Parameters										Aggregated Parameter
Simple Weighted Average											-0.0407847 (0.268)
Group-Specific Effects	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	-0.1951841	-0.043869	0.0033894	-0.0714694	-0.0602414	-0.0839769	-0.0044821	0.1381697	-0.0811235	0.4840993	-0.0292763
	0	(0.351)	(0.964)	(0.172)	(0.269)	(0.17)	(0.952)	0	(0.095)	0	(0.384)

Table 8: College Wages Aggregated Treatment Effects Estimates

<b>Unconditional Parallel Trends (without covariates. Not yet)</b>											
<b>Simple Weighted Average</b>	<b>Partially Aggregation of the Parameters</b>										<b>Aggregated Parameter</b>
											-0.054616 (0.029)
<b>Group-Specific Effects</b>	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	0.0695677 (0.017)	-0.0105801 (0.896)	-0.0401812 (0.465)	-0.0126935 (0.562)	-0.1148469 (0.02)	-0.1393085 (0.079)	-0.0077066 (0.907)	0.0158697 (0.318)	-0.1303625 (0.084)	-0.189695 0	-0.0603737 (0.006)
<b>Unconditional Parallel Trends (without covariates. Never treated as comparison)</b>											
<b>Simple Weighted Average</b>	<b>Partially Aggregation of the Parameters</b>										<b>Aggregated Parameter</b>
											-0.0742299 (0.002)
<b>Group-Specific Effects</b>	<b>1978</b>	<b>1980</b>	<b>1981</b>	<b>1982</b>	<b>1983</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1992</b>	
	0.0752623 (0.053)	-0.0273693 (0.783)	-0.0627009 (0.359)	-0.0365957 (0.101)	-0.1444209 (0.011)	-0.1648735 (0.032)	-0.0240632 (0.713)	0.0163435 (0.279)	-0.1212052 (0.113)	-0.189695 0	-0.0793199 (0.00)

Table 9: Greater than College Wages Aggregated Treatment Effects Estimates

## D Complete Solution to the Model

In the presence of firing costs, there exists two wages: inside  $w(m, \eta)$  and outside  $w_0(\bar{m}, \eta)$ . Given this, there is the need to differentiate the sharing rule for the case with and without firing costs. Hence the **outside** wages is chosen to maximize the surplus of the new matches. Initially, when the job is created productivity is at the maximum level, hence  $m = \bar{m}$ :

$$S_0 = (E(\bar{m}, \eta) - U(\eta))^\beta (J(\bar{m}, \eta) - V)^{1-\beta}$$

Initially, when jobs are created, the firing costs are not operative and therefore, they are not included in the surplus. Wages are therefore set to maximize the weighted surplus of the worker, the difference between the value function of being employed and that of being unemployed; and the surplus for the firm, the difference between the value function of the job filled and the vacancy.  $\beta$  is therefore the bargaining power of the worker with  $\beta \in (0, 1)$ .

Therefore,

$$\frac{\partial S_0}{\partial w_0(\bar{m}, \eta)} = \beta \frac{\partial E(\bar{m}, \eta)}{\partial w_0(\bar{m}, \eta)} [J(\bar{m}, \eta) - V] + (1 - \beta) \frac{\partial J(\bar{m}, \eta)}{\partial w_0(\bar{m}, \eta)} [E(\bar{m}, \eta) - U(\eta)]$$

Finding the **inside** wage, there is the need to take into account the firing costs, in such a case, we have:

$$S = (E(m, \eta) - U(\eta))^\beta (J(m, \eta) - V + F)^{1-\beta}$$

Therefore,

$$\frac{\partial S}{\partial w(m, \eta)} = \beta \frac{\partial E(m, \eta)}{\partial w(m, \eta)} [J(m, \eta) + F] + (1 - \beta) \frac{\partial J(m, \eta)}{\partial w(m, \eta)} [E(m, \eta) - U(\eta)]$$

Starting by finding the initial or outside and the inside or continuation wages, we firstly assume,

the probability of moving from unemployment to employment  $f$  is exogenous and that there is initially, directed search, the implications of the later assumption will be posteriorly discussed.

Then using the expression for the total surplus for the outside wage and assuming free entry of the firms  $V = 0$ , the surplus net for the match given the initial wages is represented below:

$$\begin{aligned}\frac{\beta}{r + \gamma}(J(\bar{m}, \eta)) &= \frac{(1 - \beta)}{r + \gamma}[E(\bar{m}, \eta) - U(\eta)] \\ -\beta J(\bar{m}, \eta) + (1 - \beta)E(\bar{m}, \eta) &= (1 - \beta)U(\eta) \\ \frac{\beta}{1 - \beta}J(\bar{m}, \eta) &= E(\bar{m}, \eta) - U(\eta)\end{aligned}$$

And in the case of the surplus net of the **inside** wages, expression, presented in the section of the model, it became:

$$\frac{\beta}{r + \gamma}(J(\bar{m}, \eta) + F) = \frac{(1 - \beta)}{r + \gamma}[E(\bar{m}, \eta) - U(\eta)] \quad (7)$$

$$\beta J(m, \eta) - (1 - \beta)E(m, \eta) = -(1 - \beta)U(\eta) - \beta F \quad (8)$$

Using the previous expressions we are able to find outside  $w_0$  and inside  $w$  wages. Starting with expression (5) and replacing by its respective asset value equations:

$$\begin{aligned}& \beta \left\{ \bar{m} + \eta - w_0(\bar{m}, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} J(x, \eta)g(x) dx - G(m_c(\eta))F \right] \right\} = \\ (1 - \beta) & \left\{ w_0(\bar{m}, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} E(x, \eta)g(x) dx + G(m_c(\eta))U(\eta) \right] - (r + \gamma)U(\eta) \right\}\end{aligned}$$

$$\begin{aligned}
\beta(\bar{m} + \eta - \gamma G(m_c(\eta))F) &= w_0(\bar{m}, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} [(1 - \beta)E(x, \eta) - \beta J(x, \eta)]g(x) dx \right] + \\
&\quad (1 - \beta)U(\eta)[G(m_c(\eta))\gamma - \gamma - r] \\
\beta(\bar{m} + \eta - \gamma G(m_c(\eta))F) &= w_0(\bar{m}, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} [(1 - \beta)U(\eta) + \beta F]g(x) dx \right] + (1 - \beta)U(\eta)[G(m_c(\eta))\gamma - \gamma - r] \\
\beta(\bar{m} + \eta - \gamma G(m_c(\eta))F) &= w_0(\bar{m}, \eta) + \gamma[(1 - \beta)U(\eta) + \beta F](1 - G(m_c(\eta))) + (1 - \beta)U(\eta)[G(m_c(\eta))\gamma - \gamma - r] \\
w_0(\bar{m}, \eta) &= \beta(\bar{m} + \eta - \gamma F) + (1 - \beta)b + f\beta J(\bar{m}, \eta)
\end{aligned}$$

Hence, we need now to determine  $J(\bar{m}, \eta)$ . But before, determining this, let us find **inside** wages. In this case we use the sharing rule (8) and following a similar procedure as before, we obtain:

$$\begin{aligned}
&\beta \left\{ m + \eta - w(m, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} J(x, \eta)g(x) dx - G(m_c(\eta))F \right] + (r + \gamma)F \right\} = \\
(1 - \beta) &\left\{ w(m, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} E(x, \eta)g(x) dx + G(m_c(\eta))U(\eta) \right] - (r + \gamma)U(\eta) \right\}
\end{aligned}$$

$$\begin{aligned}
\beta(m + \eta - \gamma G(m_c(\eta))F + (r + \gamma)F) &= w(m, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} [(1 - \beta)E(x, \eta) - \beta J(x, \eta)]g(x) dx \right] + \\
&\quad (1 - \beta)U(\eta)[G(m_c(\eta))\gamma - \gamma - r] \\
\beta(m + \eta - \gamma G(m_c(\eta))F + (r + \gamma)F) &= w(m, \eta) + \gamma[(1 - \beta)U(\eta) + \beta F](1 - G(m_c(\eta))) + \\
&\quad (1 - \beta)U(\eta)[G(m_c(\eta))\gamma - \gamma - r] \\
w(m, \eta) &= \beta(m + \eta + rF) + (1 - \beta)rU(\eta) \\
w(m, \eta) &= \beta(m + \eta + rF) + (1 - \beta)[b + f(E(\bar{m}, \eta)) - U(\eta)] \\
w(m, \eta) &= \beta(m + \eta + rF) + (1 - \beta)b + \beta f J(\bar{m}, \eta)
\end{aligned}$$

### Finding $J(\bar{m}, \eta)$

Having the wages in function of  $J(\bar{m}, \eta)$ , then let us find firstly  $J(m, \eta)$ : Observe that

$$\begin{aligned}
w(m, \eta) - w(m_c, \eta) &= \beta(m - m_c) \\
rJ(m, \eta) - rJ(m_c, \eta) &= (1 - \beta)(m - m_c) - \gamma J(m, \eta) + \gamma J(m_c, \eta) \\
r(J(m, \eta) - J(m_c, \eta)) + \gamma(J(m, \eta) - J(m_c, \eta)) &= (1 - \beta)(m - m_c) \\
(r + \gamma)(J(m, \eta) - J(m_c, \eta)) &= (1 - \beta)(m - m_c) \\
J(m, \eta) &= \frac{1 - \beta}{(r + \gamma)}(m - m_c) - F
\end{aligned}$$

Now, in order to find  $J(\bar{m}, \eta)$  we need to correct for the discontinuity around  $\bar{m}$ . Indeed, we are going to show that  $J(\bar{m}, \eta) = J(\bar{m}, \eta)^- + \beta F$

- $m \in [m_c, \bar{m})$

$$\begin{aligned}
(r + \gamma)(J(m, \eta) + F) &= m + \eta + rF - w(m, \eta) + \gamma \int_{m_c}^{\bar{m}} (J(x, \eta) + F)g(x) dx \\
w(m, \eta) &= \beta(m + \eta + rF) + (1 - \beta)b + \beta f J(\bar{m}, \eta) \Rightarrow \\
(r + \gamma)(J(m, \eta) + F) &= (1 - \beta)(m + \eta + rF - b) - \beta f J(\bar{m}, \eta) + \gamma \int_{m_c}^{\bar{m}} (J(x, \eta) + F)g(x) dx
\end{aligned}$$

- $m = \bar{m}$

$$\begin{aligned}
(r + \gamma)J(\bar{m}, \eta) &= \bar{m} + \eta - \gamma F - w(\bar{m}, \eta) + \gamma \int_{m_c}^{\bar{m}} (J(x, \eta) + F)g(x) dx \\
w(\bar{m}, \eta) &= \beta(\bar{m} + \eta - \gamma F) + (1 - \beta)b + \beta f J(\bar{m}, \eta) \Rightarrow \\
(r + \gamma)J(\bar{m}, \eta) &= (1 - \beta)(\bar{m} + \eta - \gamma F - b) - \beta f J(\bar{m}, \eta) + \gamma \int_{m_c}^{\bar{m}} (J(x, \eta) + F)g(x) dx
\end{aligned}$$

Then taking the limit by the left of  $J(m, \eta)$  and replacing with  $\bar{m}$



$$\begin{aligned}
(r + \gamma)(J(\bar{m}, \eta)^- + F) &= (1 - \beta)(\bar{m} + \eta + rF - b) - \beta f J(\bar{m}, \eta) + \gamma \int_{m_c}^{\bar{m}} (J(x, \eta) + F)g(x) dx \Rightarrow \\
(r + \gamma)(J(\bar{m}, \eta) - J(\bar{m}, \eta)^- - F) &= -(1 - \beta)(\gamma + r)F \\
J(\bar{m}, \eta) &= J(\bar{m}, \eta)^- + \beta F
\end{aligned}$$

Hence, using the value  $J(m, \eta) = \frac{1-\beta}{r+\gamma}(m - m_c) - F$ . We are able to determine  $J(\bar{m}, \eta)$  and the different wages:

$$J(\bar{m}, \eta) = (1 - \beta) \left[ \frac{\bar{m} - m_c}{r + \gamma} - F \right]$$

The **Inside wage**

$$w(m, \eta) = \beta(m + \eta + rF) + (1 - \beta)b + \beta f(1 - \beta) \left[ \frac{\bar{m} - m_c}{r + \gamma} - F \right]$$

The **Outside wage**

$$w_0(\bar{m}, \eta) = \beta(\bar{m} + \eta - \gamma F) + (1 - \beta)b + f\beta(1 - \beta) \left[ \frac{\bar{m} - m_c}{r + \gamma} - F \right]$$

## D.1 The Effect of the Firing Costs

What is the impact of  $F$  on wages (assuming  $f$  exogenous)?

$m_c$  is endogenous:

$$\begin{aligned}
-Fr &= m_c + \eta - w(m_c, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} J(x, \eta) g(x) dx - G(m_c(\eta))F \right] + \gamma F \\
-Fr &= m_c + \eta - w(m_c, \eta) + \gamma \int_{m_c}^{\bar{m}} J(x, \eta) g(x) dx + \gamma(1 - G(m_c(\eta)))F \\
-Fr &= m_c + \eta - w(m_c, \eta) + \gamma \int_{m_c}^{\bar{m}} \left( \frac{1 - \beta}{r + \gamma} (x - m_c) - F \right) g(x) dx + \gamma(1 - G(m_c(\eta)))F \\
-Fr &= m_c + \eta - w(m_c, \eta) + \gamma \frac{1 - \beta}{r + \gamma} \int_{m_c}^{\bar{m}} xg(x) dx \\
&\quad - \gamma \frac{1 - \beta}{r + \gamma} \int_{m_c}^{\bar{m}} m_c g(x) dx - \gamma \int_{m_c}^{\bar{m}} Fg(x) dx + \gamma(1 - G(m_c(\eta)))F \\
-Fr &= m_c + \eta - w(m_c, \eta) + \gamma \frac{1 - \beta}{r + \gamma} \int_{m_c}^{\bar{m}} xg(x) dx \\
&\quad - \gamma \frac{1 - \beta}{r + \gamma} (1 - G(m_c(\eta)))m_c - \gamma(1 - G(m_c(\eta)))F + \gamma(1 - G(m_c(\eta)))F \\
-Fr &= m_c + \eta - w(m_c, \eta) + \gamma \frac{1 - \beta}{r + \gamma} \int_{m_c}^{\bar{m}} xg(x) dx - \gamma \frac{1 - \beta}{r + \gamma} (1 - G(m_c(\eta)))m_c \\
-Fr &= m_c + \eta - w(m_c, \eta) + \gamma \frac{1 - \beta}{r + \gamma} \int_{m_c}^{\bar{m}} (x - m_c)g(x) dx \\
-Fr &= (1 - \beta)(m_c + \eta) - \beta(r + f)F - (1 - \beta)b \\
&\quad - \beta f \left( (1 - \beta) \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right) \right) + \gamma \frac{1 - \beta}{r + \gamma} \int_{m_c}^{\bar{m}} (x - m_c)g(x) dx \\
0 &= (1 - \beta)(m_c + \eta + rF - b) \\
&\quad - \beta f (1 - \beta) \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right) + \gamma \frac{1 - \beta}{r + \gamma} \int_{m_c}^{\bar{m}} (x - m_c)g(x) dx
\end{aligned}$$

$$0 = m_c + \eta + rF - b - \beta f \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right) + \frac{\gamma}{r + \gamma} \int_{m_c}^{\bar{m}} (x - m_c)g(x) dx \quad (9)$$

This condition, implies that avoiding dismissals, i.e.  $m_c \rightarrow 0$ , there is the need that  $\eta$  is above a certain level, above which there won't be any dismissal.

### D.1.1 Exogenous Meeting Rates

*Proof.* With exogenous meeting rates the effect of the firing costs can be found using the inside wage equation:

$$w(m, \eta) = \beta(m + \eta + rF) + (1 - \beta)b + \beta f(1 - \beta) \left[ \frac{m - m_c}{r + \gamma} - F \right]$$

$$\begin{aligned} \frac{dw(m, \eta)}{dF} &= -\beta f \frac{1 - \beta}{r + \gamma} \frac{dm_c}{dF} + \beta r - \beta(1 - \beta)f \\ &= -\beta f \frac{1 - \beta}{r + \gamma} \frac{dm_c}{dF} + \beta(r - (1 - \beta)f) \end{aligned}$$

Differentiating 9, we obtain  $\frac{dm_c}{dF}$  i.e.

$$\begin{aligned} 0 &= dm_c + rdF + \frac{\beta f}{r + \gamma} dm_c + \beta f dF - \frac{\gamma}{r + \gamma} (1 - G(m_c)) dm_c \\ -(r + \beta f)dF &= \left( 1 + \frac{\beta f}{\gamma + r} - \frac{\gamma}{\gamma + r} (1 - G(m_c(\eta))) \right) dm_c \\ -(r + \beta f)dF &= \left( \frac{r + \beta f + \gamma G(m_c(\eta))}{\gamma + r} \right) dm_c \\ \frac{dm_c}{dF} &= -\frac{(r + \beta f)(r + \gamma)}{r + \beta f + \gamma G(m_c(\eta))} < 0 \end{aligned}$$

Since,

$$\frac{d}{dm_c} \int_{m_c}^{\bar{m}} (x - m_c)g(x) dx = -(m_c - m_c)g(m_c) - \int_{m_c}^{\bar{m}} 1g(x) dx = -\int_{m_c}^{\bar{m}} g(x) dx = -(1 - G(m_c))$$

Therefore,

$$\begin{aligned} \frac{dw(m, \eta)}{dF} &= \beta f \frac{1 - \beta}{r + \gamma} \left( \frac{r + \beta f + \gamma(G(m_c(\eta)))}{(\gamma + r)(r + \beta f)} \right) + \beta(r - (1 - \beta)f) \\ &= \frac{\beta f(1 - \beta)[(r + \beta f)(1 + \gamma + r)(1 - \gamma - r) + \gamma G(m_c(\eta))] + (\gamma + r)^2 r^2 \beta}{(r + \gamma)^2 (r + \beta f)} > 0 \end{aligned}$$

The expression is then positive as long as  $1 - (\gamma + r) > 0$ .

□

### D.1.2 Effects of Firing Costs on Wages. Endogenous Meeting Rates

Differentiating wages with respect to the firing costs with endogenous meeting rates.

$$\begin{aligned}
 w(m, \eta) &= \beta(m + \eta + rF) + (1 - \beta)b + \beta\theta q(\theta)(1 - \beta) \left[ \frac{\bar{m} - m_c}{r + \gamma} - F \right] \\
 w(m, \eta) &= \beta(m + \eta + rF) + (1 - \beta)b + \beta\theta q(\theta)(1 - \beta) \left[ \frac{\bar{m} - m_c}{r + \gamma} \right] - \beta\theta q(\theta)(1 - \beta)F \\
 w(m, \eta) &= \beta(m + \eta + rF) + (1 - \beta)b + \beta\theta q(\theta)(1 - \beta) \left[ \frac{\bar{m}}{r + \gamma} \right] - \beta\theta q(\theta)(1 - \beta) \left[ \frac{\bar{m}_c}{r + \gamma} \right] - \beta\theta q(\theta)(1 - \beta)F
 \end{aligned}$$

$$\begin{aligned}
 \frac{dw(m, \eta)}{dF} &= \beta r + \beta(1 - \beta) \left[ \frac{\bar{m}}{r + \gamma} \right] (\theta q'(\theta) + q(\theta)) \frac{d\theta}{dF} - \beta(1 - \beta) \left[ \frac{\bar{m}_c}{r + \gamma} \right] (\theta q'(\theta) + q(\theta)) \frac{d\theta}{dF} \\
 &\quad - \beta(1 - \beta)\theta q(\theta) \left[ \frac{1}{r + \gamma} \right] \frac{dm_c}{dF} - \beta(1 - \beta)\theta q(\theta) - \beta(1 - \beta)(\theta q'(\theta) + q(\theta))F \frac{d\theta}{dF} \\
 &= \beta r + (\beta(1 - \beta)(\theta q'(\theta) + q(\theta))) \left[ \frac{\bar{m}}{r + \gamma} \frac{d\theta}{dF} - \frac{\bar{m}_c}{r + \gamma} \frac{d\theta}{dF} - F \frac{d\theta}{dF} \right] \\
 &\quad - \beta(1 - \beta)\theta q(\theta) \left[ \frac{1}{r + \gamma} \frac{dm_c}{dF} + 1 \right] \\
 &= \beta r + \beta(1 - \beta)(\theta q'(\theta) + q(\theta)) \left[ \frac{\bar{m} - m_c}{r + \gamma} - F \right] \frac{d\theta}{dF} - \beta(1 - \beta)\theta q(\theta) \left[ \frac{1}{r + \gamma} \frac{dm_c}{dF} + 1 \right] \\
 &= \beta r + \beta(\theta q'(\theta) + q(\theta)) \frac{c}{q(\theta)} \frac{d\theta}{dF} - \beta(1 - \beta)\theta q(\theta) \left[ \frac{1}{r + \gamma} \frac{dm_c}{dF} + 1 \right]
 \end{aligned}$$

Before, when meeting rates were exogenous, the effect of the firing costs on wages was defined as follows:

$$\frac{dw(m, \eta)}{dF} = -\beta f \frac{1 - \beta}{r + \gamma} \frac{dm_c}{dF} + \beta(r - (1 - \beta)f)$$

Therefore, re-expressing the effect of the firing costs on wages with endogenous meeting rates in terms of the last expression, we have:

$$\frac{dw(m, \eta)}{dF} = \underbrace{-\beta (1 - \beta)\theta q(\theta) \frac{1}{r + \gamma} \frac{dm_c}{dF} + \beta(r - (1 - \beta)\theta q(\theta))}_{\text{Expression 2}} + \underbrace{\beta(\theta q'(\theta) + q(\theta)) \frac{c}{q(\theta)} \frac{d\theta}{dF}}_{\text{New Expression}}$$

### D.1.3 Endogenous Meeting Rates

*Proof.* Now consider endogenous meeting rates, hence

$$\begin{aligned} F &= (u, v) \\ q(\theta) &= \frac{F(u, v)}{v} = F\left(\frac{1}{\theta}, 1\right) \\ f &= \theta q(\theta) \end{aligned}$$

### Job Destruction Condition

The asset value equation of a filled job and the wage equation (inside) are:

$$\begin{aligned} rJ(m, \eta) &= m + \eta - w(m, \eta) + \gamma \left[ \int_{m_c}^{\bar{m}} J(x, \eta) g(x) dx - G(m_c(\eta))F \right] - \gamma J(m, \eta) \\ w(m, \eta) &= \beta(m + \eta + rF) + (1 - \beta)b + \beta\theta q(\theta)(1 - \beta) \left[ \frac{m - m_c}{r + \gamma} - F \right] \end{aligned}$$

Using the fact that  $J(m_c, \eta) = -F$

$$\begin{aligned} -F(r + \gamma) &= m_c(\eta) + \eta - \beta(m_c(\eta) + \eta + rF) - (1 - \beta)b - \beta\theta q(\theta)(1 - \beta) \left[ \frac{m - m_c}{r + \gamma} - F \right] + \\ &\quad \gamma(1 - \beta) \int_{m_c}^{\bar{m}} \frac{x - m_c}{\gamma + r} g(x) dx - \gamma G(m_c(\eta))F - \gamma F(1 - G(m_c(\eta))) \\ 0 &= m_c(\eta) + \eta - b - \beta\theta q(\theta) \frac{m - m_c}{r + \gamma} + F(r + \beta\theta q(\theta)) + \gamma \int_{m_c}^{\bar{m}} \frac{x - m_c}{\gamma + r} g(x) dx \end{aligned}$$

### Job Creation Condition

- Consider  $w_0(\bar{m}, \eta) - w(m_c, \eta)$

$$\begin{aligned} w_0(\bar{m}, \eta) - w(m_c, \eta) &= \beta(\bar{m} - m_c) - \beta F(r + \gamma) \Rightarrow \\ (J(\bar{m}, \eta) - J(m_c, \eta))(r + \gamma) &= (1 - \beta)(\bar{m} - m_c) + \beta F(r + \gamma) \end{aligned}$$

- If we consider initially a segmented market (directed search) and the free entry condition:

$$\frac{C}{q(\theta)} = J(\bar{m}, \eta)$$

Hence, the Job creation condition (two:  $\eta_H, \eta_L$ ) using the versions previously found of  $J(\bar{m}, \eta)$

$$\frac{c}{q(\theta)} = (1 - \beta) \left( \frac{\bar{m} - m_c}{\gamma + r} - F \right)$$

**Total Differential Job Creation and Job Destruction Condition** Now, to find the effects of the firing costs, let us compute the total differential of the job creation and job destruction conditions. The total differential of the job destruction is:

$$0 = \frac{dm_c}{dF} \left[ 1 + \frac{\beta \theta q(\theta)}{r + \gamma} - \frac{\gamma}{\gamma + r} (1 - G(m_c(\eta))) \right] + \frac{d\theta}{dF} \left[ (\theta q'(\theta) + q(\theta)) \left( -\frac{\beta \bar{m}}{r + \gamma} + \frac{\beta m_c}{r + \gamma} + F\beta \right) \right] + r + \theta q(\theta) \beta$$

Subsequently, the differential total with respect to the firing cost is (derived from the job creation):

$$\frac{d\theta}{dF} = \frac{q(\theta)^2}{c q'(\theta)} (1 - \beta) \left[ \frac{1}{r + \gamma} \frac{dm_c}{dF} + 1 \right] = \theta q(\theta) \frac{q(\theta)}{c q'(\theta) \theta} (1 - \beta) \left[ \frac{1}{r + \gamma} \frac{dm_c}{dF} + 1 \right] = -\frac{(1 - \beta) f}{c \varepsilon_{q|\theta}} \left[ \frac{1}{r + \gamma} \frac{dm_c}{dF} + 1 \right]$$

with  $\varepsilon_{q|\theta} = -q'(\theta) \frac{\theta}{q(\theta)}$

Which yields a system of 2 equations with two unknowns. By solving the system, we obtain:

$$\frac{dm_c}{dF} = \frac{(-\varepsilon_{q|\theta} r - \beta q(\theta) \theta)(r + \gamma)}{\varepsilon_{q|\theta} (r + \gamma G(m_c(\eta))) + \beta q(\theta) \theta} < 0$$

$$\frac{d\theta}{dF} = -\frac{(1 - \beta) q(\theta) \theta \gamma G(m_c(\eta))}{\varepsilon_{q|\theta} (r + \gamma G(m_c(\eta))) + \beta q(\theta) \theta} < 0$$

□



## E Deriving the Expression for $\frac{dw}{dF}$

Based on the proof [D.1.3](#). We can derive an expression to find  $\frac{dw}{dF}$ . Let us recall the equation for the wages:

$$w(m, \eta) = \beta(m + \eta + rF) + (1 - \beta)b + \beta f(1 - \beta) \left[ \frac{\bar{m} - m_c}{r + \gamma} - F \right]$$

Then, the total differential can be expressed as:

$$\begin{aligned} \frac{dw(m, \eta)}{dF} &= r\beta + (\theta q'(\theta) + q(\theta))\beta \frac{c}{q(\theta)} \frac{d\theta}{dF} - \beta(1 - \beta)\theta q(\theta) \left[ \frac{1}{\gamma + r} \frac{dm_c}{dF} + 1 \right] \\ &= r\beta + (1 - \varepsilon_{q|\theta})\beta c \frac{d\theta}{dF} - \beta(1 - \beta)f \left[ \frac{1}{\gamma + r} \frac{dm_c}{dF} + 1 \right] \end{aligned}$$

$$\begin{aligned} \frac{dw}{dF} &= r\beta - (1 - \varepsilon_{q|\theta})\beta \frac{(1 - \beta)f}{\varepsilon_{q|\theta}} \left[ \frac{1}{r + \gamma} \frac{dm_c}{dF} + 1 \right] - \beta(1 - \beta)f \left[ \frac{1}{\gamma + r} \frac{dm_c}{dF} + 1 \right] \\ &= r\beta - \beta(1 - \beta)f \frac{1}{\varepsilon_{q|\theta}} - \beta(1 - \beta)f \frac{1}{\varepsilon_{q|\theta}} \frac{1}{r + \gamma} \frac{dm_c}{dF} \end{aligned}$$

Observe that in this case  $f = \theta q(\theta)$ . And after several transformations and replacing the respective derivatives, we find

$$\frac{dw}{dF} = \beta \left( \frac{r\varepsilon_{q|\theta}(r + \gamma G(m_c(\eta))) + q(\theta)\theta(-(1 - \beta)\gamma G(m_c) + r\beta)}{\varepsilon_{q|\theta}(r + \gamma G(m_c(\eta))) + \beta q(\theta)\theta} \right)$$

The sign and therefore the direction of the effects is not possible to be determined.

## F Determining the Effects of Firing Costs on $m_c$

$$\begin{aligned}
\frac{dm_c}{dF} &= -\frac{q(\theta)\theta \left( r \frac{q'(\theta)}{(q(\theta))^2} - \beta \right) (r + \gamma)}{q(\theta)\theta \left( \frac{q'(\theta)}{(q(\theta))^2} (r + \gamma G(m_c(\eta))) - \beta \right)} \\
&= -\frac{\left( r \frac{q'(\theta)}{(q(\theta))^2} - \beta \right) (r + \gamma)}{\left( \frac{q'(\theta)}{(q(\theta))^2} (r + \gamma G(m_c(\eta))) - \beta \right)} \\
&= -\frac{(r q'(\theta) - \beta (q(\theta))^2) (r + \gamma)}{q'(\theta) (r + \gamma G(m_c(\eta))) - \beta (q(\theta))^2} \\
&= -\frac{q'(\theta) \left( r - \beta \frac{q(\theta)^2}{q'(\theta)} \right) (r + \gamma)}{q'(\theta) \left( r + \gamma G(m_c(\eta)) - \beta \frac{q(\theta)^2}{q'(\theta)} \right)} \\
&= -\frac{\left( r - \beta \frac{q(\theta)^2}{q'(\theta)} \right) (r + \gamma)}{\left( r + \gamma G(m_c(\eta)) - \beta \frac{q(\theta)^2}{q'(\theta)} \right)} \\
&= -\frac{\left( r + \beta f \frac{1}{\varepsilon_{q|\theta}} \right) (r + \gamma)}{\left( r + \gamma G(m_c(\eta)) + \beta f \frac{1}{\varepsilon_{q|\theta}} \right)}
\end{aligned}$$

Where  $\frac{q(\theta)^2}{q'(\theta)} = \theta q(\theta) \frac{q(\theta)}{\theta} \frac{1}{q'(\theta)} = -f \frac{1}{\varepsilon}$ , with  $\varepsilon = |q'(\theta) \frac{\theta}{q(\theta)}|$ .

## G Calibration of the General Equilibrium Model

The system of equations can be presented as follows

$$0 = m_c + \eta + rF - b + \frac{\gamma}{r + \gamma} \frac{(\bar{m} - m_c)^2}{2(\bar{m} - \underline{m})} - f\beta \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right) \quad (10)$$

$$\frac{c}{q} = (1 - \beta) \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right) \quad (11)$$

$$fu = \gamma \frac{m_c - \underline{m}}{\bar{m} - \underline{m}} (1 - u) \quad (12)$$

$$f = A\theta^\alpha \quad (13)$$

$$q = A\theta^{\alpha-1} \quad (14)$$

Therefore, the parameters of the model are  $\{\underline{m}, \bar{m}, \eta, F, r, \gamma, \alpha, \beta, b, c, A\}$ . And the unknowns are  $\{m_c, f, q, \theta, u\}$ .

The inside wage is

$$w(m) = \beta(m + \eta + rF) + (1 - \beta)b + (1 - \beta)f\beta \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right) \quad (15)$$

We impose  $f$  and the job separations rate  $\delta = \gamma \frac{m_c - \underline{m}}{\bar{m} - \underline{m}}$ . We can re-calculate  $A$  and  $\bar{m}$ .

Imposing  $\Psi$  and hence  $F = \Psi w_c$  with:

$$w_c = \beta(m_c + \eta + rF) + (1 - \beta)b + (1 - \beta)f\beta \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right) \quad (16)$$

We can alternatively use the average productivity wage

$$\bar{w} = \beta \left( \frac{m_c + \bar{m}}{2} + \eta + rF \right) + (1 - \beta)b + (1 - \beta)f\beta \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right) \quad (17)$$

With  $F = \Psi \bar{w}$ . Imposing  $\underline{m} = 0$ . We can derive  $\delta = \gamma \frac{m_c}{\bar{m}}$  the relation  $m_c = \frac{\delta}{\gamma} \bar{m} = \phi \bar{m}$ .

Replacing in (10), we obtain:

$$\left( \phi + \frac{\gamma}{r + \gamma} \frac{(1 - \phi)^2}{2} - f\beta \frac{1 - \phi}{r + \gamma} \right) \bar{m} + (r + f\beta)F = -\eta + b \quad (18)$$

Using (16),  $F = \Psi w_c$  and  $m_c = \phi \bar{m}$ , we derive:

$$\left( \beta\phi + (1 - \beta)f\beta \frac{1 - \phi}{r + \gamma} \right) \bar{m} + \left( -\frac{1}{\Psi} + \beta r - (1 - \beta)f\beta \right) F = -\beta\eta - (1 - \beta)b \quad (19)$$

We derive (18) and (19) the values of  $\{\bar{m}, F\}$ . And then:

$$\begin{aligned}
 m_c &= \phi \bar{m} \\
 u &= \frac{\delta}{f + \delta} \\
 q &= \frac{c}{(1 - \beta) \left( \frac{\bar{m} - m_c}{r + \gamma} - F \right)} \\
 \theta &= \frac{f}{q} \\
 A &= \frac{f}{\theta^\alpha}
 \end{aligned}$$

The two lines of the program are those representing graphically the solutions to equations (18) et (19):

$$\begin{aligned}
 F &= \frac{-\eta + b}{(r + f\beta)} - \frac{\left( \phi + \frac{\gamma}{r + \gamma} \frac{(1 - \phi)^2}{2} - f\beta \frac{1 - \phi}{r + \gamma} \right)}{(r + f\beta)} \bar{m} \\
 F &= \frac{-\beta\eta - (1 - \beta)b}{\left( -\frac{1}{\Psi} + \beta r - (1 - \beta)f\beta \right)} - \frac{\left( \beta\phi + (1 - \beta)f\beta \frac{1 - \phi}{r + \gamma} \right)}{\left( -\frac{1}{\Psi} + \beta r - (1 - \beta)f\beta \right)} \bar{m}
 \end{aligned}$$

## H Evolution of the Wages Pre and Post Treatment

States enacted first regulation	year	States enacted first regulation	year
California	1959	Alaska	1983
Indiana	1973	Arizona	1983
Illinois	1974	Colorado	1983
New Hampshire	1974	Kentucky	1983
Pennsylvania	1974	Minnesota	1983
Oregon	1975	Missouri	1983
Michigan	1976	Nebraska	1983
Oklahoma	1976	Nevada	1983
Idaho	1977	South Dakota	1983
Maine	1977	Virginia	1983
Massachusetts	1977	North Dakota	1984
Washington	1977	Texas	1984
West Virginia	1978	Iowa	1985
Arkansas	1980	North Carolina	1985
Connecticut	1980	South Carolina	1985
Montana	1980	Vermont	1985
New Jersey	1980	Wyoming	1985
New Mexico	1980	Utah	1986
Wisconsin	1980	Alabama	1987
Kansas	1981	Mississippi	1987
Maryland	1981	Delaware	1992
Tennessee	1981	Florida	0
Hawaii	1982	Georgia	0
New York	1982	Louisiana	0
Ohio	1982	Rhode Island	0
		DC	NA

Information retrieved from [Autor \(2003\)](#)

Table 10: **Starting Time of the Adoption of Exceptions**

## I Characteristics of the Selected States

Figures below present the main characteristics of the selected states figures [7](#) [8](#) [9](#)

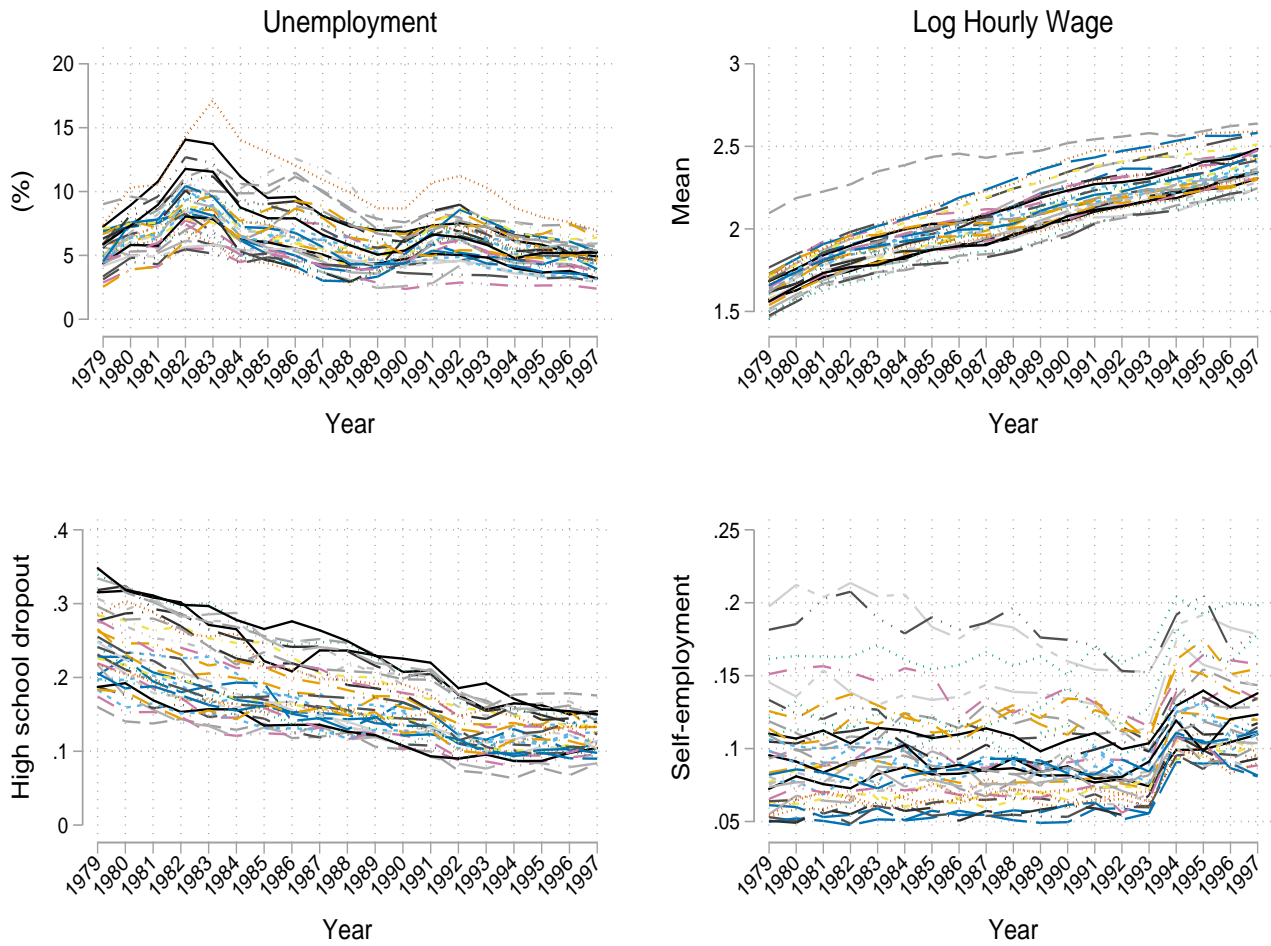


Figure 7: **Evolution Across Selected States of Certain Characteristics**  
 The graphs used data from Autor (2003). Each line on the graph corresponds to a specific state.

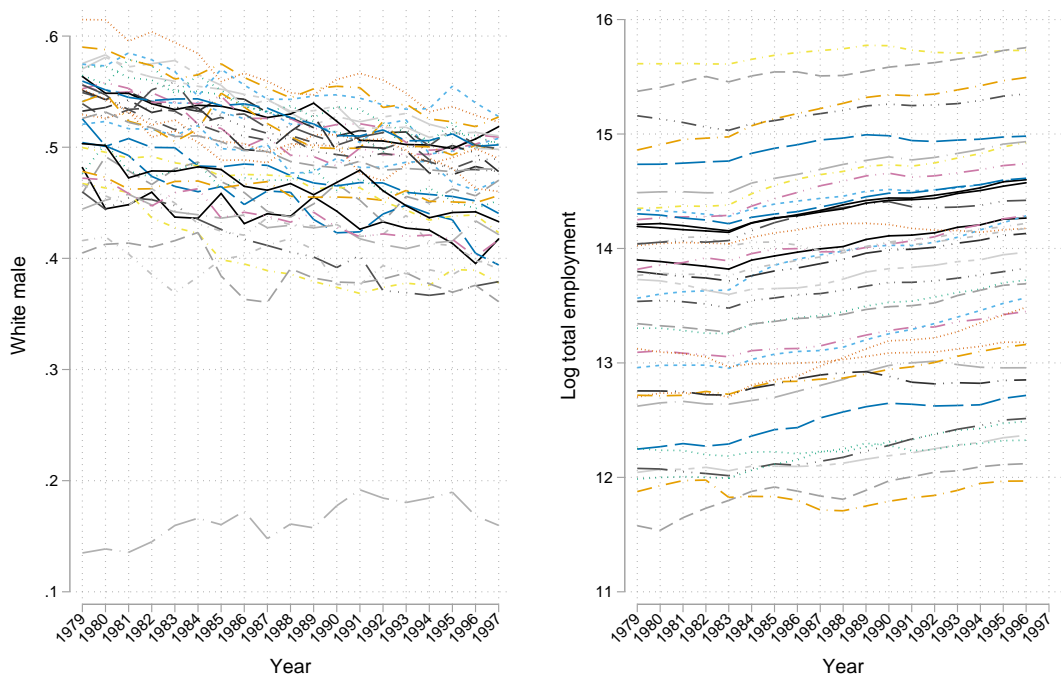


Figure 8: **Evolution Across Selected States of Certain Characteristics**

The graphs used data from Autor (2003). Each line on the graph corresponds to a specific state.

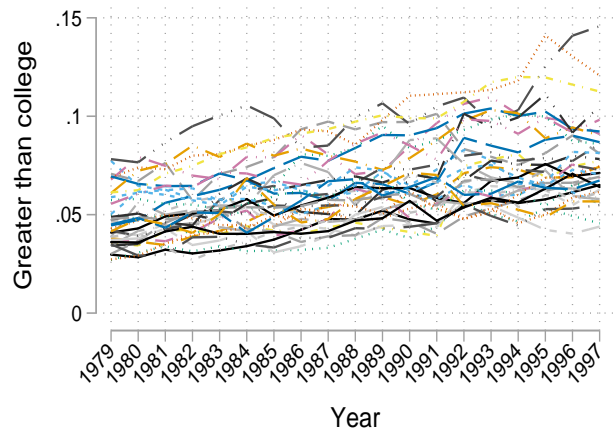
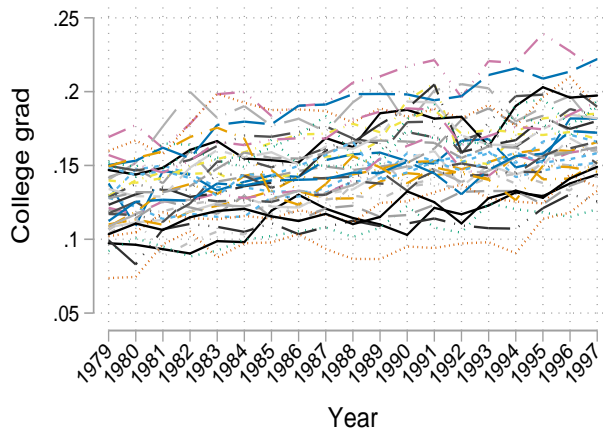
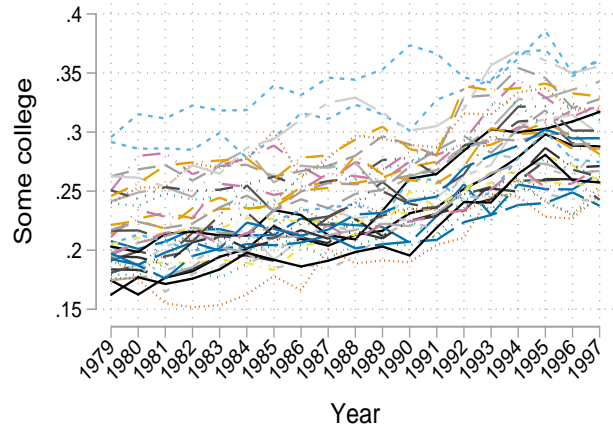
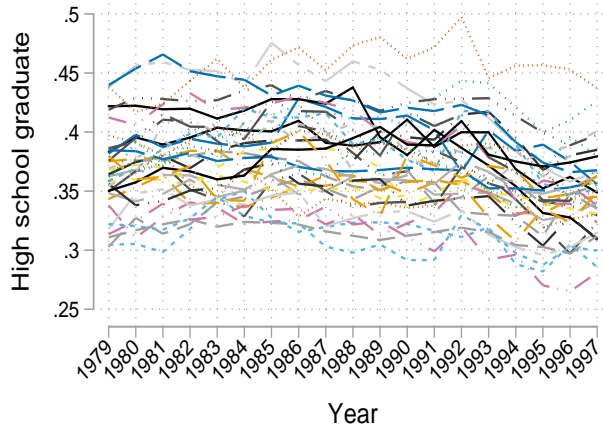


Figure 9: **Evolution Across Selected States of Certain Characteristics**  
 The graphs used data from Autor (2003). Each line on the graph corresponds to a specific state.



