Do Firing Costs Change Wages of Low and High Educated Workers Differently?

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Abstract

Wages of highly educated workers are affected differently by firing taxes compared to wages of less educated workers. Using a variety of data sources, we evaluate the effects of increasing firing taxes across the United States on wages of high and low-educated workers, in particular, we analyze how changes in the regulation of the employment-at-will across states affected the wages between 1970-1995. Application of quasi-experimental methods yields results suggesting a negative effect for low-educated workers and no significant effects for the highly educated. The standard search and matching model with endogenous search extended to account for two types of agents point as well to a negative effect of the firing costs on wages, with a more pronounced effect for low-educated workers.

Keywords: firing costs, employment-at-will, regulations, difference-in-difference.

JEL Classification: D04, J01, J08

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1 Introduction

Time series data on wages of high and low-educated workers exhibit different trends over the last decades in the United States. Multiple determinants are behind these patterns but research points to technological change as the main predictor. We explore other reasons and wonder if the increase in the firing costs observed across the United States may be another factor to take into account. Firing costs are indeed rising in the United States because states have individually enacted laws restricting the optimal firing choices of the firms. In particular, states have adopted different exceptions to the employment-at-will policy which grants complete freedom to employers to easily terminate contracts with workers. States have particularly adopted the following exceptions to the employment-at-will: the Implied Contract Exception, the Covenant of Good Faith Exception, and the Public Policy Exception. Implementation of such regulations started during the '70s and lasted until the '90s.

Given these policy reforms, we wonder if they have a significant and differentiated impact on wages depending on the workers' level of education. We think that there is a differentiated impact because the presence of firing taxes might modify the conditions of the labor market faced by highly and less educated workers. In particular, firing costs might increase the effects of adverse selection. Consider an economy with imperfect information about the type of workers (highly or low efficient), firms can only observe if the worker is highly or low-educated, depending on the proportion of highly efficient workers among the highly educated, which is assumed to be known, firms might be more inclined to hire highly educated workers; while firms are more reluctant to hire workers because of firing costs, we expect a more pronounced effect on low-educated workers.

In order to test this intuition, we examine the data by constructing a panel using a variety of data sources such as the Current Population Survey, the Bureau of Economic Analysis surveys, the Employment Survey of the Bureau of Labor Statistics, and data from Autor (2003). The panel contains information at the state level on wages for high and low-skilled individuals, states adopting exceptions to the employment-at-will, GDP, employment, and other covariates. This allows us to first provide empirical evidence of the link between firing costs and wages by estimating fixed effects models. Second, estimate the average treatment effect of implementing these regulations on wages of high and low-educated individuals, using different quasi-experimental methods.

Most of the states started to implement exceptions to the employment-at-will policy in 1972 except California that enacted regulations before 1960. Using this information we create two indexes to account for the variation of the regulation across the different states. Maps depicting the evolution of the indexes across states show an effect of the state and time variation of the regulation to the employment-at-will on wages. This effect appears to be positive, and the causality is determined through the different econometric models specified in this paper. Simple correlations and standard panel regressions point to a positive effect of these indicators on the wages of low-educated workers.

We compute as well the individual and average treatment effect for each state. To this end, states were classified as treated, never treated, and not yet treated. A state classified as treated, has implemented at least one of the most common exceptions to the employment-at-will in a particular year during the period 1976-1997. Results suggest that the adoption of the exceptions to the employment-at-will has no definitive effects on the wages of highly educated workers. On the other hand, the average wages for low-educated workers were negatively affected by the variation in the firing costs.

We also construct a model based on Kugler and Saint Paul (2004), and Pissarides (2000) extended to account for different types of workers, the model includes wage bargaining à la Nash and endogenous job destruction. Workers might be good or bad and be highly educated or low-educated. Before the match, the firm cannot observe the quality of the agent neither their past labor history. The firm only observes the level of education of the worker. After the match, the firm can observe the sum of the total match-specific and the workers-specific component, but it does not know if this output is explained by a high worker component or a high match-specific component. The firm will prefer to hire workers that contribute with a high output component to ensure itself against a bad worker and hence, avoid paying firing costs. We assume that there is a higher share of good workers among the highly educated, so the firm will prefer to hire highly educated workers. The share of bad workers among the low educated is higher.

The model also assumes that the firm can be hit by a shock that arrives with a certain probability. The model adds firing taxes that a firm pays to a third party when dismissing a worker. We focus on inside wages. Initially, with a segmented labor market, we solve the model with exogenous meeting rates that become endogenous afterward. In the exogenous case, the partial effect of the rise of the firing costs on wages of both highly and low-educated workers is positive. With endogenous rates, it is not possible to determine the sign of the effect. Because of this indeterminacy, we calibrate the model assuming that the firing costs, F, are such that $F = \psi w$, where w is the wage of the worker; and we estimate the effect on wages given continuous variations of the firing costs, and in particular, variations in ψ. We compute, therefore, the trajectory of the wages for highly and low-educated workers given subsequent variations in the firing costs. The results point to a negative effect on the wages of highly and low-educated workers. The effect is more pronounced in the case of low-educated workers. Econometric and calibrations results converge to point out a differentiated effect of firing costs on wages.

Related Literature Kugler and Saint-Paul (2004) studied if the firing costs to the employer reduce the probability to find a job for unemployed job seekers. They found that in the United States states where the regulation of the employment-at-will imposes higher firing costs to the employer, the unemployed job seekers have a lower probability to find a job than the employed, which is interpreted as an effect of the adverse selection. In their setup, they analyzed the distortion on the extensive margin due to the firing costs.

Blanchard and Tirole (2008) analyze the optimal design of the policy of firing taxes and other social transfers to reach maximum welfare. They introduce different scenarios and in particular, when wages are bargained à la Nash, positive variations in the firing taxes induce higher wages as the bargaining power of the workers increases.

In Pissarides (2000) the outside wage increases by a fraction of the hiring subsidy because the payment of the subsidy is conditional on the worker's agreement to accept the job offer. But it decreases by a fraction of the firing tax since if the worker agrees to sign the contract, the firm becomes liable to the firing tax. On the other hand, the inside wage is independent of the hiring subsidy, since it has been already received, but now it increases with the firing taxes since the firm has to pay the tax if the worker does not agree to continue the job match. In the absence of hiring subsidies, wages are low at first and increase after renegotiation. However, if the hiring taxes are higher than the hiring subsidy, the inside wage is higher than the outside one.

Lazear finds that the effects of the severance payments can be offset by any efficient contract, and points to the relevance of the empirical evaluations. On this ground, severance payment has an effect on the employment-population ratio. In effect, unemployment can fluctuate as a result of employment restrictions: it might be the case that severance payments reduce unemployment because employers are now more reluctant to hire new workers, but also, unemployment can lower if a sufficiently high number of workers leave the labor force. In the case of a negative effect of employment, labor force participation rates will fall and so, employment-population ratios. Implementing severance payments of three months for workers with 10 years of service would reduce the ratio of employment-population by 10%. On the other hand, severance payments might appear to increase unemployment rates in the United States.

The paper is organized as follows, section 2 presents the data, section 3, the stylized facts and the section 4 the econometric strategy. Sections 5 presents the underlined mechanism with the help of a theoretical model and its respective calibration, and section 6, concludes.

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

We construct a panel data by aggregating individual observations at the state level using the version of the Current Population Survey of the United States that is administered by IPUMS. The panel contains time series data from 1962 to 2020 depending on the state. Subsequently, we compile information on Gross Domestic Product and Employment using data retrieved from the Bureau of Economic Analysis. In addition, we assemble data on unemployment and other state level characteristics using the surveys of the Bureau of Labor Statistics. Finally, the information on states adopting regulations to the employment-at-will is based on data from David Autor (2003).

2.1 Wages

High Educated vs. Low Educated Individuals. We use the Current Population Survey and extract individual information on wages, level of education, household residence and other individual and household demographic characteristics. We then aggregate these observations at the state level, divide the population between high and low educated and identify the wages for each of these groups. Groups identified as high educated are composed by individuals having at least a bachelor degree. Low educated individuals are respectively those without a bachelor degree. The variables presenting information on wages for high and low educated individuals are thus, the average wage among these two groups for a determined state in a particular year. Nominal values have been deflated using the CPI index retrieved from the IMF website.

2.2 Labor Productivity and Covariates

We compile information on Gross Domestic Product, employment, unemployment, and other features of the labor market at the state level, using data from the Bureau of Economics Analysis and the Bureau of Labor Statistics.

2.3 Regulation on Employment at Will

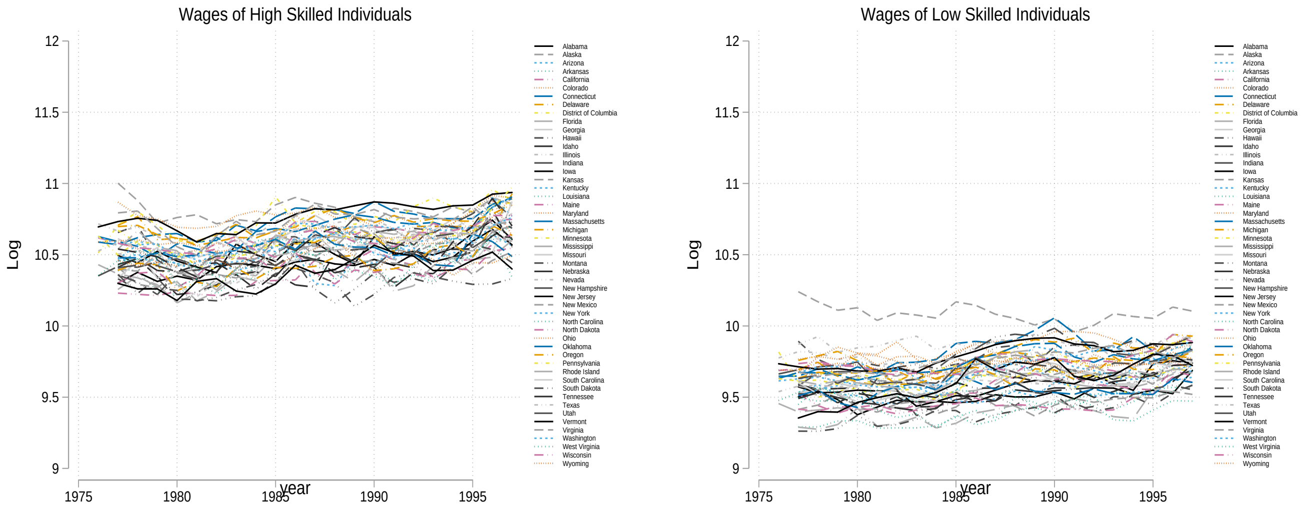
David Autor gathered and documented information on reforms to the employment-at-will by state from 1950 to 1997, which he subsequently used in his article "Outsourcing at Will: The Contribution of Unjust Dismissal Doctrine to the Growth of Employment Outsourcing". Having access to this data, we are able to identify when a state enacted a law to adopt at least one of the three most common exceptions to the employment-at-will: the implied contract, the good faith or/and the public policy. "The implied contract exception states that the context of employment may imply a binding contract through indirect statements of the employer on the conditions of employment, treatment of other employees or recurring industry practices. Since the required corpus delicti are not very well defined and subject to interpretation by courts, this exception induces uncertainty to the employers and higher expected firing costs. The covenant of good faith exception avoids employers from terminating contracts without just cause. Specifically it was introduced to prevent employers from denying employees already earned benefits such as end-of-year bonuses or pensions by letting them go shortly before. This is generally considered to be the tightest exception to at-will employment. Finally the public policy exception makes it illegal to "retaliate against employees for upholding the law or exercising their statutory rights for example by attending jury duty, whistle-blowing or refusing to commit a fraudulent act" Autor (2003).

3 Stylized Facts

Wages and Employment Productivity. Figure (1) and (2) present the evolution of wages for high and low educated workers, and the trends of the labor productivity across states. These trends are positive and correlated. Appendix (B) presents the results of different specifications linking wages and labor productivity by state.

States Adopting Regulations on the Employment-at-will. Most of the states started to implement exceptions to the employment-at-will policy from 1972 excepting California that enacted regulations before 1960. Figure (3) presents the number of states adopting such reforms, in particular, it is computed by counting the number of states that implemented one of the three most common exceptions in a specific year. In this manner, line black represents the number of states adopting the implied contract exception, the doted blue line represents the states adopting the public policy exception and the doted gray line represents the number of states adopting the good faith exception[1]. This graph suggests an increase in the number of states regulating the employment-at-will doctrine and therefore, distorting the optimal firing choices of the firms. We subsequently

[1] This graph is as well presented in Autor (2003)



(a) High Educated (b) Low Educated

Figure 1: **Evolution of the Wages Across States in the United States**
The graph uses individual information assembled at the state level retrieved from the Current Population Survey on the United States.

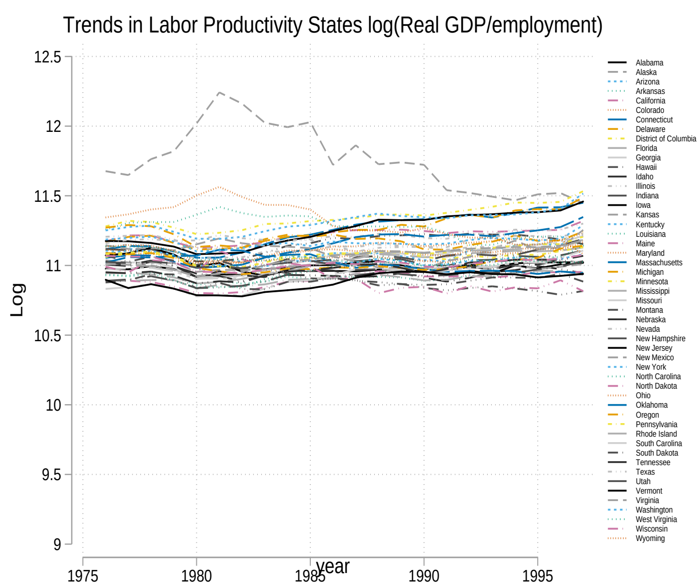


Figure 2: **Evolution of the Labor Productivity**
The graph uses data on employment and GDP from the Bureau of Economic Analysis.

proceed by computing an index that allows to visualize the tightness of this regulation across states in the United States and infer preliminary conclusions about the effect of increasing the firing costs on the level of wages of high and low educated individuals.

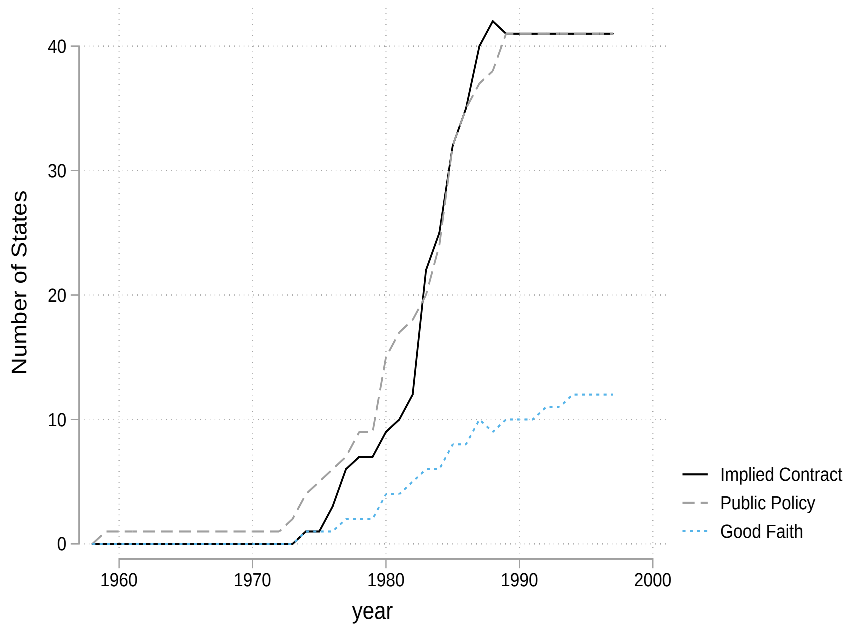


Figure 3: **States Adopting Exceptions to the Employment-at-will**
The graph was computed using data provided by David Autor (2003).

Using the information assembled in our panel data, we construct an index that indicates the level of regulation on the employment-at-will at the state level. This index is computed using the expression (1).

$$In1_{i,t} = \frac{\sum_{j=1}^{3} D_{i,t,j}}{3} \quad (1)$$

Where $In1_{i,t}$ is a state i indicator that changes over time t, $D_{i,j,t}$ is a categorical variable that is equal to 1, 2 or 3, depending if the state has implemented 1, 2 or the 3 most common exceptions j to the employment-at-will (the Implied Contract Exception, the Covenant of Good Faith Exception and Public Policy Exception). The indicator is divided by 3, hence a state with the tightest regulation on the employment-at-will, would have an indicator equal to 1, and 0 if the he state did not adopt any of the exceptions. The evolution of this indicator is presented in figure (4) and point to the fact that states became more reluctant to allow firms to fire workers easily, increasing therefore their firing costs. It is important to note as well that Florida, Georgia, Louisiana and Rhode Island did not implement any regulation on the employment-at-will policy during the period considered in this study.

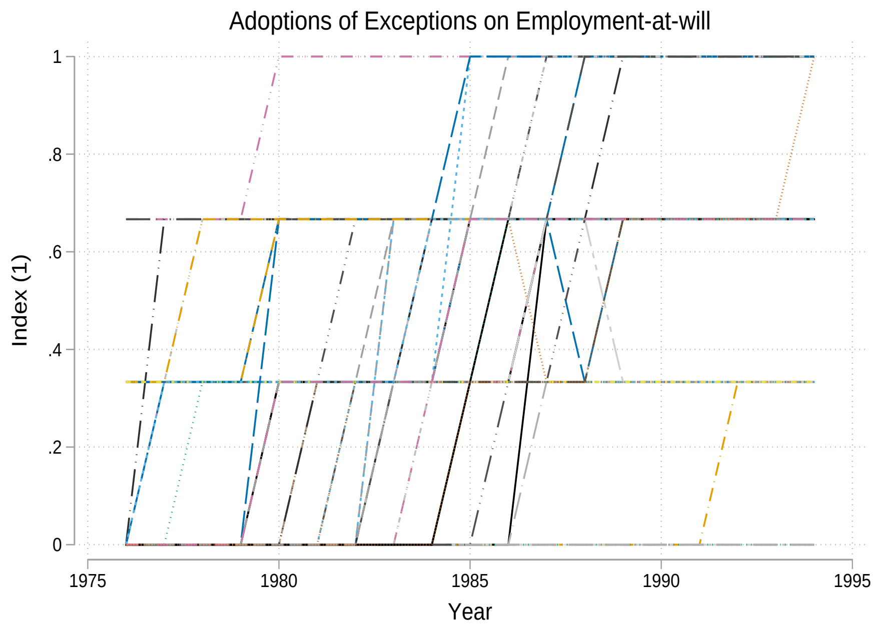


Figure 4: **Variation Index (1) Across States**
The graph was computed using observations of Autor (2003).

Depending on the adopted exceptions to the employment-at-will by a particular state, firms may have higher or lower firing costs. This "degree" of the regulation should be captured by the indicator presented previously. Index $In2_{i,t}$ represented by expression (2) accounts for these heterogeneous regulations, in particular, it is a weighted indicator that takes into account the degree of the limitations imposed by each of the exceptions to the employment-at-will.

$$In2_{i,t} = \frac{\sum_{j=1}^{6} 3 * GF_{ij} + 2 * PP + 1 * IC}{6} \quad (2)$$

Where $In2_{i,t}$ is an indicator of the regulation of the employment-at-will currently implemented in period t in state i. GF is a dummy variable that is equal to 1 if the state has adopted the Good Faith exception, receiving in this case, a weight equal to 3, because this exception imposes the highest restrictions. PP is as well a dummy that is equal to 1 if the state i has implemented the Public policy exception in year t, in such a case, the state has a weight equal to 2. Consequently, if the state has implemented the implied contract exception, IC is equal to 1 and the corresponding weight is 1. The indicator is divided by 6, hence it hinges on a range between 0 and 1. Figure (5) presents how $In2_{i,t}$ has evolved across the states in the United States. Already suggested by the first indicator, this second index also shows that states have imposed more regulations and impediments for the firms to easily fire a worker. Figure (6) presents on the other hand, when the different states started to implement regulations. Some of them started in the middle of the 70's and most of the states had adopted exceptions during the 80's.

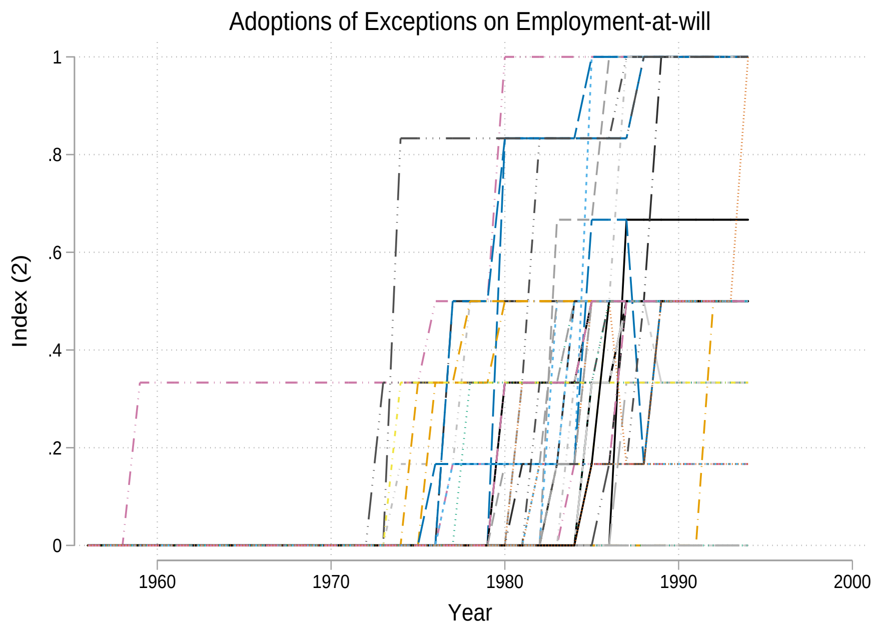


Figure 5: **Variation Index (2) Across States**

The graph presents information on the regulation of the employment at will across states using data provided by David Autor.

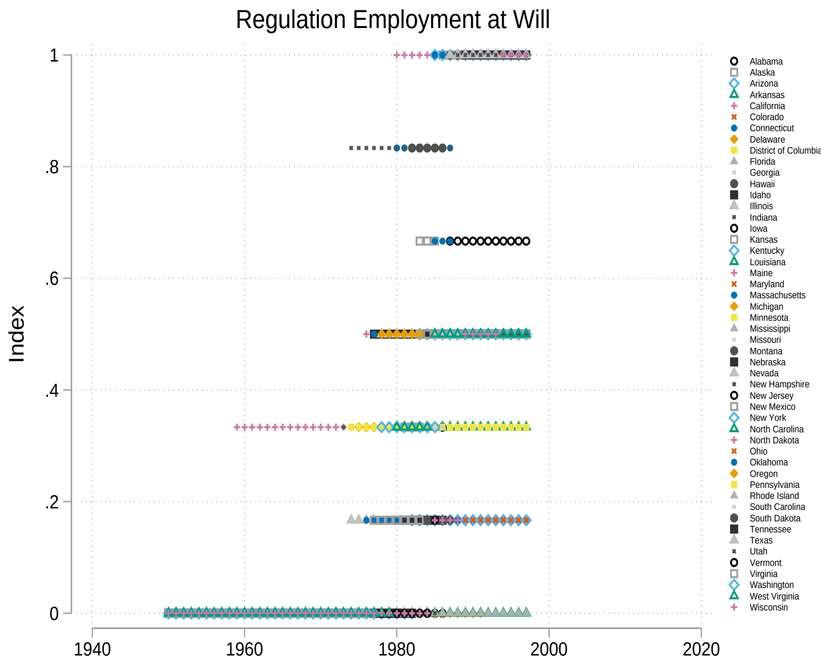


Figure 6: **Starting Points in Time, Adoption of Exceptions**
The graph presents information regarding the year when the state implemented one or several exceptions to the employment-at-will. The graph uses data provided by David Autor

States are classified exploiting the information provided by the indexes on state variation of the regulation to the employment-at-will, which allows to construct several maps to visualize how wages for high and low educated, and the regulation of the employment-at-will have evolved along two points in time: 1976 and 1996. Figure (7) presents different maps illustrating a possible correlation between the increase in the wages and the increase in the regulation of the firing procedures. In particular, panel A and D show that some states became blue light suggesting an increase of the wages for high educated individuals. Panels B and E show as well that some states became blue light suggesting an increase in wages of low educated individuals. Finally, panels C and F, computed using the index $In1_{i,t}$, suggest that most of the states implemented more exceptions to the employment-at-will: states passed from blue to red.

The maps allow to suspect an effect of the state and time variation of the regulation to the employment-at-will, on wages. This effect appears to be positive, but the causality remains to be determined. In order to clear these alleged claims, next section presents a clean estimation strategy that looks to exploit the information provided by the different indexes and the quasi experimental methods used in the literature of public policy evaluation.

3.1 Initial Correlations

States that become blue light are as well those that became red, hence is there any causal relationship between wages of high and low educated individuals, and reforms to the firing policy? We try to answer this question in this section of the paper by initially estimating some correlations, that exploit the information provided by the indexes. In particular, models (3) and (4) try to isolate the effect of the indicator of the regulation of the employment-at-will ($In2_{i,t}$) on wages of high and low educated workers. Corresponding results are presented in tables (1) and (2).

$$log(W^j_{i,t}) = \phi + \beta log(X_{i,t}) + \gamma I_{2,(i,t)} + \delta_t + \varepsilon^j_{i,t} \quad (3)$$

$$log(W^j_{i,t}) = \phi + \beta log(X_{i,t}) + \gamma I_{2,(i,t)} + \phi_1 ur_{i,t} + \delta_t + \varepsilon^j_{i,t} \quad (4)$$

Model (3) presents the effects of the labor productivity $log(X_{i,t})$ and the indicator, $In2_{i,t}$, on wages $log(W^j_{i,t})$ of state i and year t of the group j, high or low educated. Model (3) is estimated by using ordinary least squares and serves as benchmark. Column 1 of tables (1) and (2) present the estimates for these models. Column 2 of these tables presents estimates including time effects because of the nature of the index and wages, whose trends evolve positively over time. We do not include state fixed effect at this stage because the main objective of this section is to highlight some initial correlations, causal and treatment effects are deeply analyzed in the following sections. Model (3) add additional covariates and serve as robustness checks, in particular it incorporates the effects of the state unemployment rate.

There is a positive effect of our indicator of the regulation on the employment-at-will, on wages of low educated individuals across states. Line 2 in table (2) shows a positive correlation $\gamma > 0$. The estimate of γ is as well significant in all the specifications. β, the effect of the labor productivity,

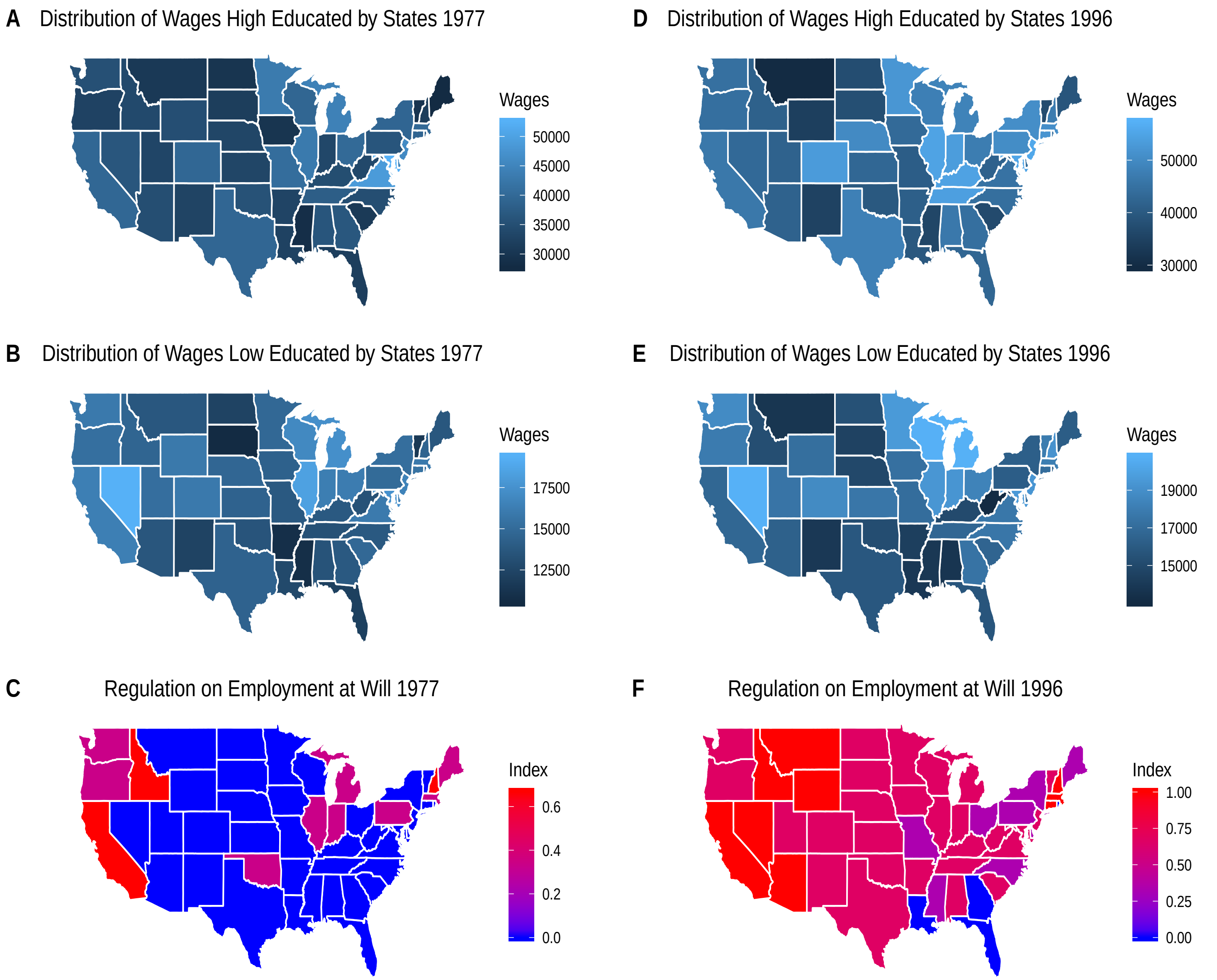


Figure 7: **States, Employment-at-will and Wages**

The map exploits the cross-state variation of the wages for high educated individuals between two periods 1977 (panel A) and 1996 (panel D). Wages of low educated individuals between 1977 (B) and 1996 (E). The regulation of the employment-at-will between 1996 (C) and 1997 (F).

	Wages HE	Wages HE	Wages HE
β (Lab. prod.)	0.557***	0.528***	0.537***
	(0.0373)	(0.0311)	(0.0325)
γ (Index)	0.0890***	0.00755	0.00792
	(0.0125)	(0.0124)	(0.0123)
ϕ_1 (unem. r.)			-0.00405
			(0.00214)
ϕ	4.350***	4.692***	4.628***
	(0.411)	(0.347)	(0.357)
Observations	1062	1062	1062
Adjusted R^2	0.405	0.509	0.511
Time Effects		✓	✓

Standard errors in parentheses

Note: Robust standard errors. Source: BEA, BLS, Autor (2003), CPS.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1: **Effects of the Adoption of Exceptions on Wages Highly Educated**

	Wages LE	Wages LE	Wages LE
β (Lab. prod.)	0.575***	0.569***	0.619***
	(0.0234)	(0.0228)	(0.0241)
γ (Index)	0.128***	0.0987***	0.101***
	(0.0114)	(0.0124)	(0.0111)
ϕ_1 (unemp. r.)			-0.0235***
			(0.00212)
ϕ	3.228***	3.296***	2.923***
	(0.258)	(0.253)	(0.267)
Observations	1062	1062	1062
Adjusted R^2	0.475	0.494	0.555
Time Effects		✓	✓

Standard errors in parentheses

Note: Robust standard errors. Source: BEA, BLS, Autor (2003), CPS.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: **Effects of the Adoption of Exceptions on Wages Low Educated**

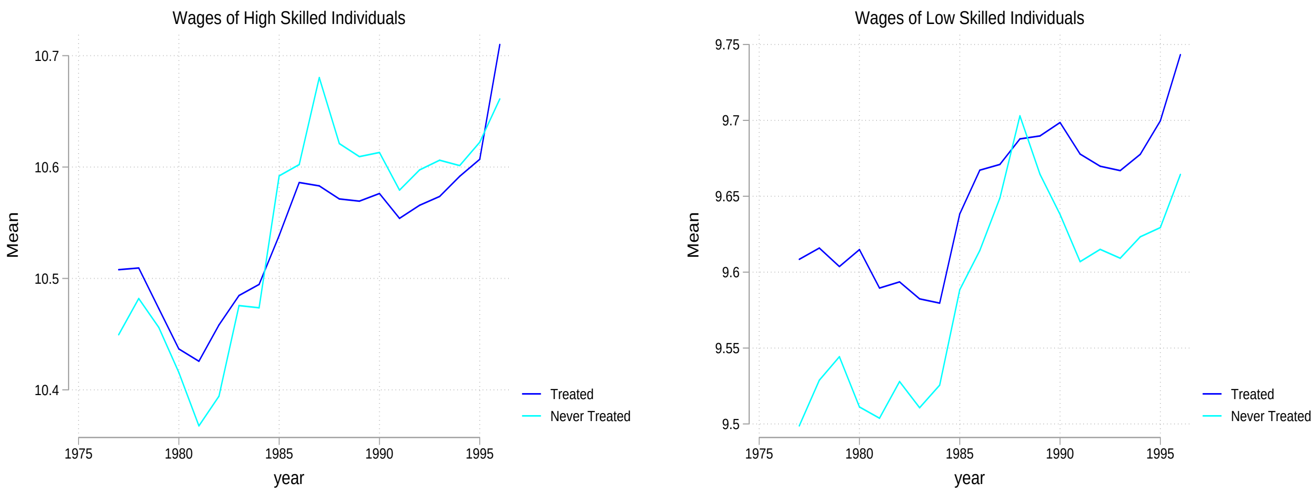
is as well positive and significant in all the different specifications, suggesting a positive correlation with wages of high (line 1 of table (1)) and low educated (line 1 of table (2)). β is as well the elasticity between the wage variable and the labor productivity. Finally, estimation of model (4) yields a theoretically expected effect of the unemployment rate ($\phi_2 < 0$), and this is the case because people looking for a job are less reluctant to accept lower wages; observe this effect is higher in the case of high educated workers. There is no effect of the firing taxes reform on wages of high educated workers, suggesting a differentiated impact.

The econometric results discussed previously put forward an important intuition regarding the effects of the firing costs on wages of high and low educated individuals in line with expected predictions of the theoretical model. Indeed the interaction between firing taxes and adverse selection, affect the probabilities differently for high and low educated workers, yielding a differentiated impact of the firing taxes on wages. Blanchard and Tirole (2008) advance another explanation to this plausible result, in their framework, negotiated wages are higher in the presence of firing costs because workers have a higher bargaining power.

While our results highlight interesting findings, it is important to remark that in order to exploit the variation of the regulation of the employment-at-will across the different states, quasi-experimental methods should be implemented. Difference-in-difference is the straightforward method to use in this case, however, given the staggered nature of the implementation of the policy and the possible existence of heterogeneous treatment effects, more advanced tools are needed. Next section presents the econometric framework that will be used to explore the causal effects of the adoption of exceptions to the employment-at-will on wages.

4 Econometric Strategy: Treatment Effects

Given the staggered nature of the implementation of the reforms to the employment-at-will and the structure of the data set, it is possible as well to implement difference-in-difference techniques. We start by computing some statistical comparisons between wages of high and low educated individuals by treatment status. In particular, states are classified between treated, never treated and not yet treated. A treated state has implemented at least one of the most common exceptions to the employment-at-will in a specific year between 1976 and 1997. The never treated states are therefore, those that never implemented any regulations on the employment-at-will between 1976 and 1997, namely Florida, Georgia, Louisiana and Rhode Island. As the states became treated because the implementation is staggered (see figures of the evolution of the indexes), they are "not yet treated" units until they implement one of the regulations. Figures (8) and (9) present the main results (See Appendix (D)for complementary results).



(a) High Educated

(b) Low Educated

Figure 8: **Wages High Educated vs Low Educated Across Treated and Never Treated States**
The graph presents averages estimates of wages for high and low educated workers in states that have been treated, adopted exceptions to the employment-at-will, vs states never treated.

Figure (8) presents the evolution of the average wages for high and low educated groups between treated and never-treated states. Panel (a) suggests that the adoption of the exceptions to the employment-at-will has no definitive effects on wages of high educated workers. Indeed, between 1976 and 1997, main period during which most of states implemented reforms, the average value of wages for high educated was 10.54084 (s.d.=0.067745) among the treated states, while among the never treated states the average was 10.545 (s.d.=0.094731), therefore and according to a t-test of mean comparison, there is no significant difference between these two means, suggesting a no significant impact of the treatment between treated and **never** treated states. On the other hand,

(a) High Educated

(b) Low Educated

Figure 9: **Wages High Educated vs Low Educated Across Treated and Never Treated States**
The graph presents the evolution of $log(W_{it}^{j}) - \hat{\beta}log(X_{it})$ between treated states and never treated states.

the average wages for low educated during the same period of time was 9.648784 (s.d. = 0.0471451) for the treated states, and 9.587801 (s.d = 0.0633093) for the untreated ones, suggesting a small positive effect of the firing taxes on wages of low educated. This is a significant difference according to a mean t-test.

Figure (9) presents the evolution of $log(W_{it}^{j}) - \hat{\beta}log(X_{it})$, where $\hat{\beta}$ is the slope coefficient associated to the regression (7), which estimates the effect of being always treated AT_i on wages of high and low educated workers, allowing to have a comparison with the graphs of figure (8). $AT_i = 1$ if the state has implemented a reform to the employment-at-will between 1976 and 1997, and 0 otherwise (never treated). Hence, figure (9) takes into account the effects of the labor productivity on wages, the residuals are the result of the reforms to the firing taxes and other not included effects. The result shows similar trends to those of figure (8), and table (5) (columns 2 and 4 for highly and less educated workers) presents the definitive results of the estimations of this model, in particular, we observe a significant and negative effect of increasing firing costs on wages of less educated workers. However, this conclusion should be carefully analyzed because the comparison is made between treated and never treated, hence the staggered nature of the treatment is not considered, in fact, treatment status is fixed during the period. These preliminary results, point to the need of estimating models that capture the heterogeneity across the treatment implementation. We start by estimating the following models:

$$log(W^{j}_{i,t}) = \alpha_i + \beta log(X_{i,t}) + \gamma_i D_{i,t} + \delta_t + \varepsilon_{i,t} \quad (5)$$

$$log(W^{j}_{i,t}) = \alpha_i + \beta log(X_{i,t}) + \gamma D_{i,t} + \delta_t + \varepsilon_{it} \quad (6)$$

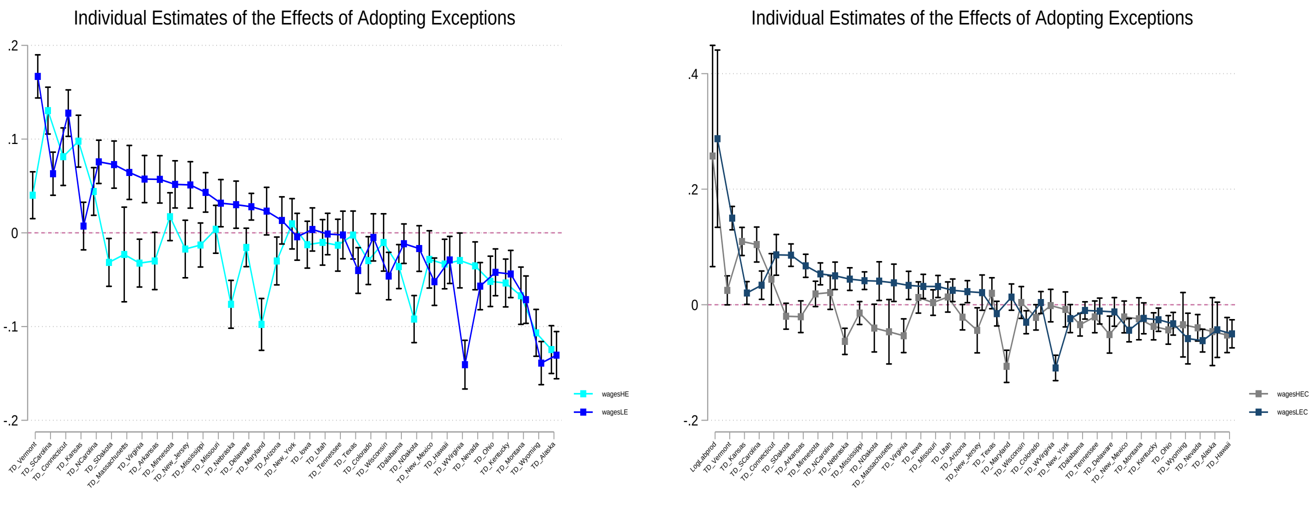
$$log(W^{j}_{i,t}) = \alpha_i + \beta log(X_{i,t}) + \phi AT_i + \varepsilon_{it} \quad (7)$$

Model (5) tries to capture the individual-state effect of implementing at least one of the three exceptions to the employment-at-will on wages of high and low educated individuals. In particular, it estimates a state i level coefficient γ of an interaction effect, represented by $D_{i,t}$ between two dummy variables $T_{i,t}$ and A_i that are different for every state and time. For every state $D_{i,t} = T_{i,t}A_i$. $T_{i,t}$ is equal to 1 from the moment the state i has implemented regulations to the employment-at-will and 0 otherwise. It remains equal for all the other states. A_i is a variable that is equal to 1 if the state i is treated and 0 for the other different states[2]. This model add time and state fixed effects because it is important to capture the evolution of the probability of becoming treated over the time and the unobserved heterogeneity factors that are fixed over time. Results are presented in tables (3) and (4), and figure (10).

The implementation of the adoption of the exceptions or the increase in the firing costs is positive or negative depending on the state. Table 3 shows that the impact on wages of high educated individuals is rather negative in Alabama, Arizona, Arkansas, Idaho, Iowa, Kansas, Kentucky, Maine, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Mexico, North Carolina, North Dakota, Oregon, South Dakota, West Virginia and Wyoming, taking into account labor productivity. Regarding the wage of low educated individuals, the effect of the regulation on the firing costs is negative in Alabama, Arkansas, Idaho, Kentucky, Mississippi, Montana, New Mexico, New York, North Dakota, Oklahoma, South Dakota, Texas, Tennessee and West Virginia. According to figure

[2] Appendix E presents an example of the computations for $T_{i,t}$ and $A_{i,t}$.

10, the effect in average seems to be positive for high and low educated individuals[3].



(a) (b)

Figure 10: **State-individual Effects of Adopting Exceptions on the Employment-at-will** The graphs present the estimates for each state using specification (12). Panel (b) adds the labor productivity (ordered parameters).

Model (6) evaluates the global effect of the treatment, implementing the exceptions to the employment-at-will on wages of high and low educated individuals. γ measures the treatment effect. D_{it} is therefore a dummy variable that is equal to 1 from the moment a particular state i has started to adopt one of the three most common exceptions to the employment-at-will. β is the effect stemming from the labor productivity, it is as well the elasticity between the labor productivity and the wages of high and low educated individuals j. The specification adds also time and state effects, it is indeed a twoway fixed effect model. Results are presented in table (5) (columns 1 and 3) and suggest no effect of increasing the firing costs on wages of highly and less educated workers. However, recent research has pointed out problems with weights related to the twoway fixed effects estimations, for this reason, we implement recent advances in the estimations of difference in difference with staggered treatments.

[3]Florida, Georgia, Louisiana and Rhode Island have zero estimates because of collinearity. DC is not added to the estimations because of lack of observations

	Wages HE	Wages HE	Wages LE	Wages LE
γAlabama	-0.0438	-0.00653	-0.117***	-0.0680**
	(0.0286)	(0.0261)	(0.0285)	(0.0239)
γAlaska	0.227***	0.0315	0.433***	0.175***
	(0.0247)	(0.0263)	(0.0246)	(0.0241)
γArizona	-0.0469	-0.0424	0.0234	0.0293
	(0.0247)	(0.0224)	(0.0246)	(0.0205)
γArkansas	-0.173***	-0.110***	-0.212***	-0.130***
	(0.0225)	(0.0209)	(0.0225)	(0.0192)
γCalifornia	0.0842***	0.0429*	0.0971***	0.0426*
	(0.0204)	(0.0188)	(0.0203)	(0.0172)
γColorado	0.0411	0.0546*	0.153***	0.171***
	(0.0247)	(0.0225)	(0.0246)	(0.0205)
γConnecticut	0.200***	0.139***	0.216***	0.135***
	(0.0225)	(0.0209)	(0.0225)	(0.0191)
γDelaware	0.105**	0.0130	0.163***	0.0422
	(0.0382)	(0.0353)	(0.0381)	(0.0323)
γHawaii	0.0255	-0.000843	0.169***	0.135***
	(0.0239)	(0.0218)	(0.0238)	(0.0199)
γIdaho	-0.162***	-0.110***	-0.0833***	-0.0146
	(0.0213)	(0.0197)	(0.0213)	(0.0181)
γIllinois	0.137***	0.101***	0.155***	0.108***
	(0.0204)	(0.0187)	(0.0203)	(0.0171)
γIndiana	0.00135	0.0186	0.0807***	0.103***
	(0.0204)	(0.0186)	(0.0203)	(0.0170)
γIowa	-0.114***	-0.0652**	-0.0355	0.0286
	(0.0264)	(0.0243)	(0.0264)	(0.0222)
γKansas	-0.0385	-0.000293	0.0303	0.0805***
	(0.0232)	(0.0212)	(0.0231)	(0.0194)
γKentucky	-0.0469	-0.0209	-0.0991***	-0.0649**
	(0.0247)	(0.0225)	(0.0246)	(0.0206)
γMaine	-0.181***	-0.115***	-0.0787***	0.00861
	(0.0213)	(0.0199)	(0.0213)	(0.0182)
γMaryland	0.202***	0.190***	0.229***	0.214***
	(0.0232)	(0.0211)	(0.0231)	(0.0193)
γMassachusetts	0.118***	0.0995***	0.124***	0.0995***
	(0.0209)	(0.0190)	(0.0208)	(0.0174)
γMichigan	0.155***	0.125***	0.145***	0.106***
	(0.0213)	(0.0195)	(0.0213)	(0.0178)
γMinnesota	0.0742**	0.0849***	0.130***	0.144***
	(0.0247)	(0.0224)	(0.0246)	(0.0205)
γMississippi	-0.194***	-0.130***	-0.205***	-0.121***
	(0.0286)	(0.0264)	(0.0285)	(0.0241)
γMissouri	-0.00931	0.0250	0.00851	0.0537**
	(0.0247)	(0.0226)	(0.0246)	(0.0206)
γMontana	-0.269***	-0.198***	-0.134***	-0.0406*
	(0.0225)	(0.0211)	(0.0225)	(0.0193)
Observations	1024	1024	1024	1024
Time Effects	✓	✓	✓	
Adjusted R^2	0.668	0.726	0.668	0.769

Standard errors in parentheses

Note: Robust standard errors. Source: BEA, BLS, Autor (2003), CPS.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: **Individual Effects of the Adoption of Reforms**

	Wages HE	Wages HE	Wages LE	Wages LE
γNebraska	-0.114***	-0.0679**	-0.0233	0.0371
	(0.0247)	(0.0227)	(0.0246)	(0.0207)
γNevada	0.0332	0.0159	0.246***	0.223***
	(0.0247)	(0.0225)	(0.0246)	(0.0206)
γHampshire	-0.00208	0.0288	0.173***	0.214***
	(0.0213)	(0.0195)	(0.0213)	(0.0179)
γNew_Jersey	0.228***	0.167***	0.190***	0.109***
	(0.0225)	(0.0209)	(0.0225)	(0.0191)
γNew_Mexico	-0.0837***	-0.0854***	-0.167***	-0.169***
	(0.0225)	(0.0205)	(0.0225)	(0.0187)
γNew_York	0.103***	0.0219	0.0369	-0.0696***
	(0.0239)	(0.0225)	(0.0238)	(0.0205)
γNCarolina	-0.0150	0.0130	0.0360	0.0728***
	(0.0264)	(0.0241)	(0.0264)	(0.0221)
γNDakota	-0.181***	-0.0981***	-0.170***	-0.0614**
	(0.0255)	(0.0239)	(0.0254)	(0.0219)
γOhio	0.0690**	0.0698**	0.0987***	0.0998***
	(0.0239)	(0.0217)	(0.0238)	(0.0199)
γOklahoma	-0.0155	0.0117	-0.0699**	-0.0342
	(0.0213)	(0.0195)	(0.0213)	(0.0178)
γOregon	-0.113***	-0.0840***	0.0538*	0.0919***
	(0.0213)	(0.0195)	(0.0213)	(0.0178)
γPennsylvania	0.0575**	0.0611**	0.00407	0.00888
	(0.0204)	(0.0185)	(0.0203)	(0.0170)
γSCarolina	0.0141	0.0603*	0.00777	0.0685**
	(0.0264)	(0.0242)	(0.0264)	(0.0222)
γSDakota	-0.244***	-0.170***	-0.198***	-0.0994***
	(0.0247)	(0.0230)	(0.0246)	(0.0211)
γTennessee	0.00254	0.0415	-0.0803***	-0.0289
	(0.0232)	(0.0213)	(0.0231)	(0.0194)
γTexas	0.0837**	0.0719**	-0.00939	-0.0250
	(0.0255)	(0.0232)	(0.0254)	(0.0212)
γUtah	-0.0699*	-0.0184	0.0543*	0.122***
	(0.0275)	(0.0252)	(0.0274)	(0.0231)
γVermont	-0.165***	-0.100***	0.0624*	0.148***
	(0.0264)	(0.0244)	(0.0264)	(0.0224)
γVirginia	0.170***	0.174***	0.154***	0.159***
	(0.0247)	(0.0224)	(0.0246)	(0.0205)
γWashington	0.0130	-0.0114	0.127***	0.0947***
	(0.0213)	(0.0195)	(0.0213)	(0.0178)
γWVirginia	-0.101***	-0.0822***	-0.215***	-0.190***
	(0.0213)	(0.0194)	(0.0213)	(0.0178)
γWisconsin	0.0582**	0.0886***	0.115***	0.155***
	(0.0225)	(0.0206)	(0.0225)	(0.0188)
γWyoming	-0.128***	-0.164***	0.0773**	0.0298
	(0.0264)	(0.0242)	(0.0264)	(0.0221)
β (lab. prod.)		0.338***		0.445***
		(0.0237)		(0.0217)
ϕ	10.54***	6.784***	9.601***	4.660***
	(0.0265)	(0.265)	(0.0264)	(0.242)
Observations	1024	1024	1024	1024
Time Effects	✓	✓	✓	
Adjusted R^2	0.668	0.726	0.668	0.769

Standard errors in parentheses

Note: Robust standard errors. Source: BEA, BLS, Autor (2003), CPS.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: **Individual Effects of the Adoption of Reforms**

	Wages HE	Wages HE	Wages LE	Wages LE
β (Lab. prod.)	0.280***	0.580***	0.336***	0.493***
	(0.0664)	(0.0595)	(0.0556)	(0.0426)
γ (Treatment: $D_{i,t}$)	-0.0120		0.0149	
	(0.0122)		(0.0104)	
ϕ (Treatment: AT_i)		-0.0349		-0.134***
		(0.0259)		(0.0180)
α_i	7.389***	4.186***	5.863***	4.223***
	(0.732)	(0.658)	(0.615)	(0.469)
Observations	1062	1062	1062	1062
Adjusted R^2	0.547	0.641	0.531	0.807
State Effects	✓	✓	✓	✓
Time Effects	✓		✓	

Standard errors in parentheses

Note: Robust standard errors. Source: BEA, BLS, Autor (2003), CPS.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: **Alternative Manners of Expressing the Treatment**

4.1 Event Study and Staggered Treatment

Given the staggering nature of the timing of the treatment, it is possible that the effect appears after some periods of the implementation justifying the estimation of model (8). We now present estimations for the average treatment effect using Callaway and Sant'Anna (2021) and the correction methods of Sun and Abraham (2020).

$$log(W^j_{i,t}) = \alpha_i + \phi_t + \sum_{k=T_0}^{-2} \gamma_k \times D_{ik} + \sum_{k=0}^{T_1} \gamma_k \times D_{ik} + \beta log(X_{it}) + \varepsilon_{it} \quad (8)$$

Model (8) is a dynamic-event study two ways fixed effect specification, where $D_{i,t}$ is the treatment variable equaling 1 if the start of the treatment for state i corresponds to the period t and 0 otherwise. T_0 and T_1 represent the lowest lag and the highest lead around the starting period of the treatment. These lags and leads are computed as the difference between the year of the start of the treatment and the current year. α_i and ϕ_t are state and time fixed effects, respectively[4]. Results

[4]Estimations reported in table (6) are based on the computations in R using the function `feols` of the package

are reported in table (6) and figure (11).

Table (6) together with figure (11) provide estimates of the different lags and leads with respect to the implementation of the treatment. Observe that table (6) presents selected estimates of these leads and lags mainly because of illustrative reasons. The results show negative effects after the implementation of the treatment on wages of high educated (panel (a)) and low educated (panel (b)) individuals. These negatives effects accentuates as time passes mainly in the case of the average treatment for low educated, which can be verified by looking at table (6) the significance of the estimates associated to later leads after the treatment implementation. On the other hand, acknowledging the existence of heterogeneous treatment effects, a re-estimation of model l (8) using correction methods seems to be the path to be followed, in particular, Sun and Abraham (2020) provide an algorithm to account for heterogeneous treatment effects. Results are presented in figure (12) (in red) along with the results yielded by the standard dynamic two ways fixed effect (in black). In this case, the effect of the treatment remains mainly negative in both cases. Figure (12) exhibits a marked trend for the low educated workers, suggesting a negative effect of the treatment on wages of these workers.

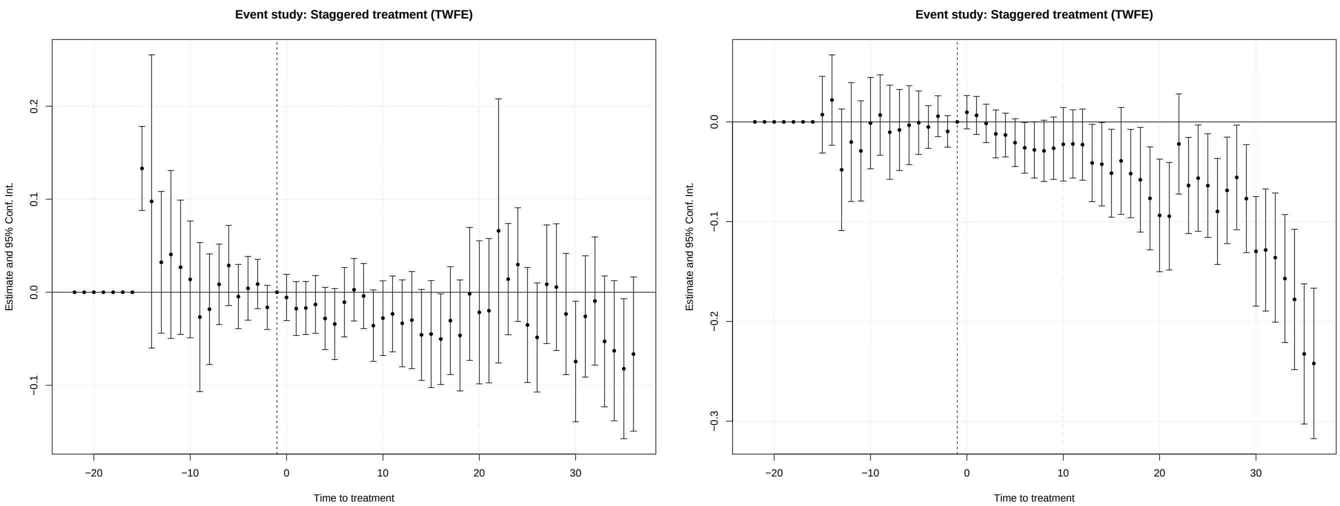
Finally, we provide estimates using Callaway and Sant'Anna (2021). Figure (13) presents the main results. Panel (a) suggests a non significant effect of the treatment on wages of high educated individuals after its implementation. Panel (b) presents the evolution of the average treatment effect on wages of low educated individuals prior and post the implementation of the treatment, which appears to be negative after implementation.

`fixest`.

Dependent Variables:	Wages High Educated	Wages Low Educated
Model:	(1)	(2)
Variables		
$\gamma_i \times D_{it}$ -15	0.1331***	0.0073
$\gamma_i \times D_{it}$ -14	0.0976	0.0219
$\gamma_i \times D_{it}$ -13	0.0321	-0.0480
$\gamma_i \times D_{it}$ -12	0.0406	-0.0202
$\gamma_i \times D_{it}$ -5	-0.0046	-0.0008
$\gamma_i \times D_{it}$ -4	0.0042	-0.0051
$\gamma_i \times D_{it}$ -3	0.0088	0.0057
$\gamma_i \times D_{it}$ -2	-0.0163	-0.0096
$\gamma_i \times D_{it}$ 0	-0.0056	0.0097
$\gamma_i \times D_{it}$ 1	-0.0176	0.0066
$\gamma_i \times D_{it}$ 2	-0.0169	-0.0015
$\gamma_i \times D_{it}$ 3	-0.0132	-0.0120
$\gamma_i \times D_{it}$ 4	-0.0283	-0.0132
$\gamma_i \times D_{it}$ 5	-0.0342*	-0.0208*
$\gamma_i \times D_{it}$ 6	-0.0107	-0.0260*
$\gamma_i \times D_{it}$ 7	0.0027	-0.0280*
$\gamma_i \times D_{it}$ 8	-0.0041	-0.0290*
$\gamma_i \times D_{it}$ 9	-0.0359*	-0.0264
$\gamma_i \times D_{it}$ 10	-0.0279	-0.0225
$\gamma_i \times D_{it}$ 11	-0.0233	-0.0221
$\gamma_i \times D_{it}$ 12	-0.0335	-0.0228
$\gamma_i \times D_{it}$ 13	-0.0300	-0.0412**
$\gamma_i \times D_{it}$ 14	-0.0459*	-0.0424*
$\gamma_i \times D_{it}$ 15	-0.0450	-0.0514**
$\gamma_i \times D_{it}$ 16	-0.0504**	-0.0391
$\gamma_i \times D_{it}$ 30	-0.0745**	-0.1298***
$\gamma_i \times D_{it}$ 31	-0.0260	-0.1284***
$\gamma_i \times D_{it}$ 32	-0.0095	-0.1360***
$\gamma_i \times D_{it}$ 33	-0.0529	-0.1570***
$\gamma_i \times D_{it}$ 34	-0.0630	-0.1780***
$\gamma_i \times D_{it}$ 35	-0.0823**	-0.2326***
$\gamma_i \times D_{it}$ 36	-0.0665	-0.2421***
β	0.3034***	0.3944***
Fixed-effects		
states	Yes	Yes
year	Yes	Yes
Fit statistics		
Observations	1,052	1,052
R^2	0.81761	0.90519
Within R^2	0.12355	0.26100

Clustered (states) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

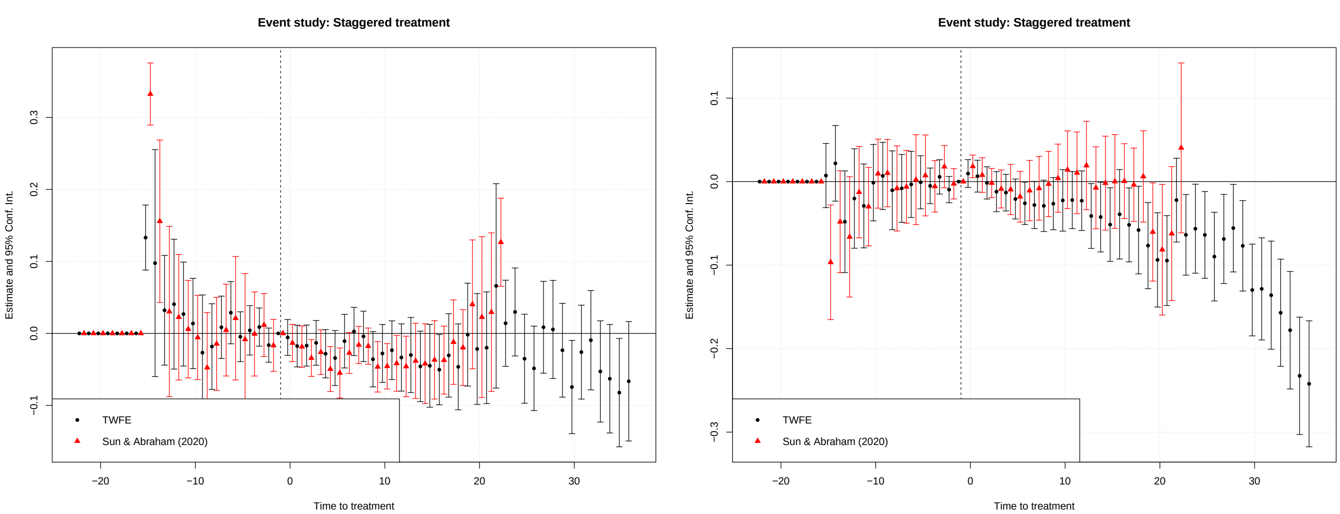
Table 6: **Estimation Event Study Difference in Difference**



(a) High Educated (b) Low Educated

Figure 11: **Estimated Event Study Difference in Difference**

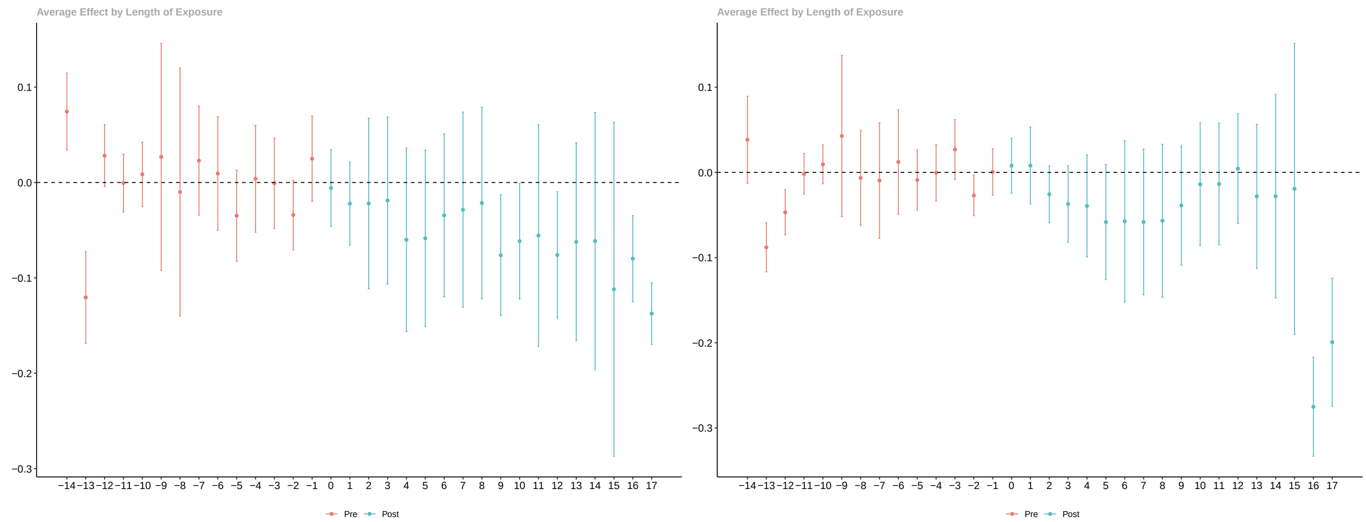
The graphs present the estimates for each of the lags and leads considered in model (21). Panel (a) is the effect on wages of high educated and panel (b) the corresponding effect on wages of low educated individuals.



(a) High Educated (b) Low Educated

Figure 12: **Estimated Event Study Difference in Difference (correction)**

The graphs present the estimates for each of the lags and leads considered in model (21) using the method of Sun and Abraham (2020). Panel (a) is the effect on wages of high educated and panel (b) the corresponding effect on wages of low educated individuals.



(a) High Educated (b) Low Educated

Figure 13: **Estimated Event Study Difference in Difference (correction)**
The graphs present the estimates for each of the lags and leads considered in model (21) using the method of Callaway and Sant'Anna (2021). Panel (a) is the effect on wages of high educated and panel (b) the corresponding effect on wages of low educated individuals. Estimation uses a balanced panel 1977-1995 and the method `reg` and the not-yet-treated as comparison group.

5 The Model

5.1 Description of the Model

The model presented is based on Pissarides (2000) extended to account different types of workers, the model includes wage bargaining à la Nash and endogenous job destruction. Workers might be good (high type η_H) or bad (low type), and be high educated (e) or low educated (u). There is a proportion of good workers among the educated (z_e) and good workers among the low educated (z_u). On the other side, 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 does 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 because, we assume that the proportion of good workers is higher among the high educated and low among the low educated workers. 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 η is worker specific, η can be high η_H for high type workers, or η_L for low type workers.

The firm observes total $m+\eta$, but it does not know if this output is explained by a high η or by a high m. The firm will prefer to hire workers with high η to ensure itself against a possible m low, hence keeping the workers and avoiding to pay firing taxes. However, how can the firm know if the workers have a high η given it is not observable? The firm hence will expect to find in average, more workers with low η among the low educated, and more workers with a high η among the high educated[5]. Therefore, the firm will prefer to hire a worker with a high level of education against the risk of paying firing taxes.

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 γ, 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. Wages are the result of a bargaining à la Nash between the firm and the worker. Firm pays firing taxes if a worker is dismissed. The other features of the model will be explained over the subsequent sections.

Once the match has occurred, there is an output per unit of time represented by $m+\eta$, m is a match specific component and η is worker specific. F represents the firing taxes a firm pays when dismissing a workers and it is paid to a third party. We initially consider a segmented market.

The Nash Sharing Rule: Initial or Outside Wages

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:

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

[5]This link can be justified by the multiple empirical and theoretical findings, suggesting that increases in level of education increases productivity.

Therefore,

$$w_0(\bar{m},\eta) = argmax\{(E(\bar{m},\eta) - U(\eta))^{\beta}(J(\bar{m},\eta) - V))^{1-\beta}\}$$

Hence, the expression can be presented as

$$\frac{\partial S_0}{\partial w_0(\bar{m},\eta)} = \beta\frac{\partial E(\bar{m},\eta)}{\partial w_0(\bar{m},\eta)}[J(\bar{m},\eta) - V] + (1-\beta)\frac{\partial J(\bar{m},\eta)}{\partial w_0(\bar{m},\eta)}[E(\bar{m},\eta) - U(\eta)] \tag{9}$$

Finding the **inside** wage needs 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,

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

$$\frac{\partial S}{\partial w(m,\eta)} = \beta\frac{\partial E(m,\eta)}{\partial w(m,\eta)}[J(m,\eta) + F] + (1-\beta)\frac{\partial J(m,\eta)}{\partial w(m,\eta)}[E(m,\eta) - U(\eta)] \tag{10}$$

The computations of the derivatives in the previous expressions require the different asset value equations, which are presented over the next subsections.

The Value Function of Being Employed

Now, let us consider the asset valuation equation of being employed

$$rE(m,\eta) = w(m,\eta) + \gamma\left[\int_{m_c}^{\bar{m}} E(x,\eta)g(x)\,dx + G(m_c(\eta))U(\eta) - E(m,\eta)\right] \tag{11}$$

Where $w(m,\eta)$ is the Nash bargained wage. γ is the probability per unit of time that shock hits the firm. 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 η and match specific component m enjoys expected return $E(m, \eta)$ which he has to give up when shock arrives. If the new productivity $m \notin [m_c, \bar{m}]$, the worker is fired and joins the pool of unemployment with an en expected return $U(\eta)$.

The Value Functions of Being Unemployed

Ending the behavior of the workers, let us consider the value function of being unemployed

$$rU(\eta) = b + f\Big[E(\bar{m}, \eta) - U(\eta)\Big] \tag{12}$$

Expression (3) presents b the unemployment insurance benefits and the expected capital gain from a change of state employed and unemployed. f is the probability of moving into employment, which is exogenous and will be endogenous later on.

The Value Functions for the Firm

As it is common in these models, the firm fires the worker if $J^j(m, \eta) < -F$. The dismissal threshold is represented by $J(m_c(\eta), \eta) = -F$. The value function of an occupied job is

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

The Value of a Vacancy

Considering a segmented market, firms can direct their search to an specific sub-market containing the right type of agent that is desired. The value of a vacancy is therefore identical for every submarket:

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

Optimal Wages

Using standard methods for solving these models we provide the analytical solution for the wages and the effects of firing costs on the dismissal threshold, the market tightness and the wages, our effect of interest[6].

The **Inside wage**

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

The **Outside wage**

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

5.2 Finding the Effects of the Firing Costs

5.2.1 Exogenous Meeting Rates

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

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

As m_c is endogenous, it is possible to compute $\frac{dm_c}{dF}$ using the inside wage equation and the condition $J(m_c,\eta)=-F$ and therefore, we obtain:

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

This condition, implies that avoiding dismissals, i.e. $m_c\to 0$, there is the need that η is above

[6] A complete solution for the model is presented in the appendix

a certain level, above which there won't be any dismissal.

We can obtain $\frac{dm_c}{dF}$ differentiating the previous expression.

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

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 $1 - (\gamma + r) > 0$, which seems to be always the case.

5.2.2 Endogenous Meeting Rates

Now consider endogenous meeting rates, hence

$$
\begin{aligned}
m &= (u, v) \\
q(\theta) &= \frac{m(u,v)}{v} = m\Big(\frac{1}{\theta}, 1\Big) \\
f &= \theta q(\theta)
\end{aligned}
$$

Job Destruction Condition

The asset value equation of a filled job and the wage equation (inside) and the fact that $J(m_c, \eta) = -F$

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

Job Creation Condition

The Job creation condition (two: η_H, η_L) using $J(\bar{m}, \eta)$

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

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:

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

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

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

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

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

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

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

Finally, 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

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

Given the impossibility to easily find the sing of this derivative, we proceed with the estimation of the general equilibrium model and subsequently introduce variations in the firing costs.

6 Estimation General Equilibrium

Job Destruction Condition

We assume that $F = \Psi w$, $G(m)$: uniform, with support $[0, \bar{m}]$

$$0 = m_c(\eta) + \eta - b - \theta q(\theta)\beta \frac{\bar{m} - m_c(\eta)}{r + \gamma} + \frac{\gamma}{\gamma + r} \frac{1}{2} \frac{(\bar{m} - m_c(\eta))^2}{\bar{m}} + \Psi w(m_c(\eta), \eta)(r + \beta\theta q(\theta))$$

The wage equation is (taking into account the job creation condition):

$$\begin{aligned} w(m_c(\eta), \eta) &= \beta(m_c(\eta) + \eta + rF + c\theta) + (1 - \beta)b \\ &= \beta(m_c(\eta) + \eta + r\Psi w(m_c(\eta), \eta) + c\theta) + (1 - \beta)b \\ &= \frac{\beta}{1 - \beta r\Psi}(m_c(\eta) + \eta + c\theta) + \frac{1 - \beta}{1 - \beta r\Psi} b \end{aligned}$$

We replace $w(m_c(\eta), \eta)$ by its expression and we obtain

$$\begin{aligned} 0 &= m_c(\eta) + \eta - b - \theta q(\theta)\beta \frac{\bar{m} - m_c(\eta)}{r + \gamma} + \frac{\gamma}{\gamma + r} \frac{1}{2} \frac{(\bar{m} - m_c(\eta))^2}{\bar{m}} \\ &\quad + \Psi(r + \beta\theta q(\theta)) \left(\frac{\beta}{1 - \beta r\Psi}(m_c(\eta) + \eta + c\theta) + \frac{1 - \beta}{1 - \beta r\Psi} b \right) \\ 0 &= \left(1 + \Psi \frac{\beta}{1 - \beta r\Psi}(r + \beta\theta q(\theta))\right)(m_c(\eta) + \eta) - \left(1 - \Psi \frac{1 - \beta}{1 - \beta r\Psi}(r + \beta\theta q(\theta))\right) b \\ &\quad + \Psi \frac{\beta}{1 - \beta r\Psi}(r + \beta\theta q(\theta))c\theta - \theta q(\theta)\beta \frac{\bar{m} - m_c(\eta)}{r + \gamma} + \frac{\gamma}{\gamma + r} \frac{1}{2} \frac{(\bar{m} - m_c(\eta))^2}{\bar{m}} \end{aligned}$$

Job Creation Condition

$$\begin{aligned} \frac{c}{A\theta^{\alpha - 1}} &= (1 - \beta)\left(\frac{\bar{m} - m_c(\eta)}{\gamma + r} - \Psi w(m_c(\eta), \eta) \right) \\ \frac{c}{A\theta^{\alpha - 1}} &= (1 - \beta)\left(\frac{\bar{m} - m_c(\eta)}{\gamma + r} - \Psi \frac{\beta}{1 - \beta r\Psi}(m_c(\eta) + \eta + c\theta) - \Psi \frac{1 - \beta}{1 - \beta r\Psi} b \right) \end{aligned}$$

Implementation High Educated Segmentation

4 unknowns: $\{\theta, m_c, \bar{m}, A\}$

4 equations:

$$\frac{c}{A\theta^{\alpha-1}} = (1-\beta)\left(\frac{\bar{m}-m_c}{\gamma+r} - \Psi\frac{\beta}{1-\beta r\Psi}(m_c+\eta+c\theta) - \Psi\frac{1-\beta}{1-\beta r\Psi}b\right) \tag{13}$$

$$\begin{aligned} 0 &= \left(1+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta\theta q(\theta))\right)(m_c(\eta)+\eta) - \left(1-\Psi\frac{1-\beta}{1-\beta r\Psi}(r+\beta\theta q(\theta))\right)b \\ &\quad +\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta\theta q(\theta))c\theta - \theta q(\theta)\beta\frac{\bar{m}-m_c(\eta)}{r+\gamma} + \frac{\gamma}{\gamma+r}\frac{1}{2}\frac{(\bar{m}-m_c(\eta))^2}{\bar{m}} \end{aligned} \tag{14}$$

$$\theta A\theta^{\alpha-1} = 0.4105 \tag{15}$$

$$\gamma\frac{m_c}{\bar{m}} = 0.0108 \tag{16}$$

with $G(x) = \frac{x-a}{b-a}$ where $a = 0$ and $b = \bar{m}$. And assume $q(\theta) = A\theta^{\alpha-1}$

Reducing the system of equations

$$\frac{c\theta}{0.4105} = (1-\beta)\left(\frac{\gamma\frac{m_c}{0.0108}-m_c}{\gamma+r} - \Psi\frac{\beta}{1-\beta r\Psi}(m_c+\eta+c\theta) - \Psi\frac{1-\beta}{1-\beta r\Psi}b\right) \tag{17}$$

$$\begin{aligned} 0 &= \left(1+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta 0.4105)\right)(m_c(\eta)+\eta) - \left(1-\Psi\frac{1-\beta}{1-\beta r\Psi}(r+\beta 0.4105)\right)b \\ &\quad +\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta 0.4105)c\theta - 0.4105\beta\frac{\gamma\frac{m_c}{0.0108}-m_c(\eta)}{r+\gamma} + \frac{\gamma}{\gamma+r}\frac{1}{2}\frac{(\gamma\frac{m_c}{0.0108}-m_c(\eta))^2}{\gamma\frac{m_c}{0.0108}} \end{aligned} \tag{18}$$

Calibrated parameters: $\{r, \beta, \alpha, c, b, \gamma, \eta, \Psi\}$

r	β	α	c	b	γ	η	Ψ	θ	m_c	w	A	$\bar{m}$
0.00333	0.5	0.5	0.1	0.4	0.0216	1 (educated)	5	9.68226	0.28435	1.3374	0.1319	0.5687

Table 7: Values for calibrated parameters (High Educated)

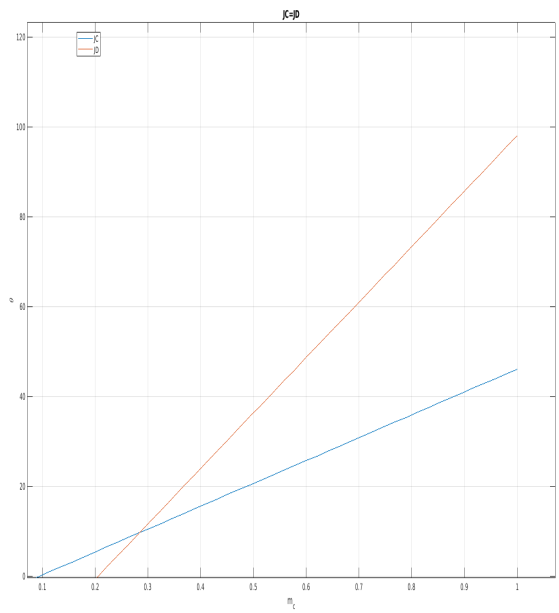


Figure 14: **Equilibrium**

Change in Ψ Knowing the different values for the different unknowns and taking into account a change in Ψ (5.1) there is the need to solve the system knowing these values and recalculate θ, m_c and wages(2).

$$\frac{c}{0.1319\theta^{\alpha-1}} = (1-\beta)\left(\frac{0.5687-m_c}{\gamma+r} - \Psi\frac{\beta}{1-\beta r\Psi}(m_c+\eta+c\theta) - \Psi\frac{1-\beta}{1-\beta r\Psi}b\right) \tag{19}$$

$$0 = \left(1+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta 0.1319\theta^{\alpha})\right)(m_c(\eta)+\eta) - \left(1-\Psi\frac{1-\beta}{1-\beta r\Psi}(r+\beta 0.1319\theta^{\alpha})\right)b$$
$$+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta 0.1319\theta^{\alpha})c\theta - 0.1319\theta^{\alpha}\beta\frac{0.5687-m_c(\eta)}{r+\gamma} + \frac{\gamma}{\gamma+r}\frac{1}{2}\frac{(0.5687-m_c(\eta))^2}{0.5687} \tag{20}$$

r	β	α	c	b	γ	η	Ψ	θ'	m'_c	w'	A	$\bar{m}$
0.00333	0.5	0.5	0.1	0.4	0.0216	1 (educated)	5.1	9.663554	0.28072	1.334889	0.36644	0.5687

Table 8: Variation in Firing Costs (High Educated)

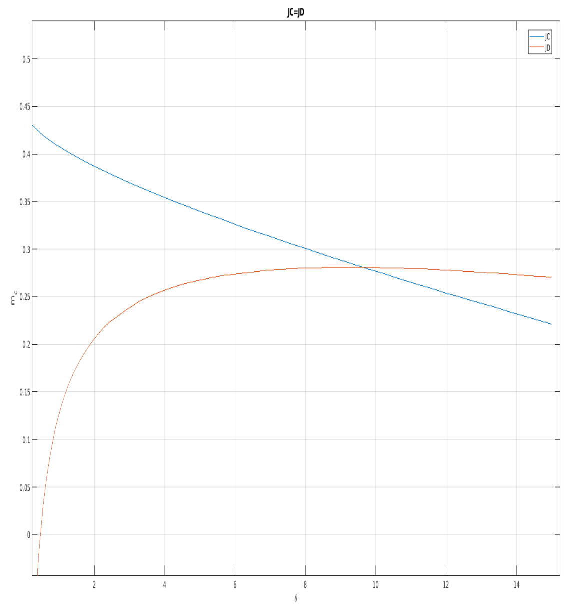


Figure 15: **Equilibrium**

After a variation in the firing costs, wages for high educated do not change.

Implementation Low Educated Segmentation

4 unknowns: $\{\theta, m_c, \bar{m}, A\}$

4 equations:

$$\frac{c}{A\theta^{\alpha-1}} = (1-\beta)\left(\frac{\bar{m}-m_c}{\gamma+r} - \Psi\frac{\beta}{1-\beta r\Psi}(m_c+\eta+c\theta) - \Psi\frac{1-\beta}{1-\beta r\Psi}b\right) \tag{21}$$

$$0 = \left(1+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta\theta q(\theta))\right)(m_c(\eta)+\eta) - \left(1-\Psi\frac{1-\beta}{1-\beta r\Psi}(r+\beta\theta q(\theta))\right)b$$
$$+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta\theta q(\theta))c\theta - \theta q(\theta)\beta\frac{\bar{m}-m_c(\eta)}{r+\gamma} + \frac{\gamma}{\gamma+r}\frac{1}{2}\frac{(\bar{m}-m_c(\eta))^2}{\bar{m}} \tag{22}$$

$$\theta A\theta^{\alpha-1} = 0.442293333 \tag{23}$$

$$\gamma\frac{m_c}{\bar{m}} = 0.029466667 \tag{24}$$

with $G(x) = \frac{x-a}{b-a}$ where $a=0$ and $b=\bar{m}$. And assume $q(\theta) = A\theta^{\alpha-1}$

Reducing the system of equations

$$\frac{c\theta}{0.442293333} = (1-\beta)\left(\frac{\gamma\frac{m_c}{0.02946}-m_c}{\gamma+r} - \Psi\frac{\beta}{1-\beta r\Psi}(m_c+\eta+c\theta) - \Psi\frac{1-\beta}{1-\beta r\Psi}b\right) \tag{25}$$

$$0 = \left(1+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta 0.4422)\right)(m_c(\eta)+\eta) - \left(1-\Psi\frac{1-\beta}{1-\beta r\Psi}(r+\beta 0.4422)\right)b$$
$$+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta 0.4422)c\theta - 0.4422\beta\frac{\gamma\frac{m_c}{0.0294}-m_c(\eta)}{r+\gamma} + \frac{\gamma}{\gamma+r}\frac{1}{2}\frac{(\gamma\frac{m_c}{0.0294}-m_c(\eta))^2}{\gamma\frac{m_c}{0.0294}} \tag{26}$$

Calibrated parameters: $\{r, \beta, \alpha, c, b, \gamma, \eta, \Psi\}$

r	β	α	c	b	γ	η	Ψ	θ	m_c	w	A	$\bar{m}$
0.00333	0.5	0.5	0.1	0.4	0.1	0.5	5	8.35378	0.3948	1.07404	0.1529	1.340154

Table 9: Values for calibrated parameters (Low Educated)

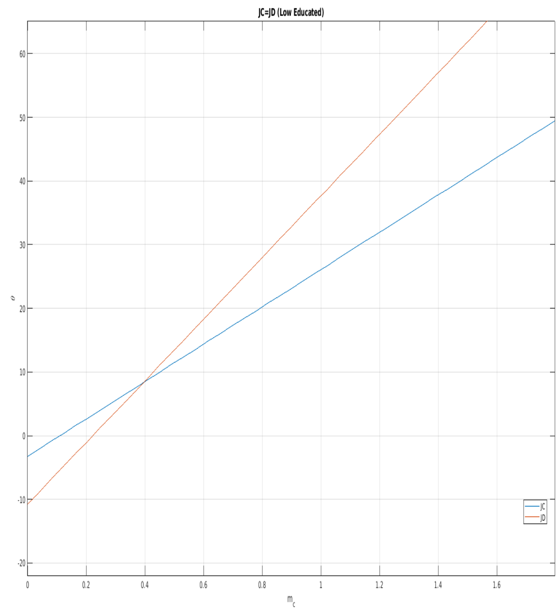


Figure 16: **Equilibrium**

Change in Ψ Knowing the different values for the different unknowns and taking into account a change in Ψ (5.1) there is the need to solve the system knowing these values and recalculate θ, m_c and wages(2).

$$\frac{c}{0.152\theta^{\alpha-1}} = (1-\beta)\left(\frac{1.34015-m_c}{\gamma+r} - \Psi\frac{\beta}{1-\beta r\Psi}(m_c+\eta+c\theta) - \Psi\frac{1-\beta}{1-\beta r\Psi}b\right) \tag{27}$$

$$\begin{aligned} 0 = {} & \left(1+\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta 0.152\theta^{\alpha})\right)(m_c(\eta)+\eta) - \left(1-\Psi\frac{1-\beta}{1-\beta r\Psi}(r+\beta 0.152\theta^{\alpha})\right)b \\ & +\Psi\frac{\beta}{1-\beta r\Psi}(r+\beta 0.152\theta^{\alpha})c\theta - 0.152\theta^{\alpha}\beta\frac{1.34015-m_c(\eta)}{r+\gamma} + \frac{\gamma}{\gamma+r}\frac{1}{2}\frac{(1.34015-m_c(\eta))^2}{1.34015} \end{aligned} \tag{28}$$

r	β	α	c	b	γ	η	Ψ	θ'	m_c'	w'	A	$\bar{m}$
0.00333	0.5	0.5	0.1	0.4	0.1	0.5	5.1	8.32568	0.385055	1.067889	0.1529	1.340154

Table 10: Variation in Firing Costs (Low Educated)

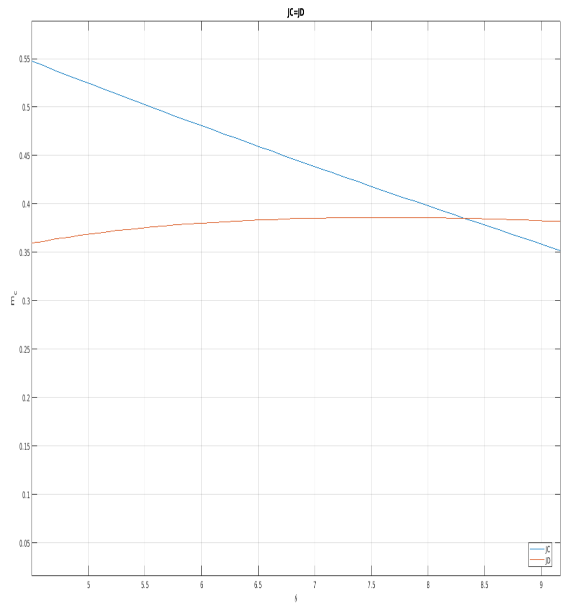


Figure 17: **Equilibrium**

After a variation in the firing costs, wages for low educated increase.

6.1 Repeated Variations in Firing Costs

From the previous exercise, we compute the trajectory of the wages for highly and low-educated workers given subsequent variations in the firing costs determinant (parameter ψ), the results are depicted in the plot below. Figure 5 shows a negative effect of variations in the parameter related to the firing costs ψ on wages of highly and low-educated workers. The effect is more pronounced in the case of the low-educated workers. As we will see over the next sections, these results are in the opposite direction to those yielded by the econometric strategy using data for the United States, however, both converge to point out a differentiated effect of firing costs on wages. The divergence of the sign of the effect might suggest the need for alternative models capable of explaining what is observed in the data.

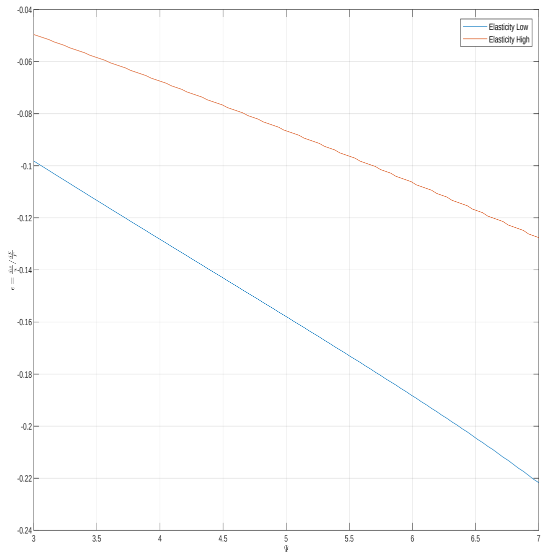


Figure 18: **Elasticity of wages of highly and low-educated workers with respect to variations in ψ**

7 Concluding Remarks

Wages of high and low educated workers, and firing taxes are rising in the United States over the last decades. We thus wonder if the increase in firing costs might have contributed to the wage trends. To this end, we estimate some econometric models and construct a theoretical framework. The empirical results sustain that wages are affected differently by the firing costs. Indeed, workers with low levels of educations, have their wages to reduce, while there is no significant effect on wages of high educated. In the theoretical framework we try to advance some explanations, we think that because of adverse selection, transition probabilities between unemployment and employment are higher for the highly educated, because the firms discriminate more against the less educated workers. The effect of the firing costs is this differentiated among high and low educated workers.

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A Complete Solution to the Model

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 previous expressions and assuming free entry of the firms $V = 0$, the surplus net (expression (1)) became

$$\frac{\beta}{r+\gamma}(J(\bar{m},\eta) = \frac{(1-\beta)}{r+\gamma}[E(\bar{m},\eta,j) - U(\eta)] \tag{29}$$

$$-\beta J(\bar{m},\eta) + (1-\beta)E(\bar{m},\eta,j) = (1-\beta)U(\eta) \tag{30}$$

$$\frac{\beta}{1-\beta}J(\bar{m},\eta) = E(\bar{m},\eta) - U(\eta) \tag{31}$$

And in the case of the surplus net of the **inside** wages, expression (2), it became:

$$\frac{\beta}{r+\gamma}(J(\bar{m},\eta) + F) = \frac{(1-\beta)}{r+\gamma}[E(\bar{m},\eta) - U(\eta)] \tag{32}$$

$$\beta J(m,\eta) - (1-\beta)E(m,\eta) = -(1-\beta)U(\eta) - \beta F \tag{33}$$

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:

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

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

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:

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

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

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

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

$$
\begin{aligned}
rJ(m,\eta) &= m+\eta-w(m,\eta)+\gamma\underbrace{\left[\int_{m_c}^{\bar{m}} J(x,\eta)g(x)\,dx - G(m_c(\eta))F\right]}_{X} - \gamma J(m,\eta)\\
w(m,\eta) &= \beta(m+\eta)+Y\\
rdJ(m,\eta) &= 1-\beta-\gamma dJ(m,\eta)\\
dJ(m,\eta) &= \frac{1-\beta}{r+\gamma}\\
J(m,\eta) &= \frac{1-\beta}{r+\gamma}m + C\\
J(m_c,\eta) &= 0 \quad\Rightarrow\quad 0=\frac{1-\beta}{r+\gamma}m_c + C\\
C &= -\frac{1-\beta}{r+\gamma}m_c\\
J(m,\eta) &= \frac{1-\beta}{r+\gamma}(m-m_c) \quad \text{because } J(m_c,\eta)=0\\
J(m_c,\eta) &= -F \quad\Rightarrow\quad -F=\frac{1-\beta}{r+\gamma}m_c + C\\
C &= -F-\frac{1-\beta}{r+\gamma}m_c\\
J(m,\eta) &= \frac{1-\beta}{r+\gamma}(m-m_c)-F \quad \text{because } J(m_c,\eta)=-F
\end{aligned}
$$

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**

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

The **Outside wage**

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

The Effect of the Firing Costs

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

ATTENTION: m_c is endogenous:

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

$$
0 = m_c + \eta + rF - b - \beta f \left(\frac{\bar{m} - m_c}{r+\gamma} - F \right) + \frac{\gamma}{r+\gamma} \int_{m_c}^{\bar{m}} (x - m_c) g(x)\, dx \qquad (34)
$$

Pour ne pas avoir de licenciements, i.e. $m_c \to 0$, il faut que la valeur de η dépasse un certain seuil. Au dessus de ce seuil il n'y a pas de licenciements.

L'équation de salaire est

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

Effet des firing costs sur le salaire

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

En différenciant (10), on obtient $\frac{dm_c}{dF}$ i.e.

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

car

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

Therefore

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

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

Endogenous Meeting Rates

Now consider endogenous meeting rates, hence

$$
\begin{aligned}
m &= (u,v)\\
q(\theta) &= \frac{m(u,v)}{v} = m\Big(\frac{1}{\theta},1\Big)\\
f &= \theta q(\theta)
\end{aligned}
$$

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: η_H, η_L) using the versions previously found of $J(\bar{m}, \eta)$

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

Finding the Effects of the Firing Costs

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:

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

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

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

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

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

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

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

Finally, 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

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

Let us parametrize the last expression and do a graph, to see how are the effects of the firing costs on wages under different circumstances.

B Wages and Labor Productivity

Figure 1 presents a positive trend for the evolution of the logarithm of real wages for high and low educated individuals across states. Multiple factors might explain these results but we think that the labor productivity plays a central role. Model (1) test the relevance of the labor productivity in explaining such trends.

$$log(W_{i,t}^j) = \delta_i + \beta log(X_{i,t}) + \varepsilon_{i,t}^j \tag{35}$$

Where $W^j_{i,t}$ represents the real wages of state i in period t for group j, where j can be high or low educated. δ_i represents state fixed effects. $X_{i,t}$ is the labor productivity for each state computed as the ratio of the state GDP to the state total employment. The results are presented in the table 1. This table suggests a positive, significant and inelastic effect of the index of the labor productivity on wages of high and low educated individuals. β remains significant despite including state-fixed effects, concluding the relevance of the labor productivity to explain aggregated wages. The evolution of the labor productivity represented in figure 2 exhibits a positive trend across states excepting Arkansas, where it appears to decline over the past decades.

	Wages HE (OLS)	Wages HE (FE)	Wages LE (OLS)	Wages LE (FE)
β	0.728***	0.971***	0.590***	0.642***
	(0.0326)	(0.129)	(0.0207)	(0.0802)
Constant	2.531***	-0.169	3.132***	2.561**
	(0.362)	(1.432)	(0.230)	(0.892)
Observations	1658	1658	1658	1658
Adjusted R^2	0.464	0.454	0.404	0.394

Standard errors in parentheses

Note: Robust standard errors. Source: BEA, BLS, Autor (2003), CPS.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Labor Productivity Effect on Wages

We perform as well the following regression to see the relevance of including the labor productivity as a one of the main explicative variables. In particular, we estimate the following model.

$$log(W_{i,t}) = \delta_i + \beta_1 HE_{i,t} + \beta_2 log(X_{i,t}) + \beta_3 HE_{i,t} log(X_{i,t}) + \varepsilon_{i,t} \quad (36)$$

Where $log(W_{i,t})$ is the logarithm of the wages of both types of workers: highly and low educated. $HE_{i,t}$ is a dummy variable that is equal to 1 if the aggregated wage belongs to the highly educated workers. And finally $HE_{i,t}log(X_{i,t})$ is an interaction term. Table 11 presents the results. Column 2 presents the OLS estimates and column 3 adds state-fixed effects. Adding labor productivity as an explicative variable is important: it survives the inclusion of state-fixed effects. In the OLS estimates, the distinction between the level of education of the workers is important to determine the observed wage trends. The state fixed effects estimation, on the other hand, shows that such a distinction between high and low-educated workers is in fact irrelevant in explaining the wage trends, however, we remark this is not our objective and that this separation is going to be key when analyzing the variations in the firing costs.

	Wages	Wages
β_2 Labor Prod.	0.606***	0.550***
	(0.0259)	(0.105)
β_1 $HE_{i,t} = 1$	1.210*	1.210
	(0.516)	(1.089)
β_3 $HE_{i,t} \times$ Labor Prod.	-0.0280	-0.0280
	(0.0467)	(0.0985)
Constant	2.941***	3.551**
	(0.286)	(1.166)
Observations	2124	2124
Adjusted R^2	0.933	0.960
FE		✓

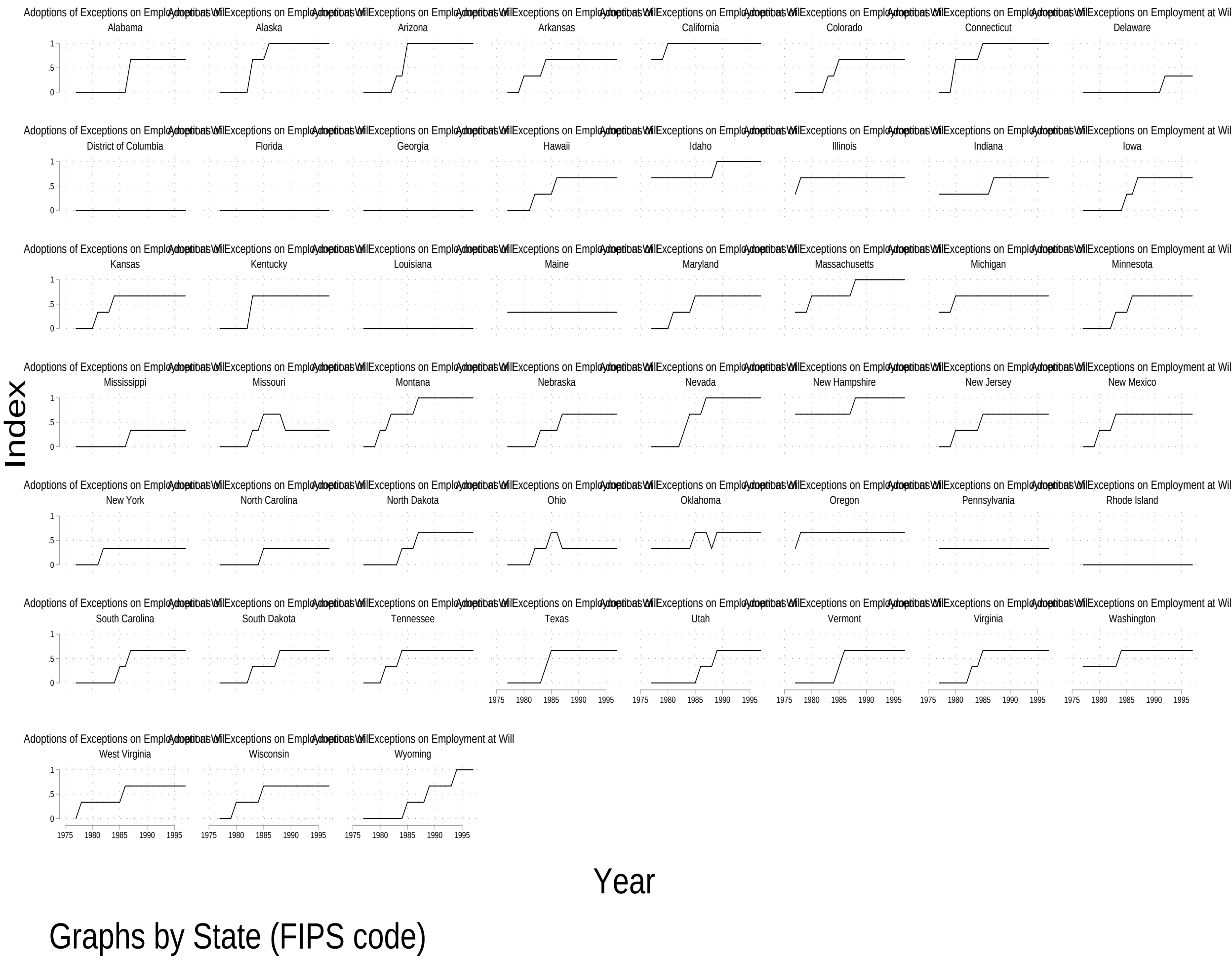
Standard errors in parentheses

Note: Robust standard errors. Source: BEA, BLS, Autor (2003), CPS.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Labor Productivity Effect on Wages

C Variation of the Employment at will index Across States



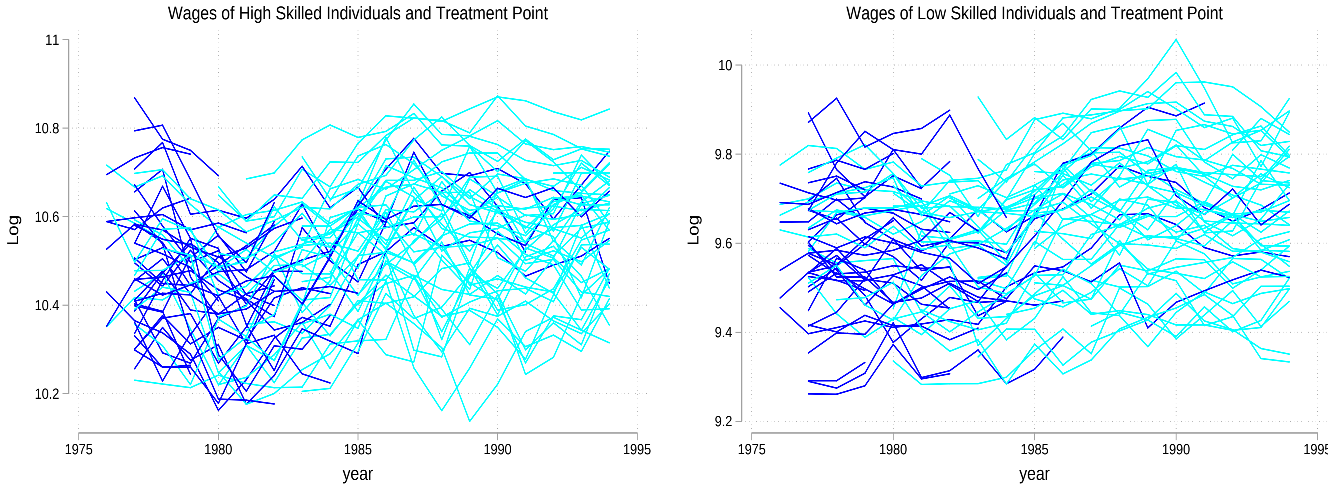
(a) Evolution of the Firing Cost (Index)

Figure 19: **Trends in Firing Costs**
The graph was computed using observations of Autor (2003).

D Evolution of the Wages Pre and Post Treatment

Year	Freq.
0	192
1959	48
1973	48
1974	144
1975	48
1976	96
1977	192
1978	48
1980	288
1981	144
1982	144
1983	480
1984	96
1985	240
1986	48
1987	96
1992	48

Table 13: **Starting Time of the Adoption of Exceptions**

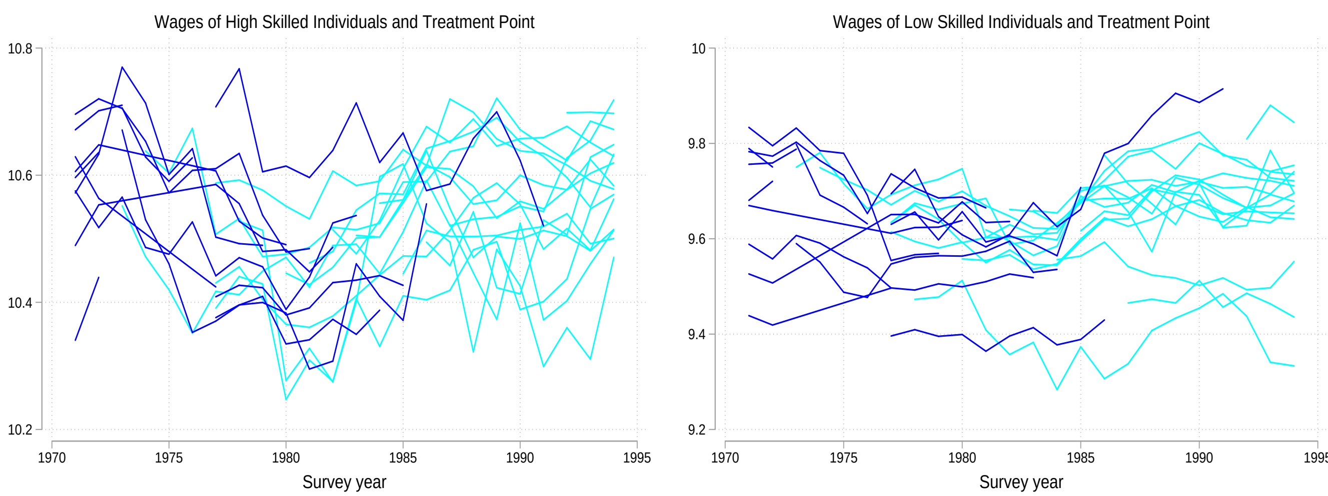


(a) High Educated

(b) Low Educated

Figure 20: **Evolution of the Wages of High and Low Educated Groups Pre and Post treatment Across States**

The graphs present the evolution of wages for high and low educated groups across states pre and post treatment. Each line represents one particular state. The parts of the lines that are dark blue corresponds to wage evolution pre-treatment, the cyan part of the line corresponds to the post-treatment period. Those states that are always dark blue or always cyan, are never treated and always treated, respectively.



(a) High Educated

(b) Low Educated

Figure 21: **Wages of High and Low Educated Groups, Pre and Post-treatment Periods**

The graphs present the average evolution of the wages across states, pre and post treatment aggregated by group of starting time of the implementation of the regulation

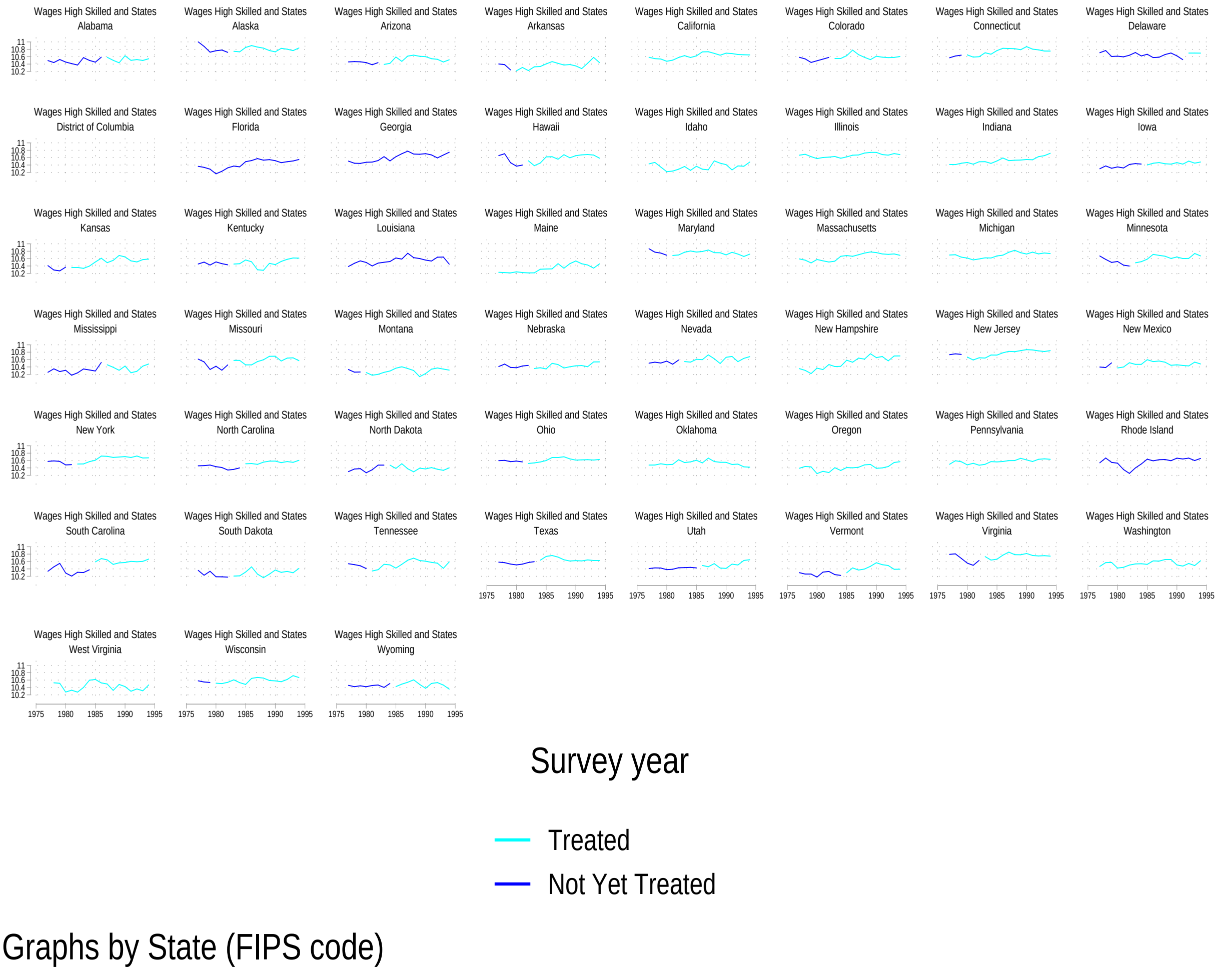


Figure 22: **Evolution of the wages across States in the United States**
The graphs presents the evolution across states pre and post treatment

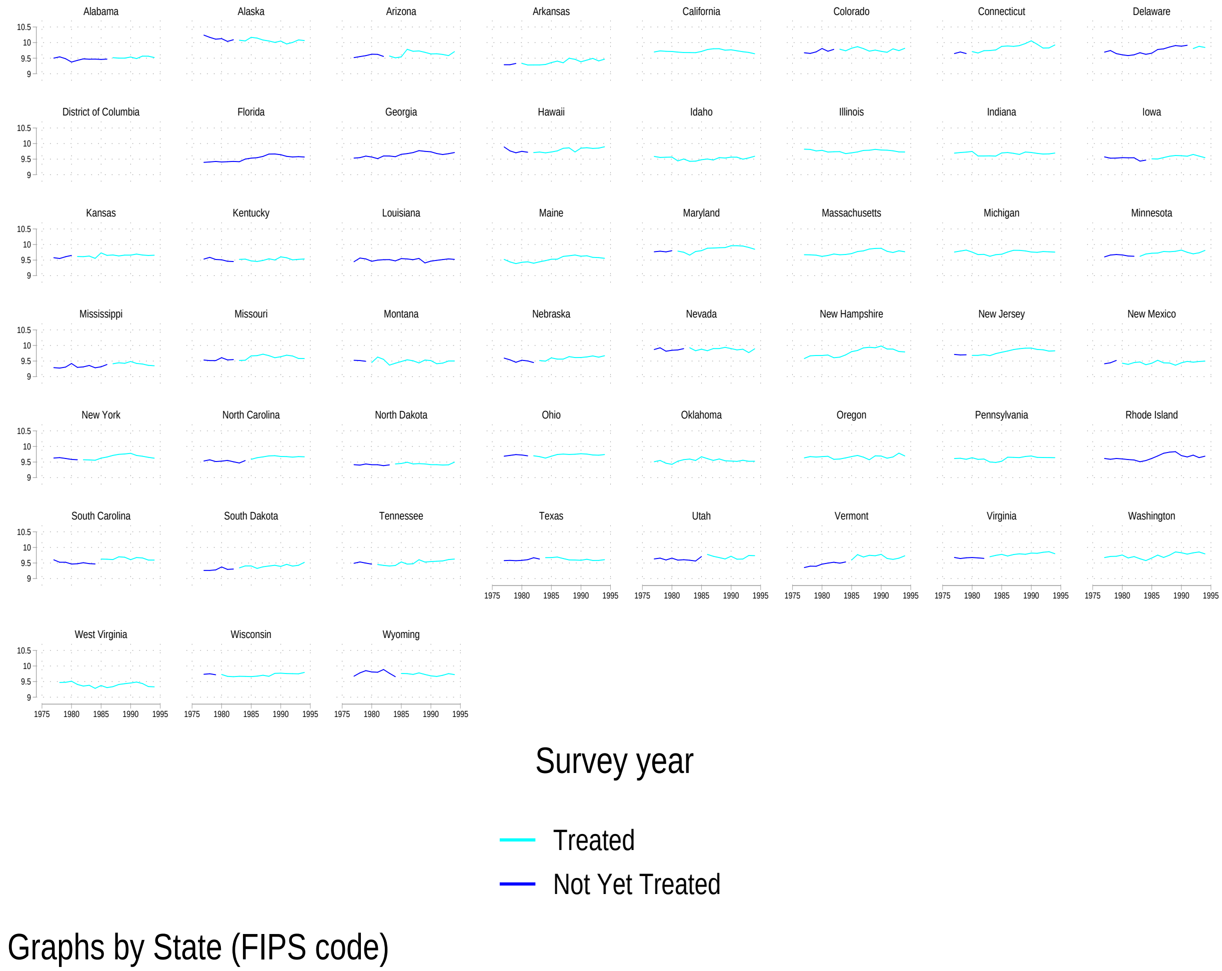
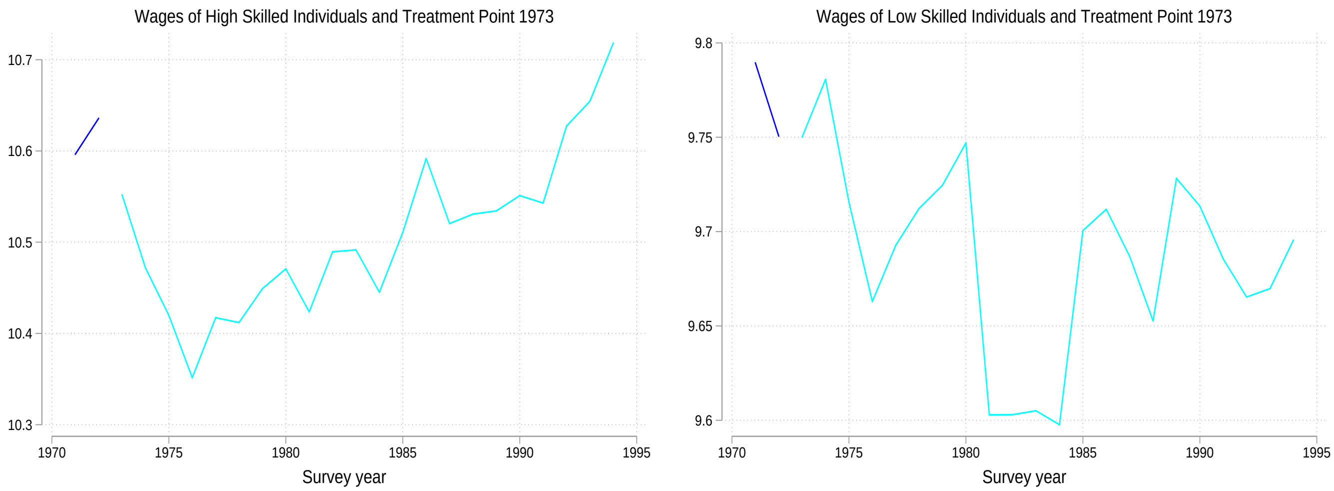


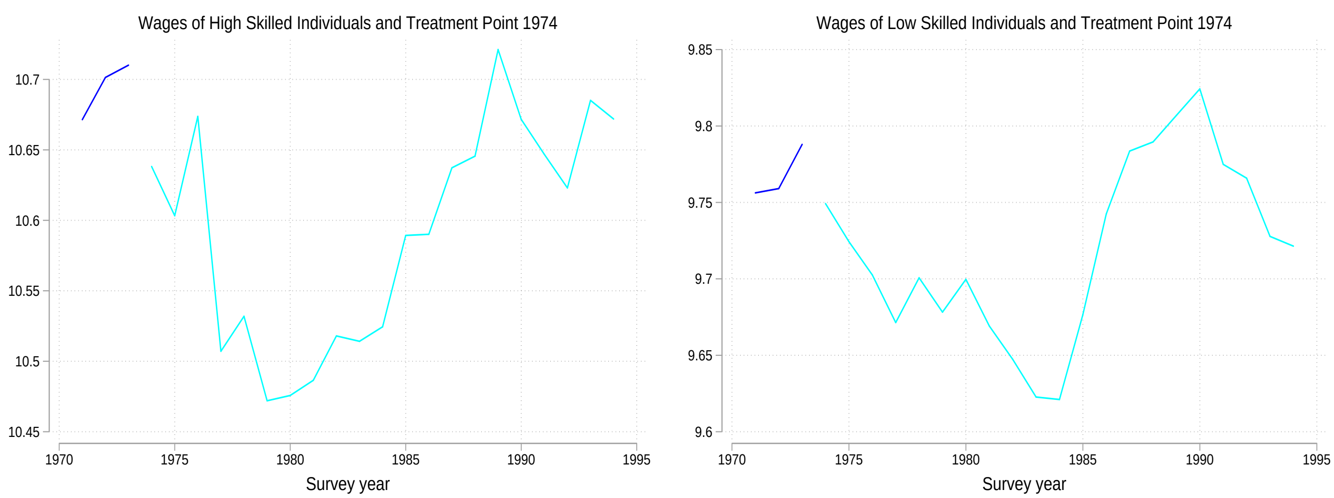
Figure 23: **Evolution of the wages across States in the United States**
The graphs presents the evolution across states pre and post treatment



(a) High Educated

(b) Low Educated

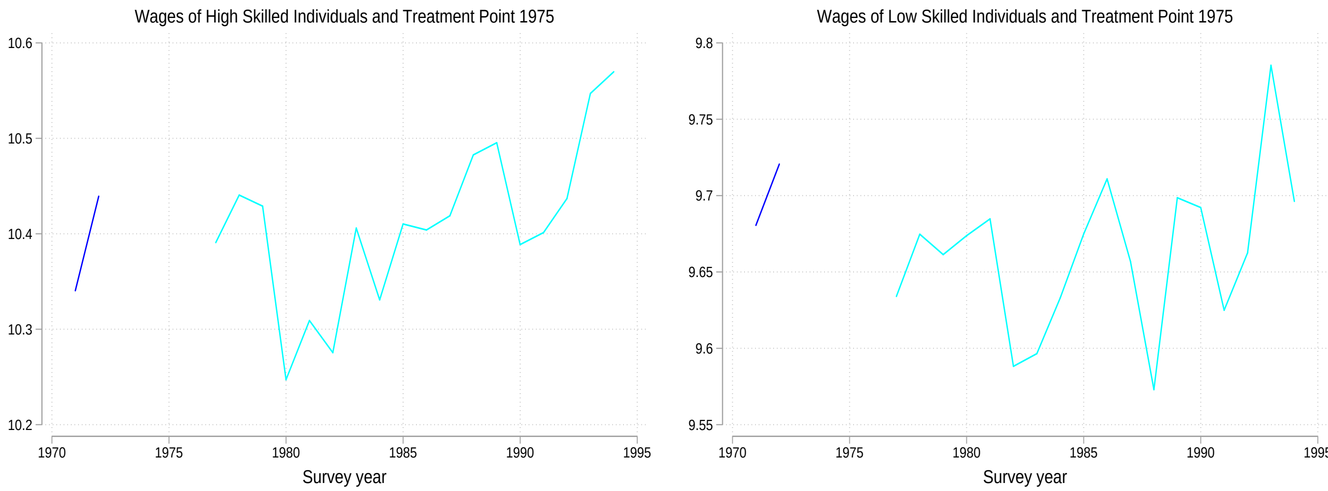
Figure 24: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1973



(a) High Educated

(b) Low Educated

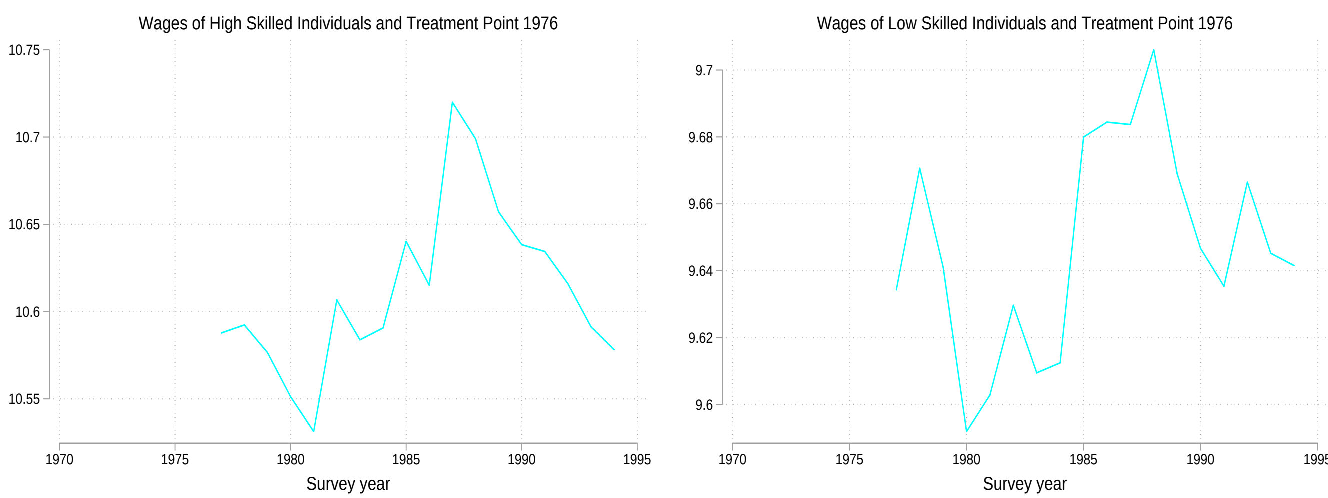
Figure 25: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1974



(a) High Educated

(b) Low Educated

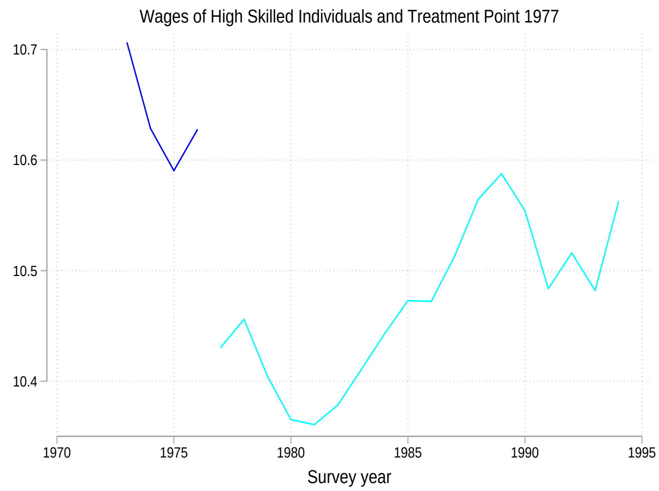
Figure 26: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1975



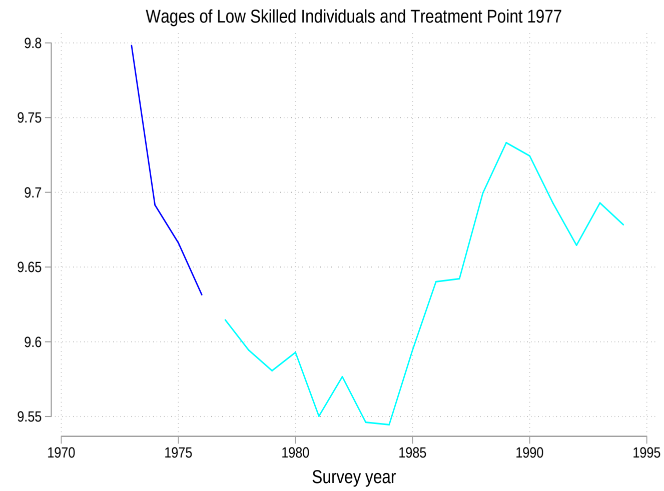
(a) High Educated

(b) Low Educated

Figure 27: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1976

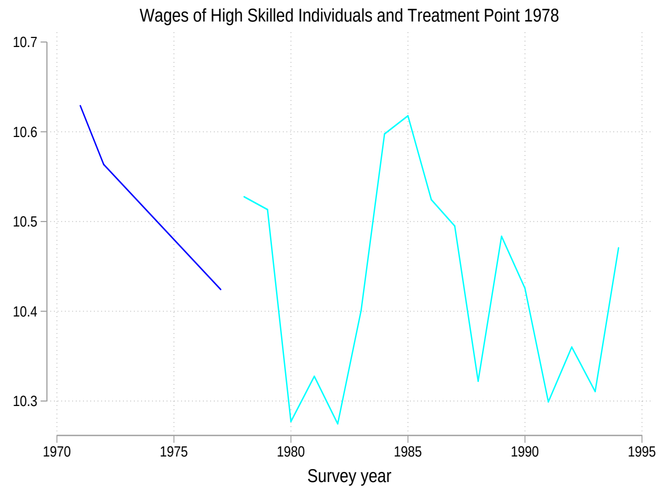


(a) High Educated

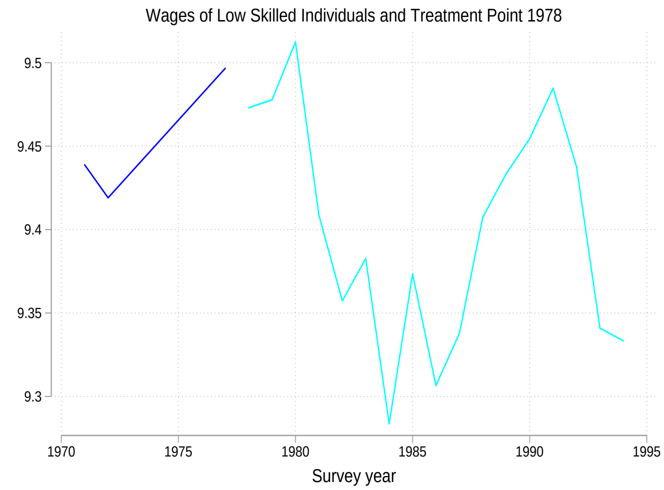


(b) Low Educated

Figure 28: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1977

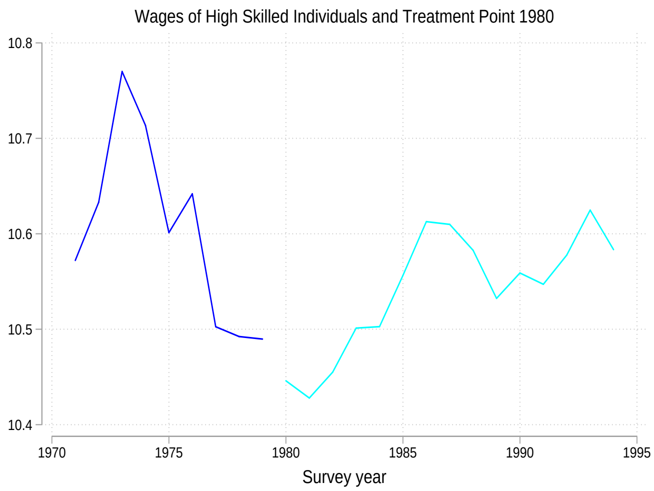


(a) High Educated

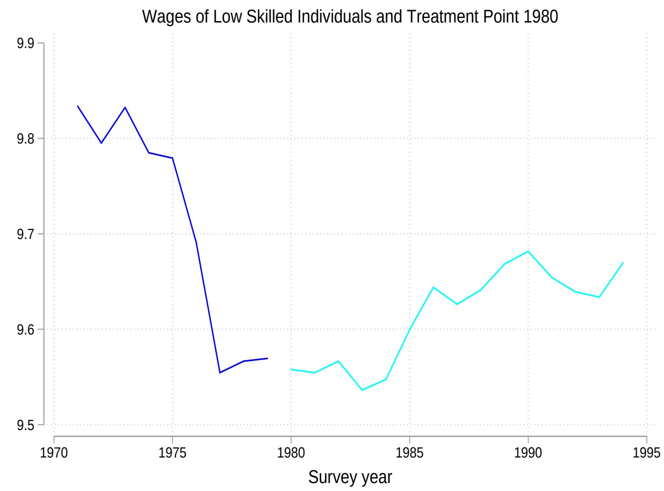


(b) Low Educated

Figure 29: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1978

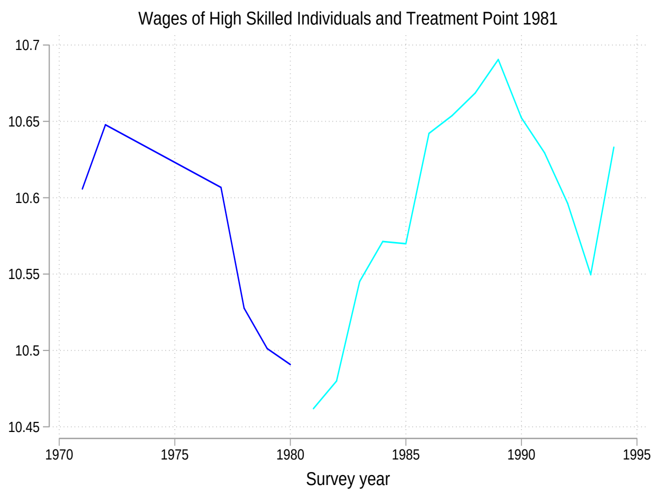


(a) High Educated

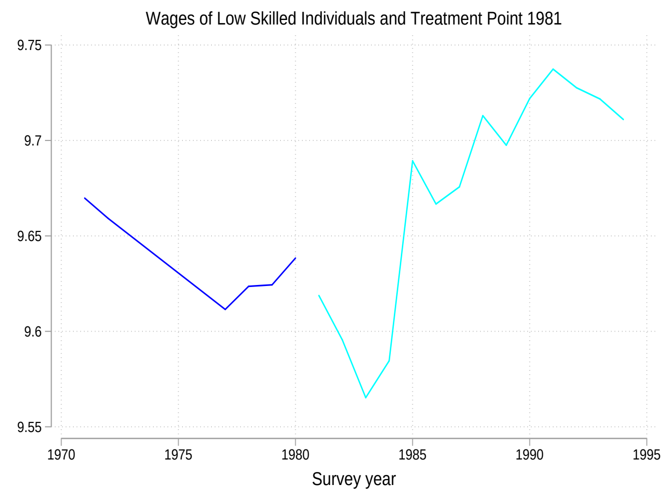


(b) Low Educated

Figure 30: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1980

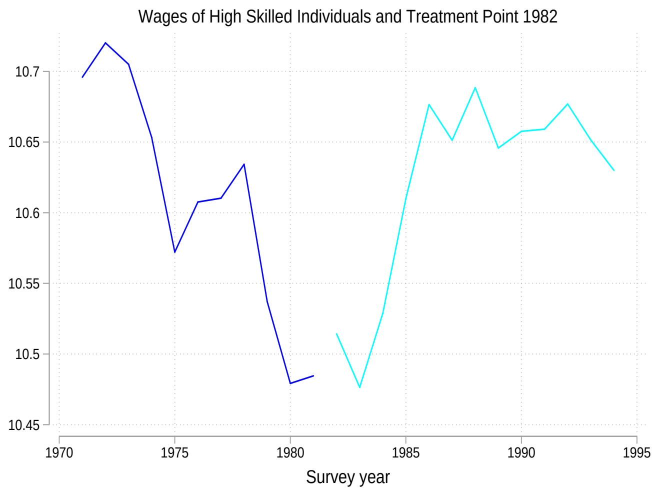


(a) High Educated

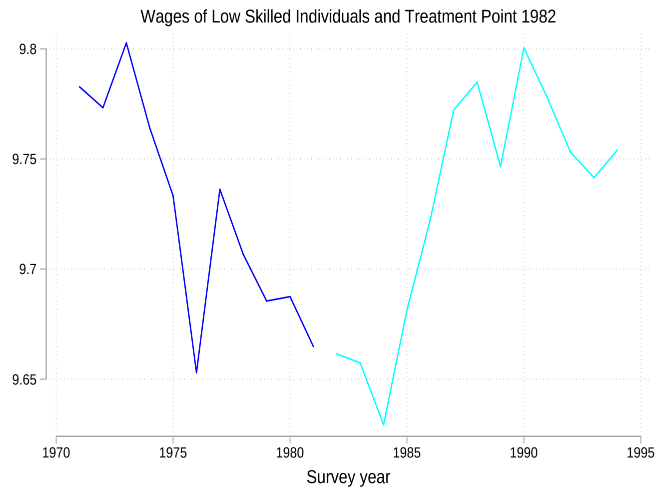


(b) Low Educated

Figure 31: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1981

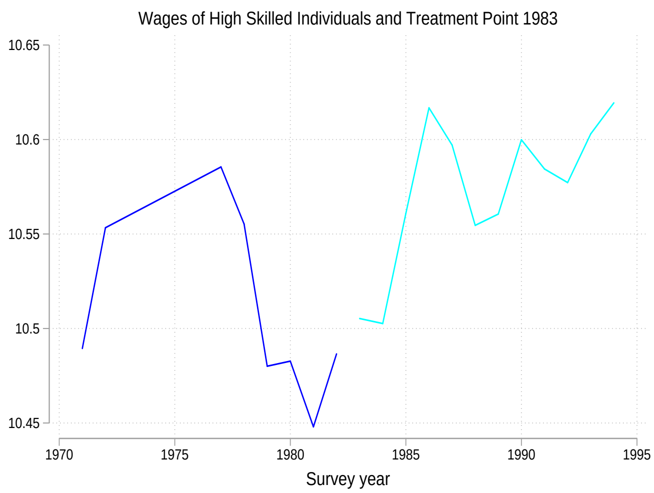


(a) High Educated

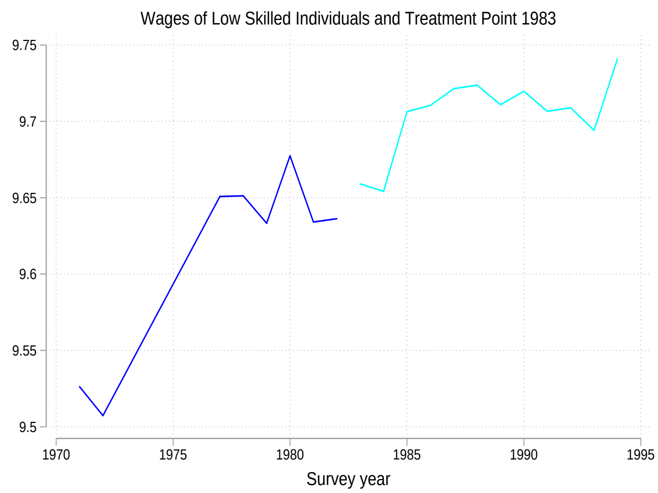


(b) Low Educated

Figure 32: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1982

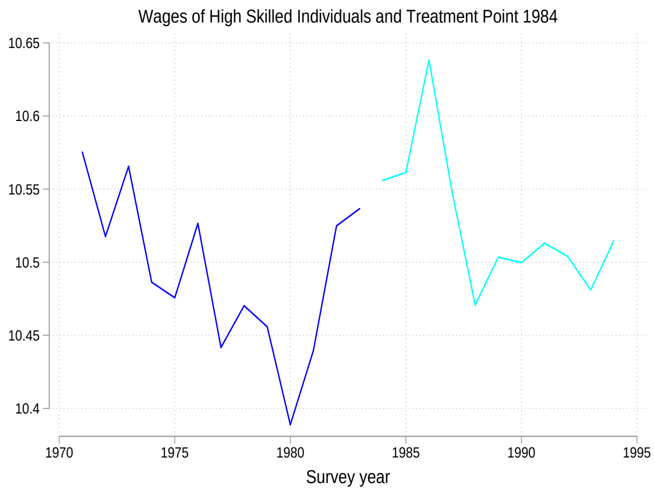


(a) High Educated

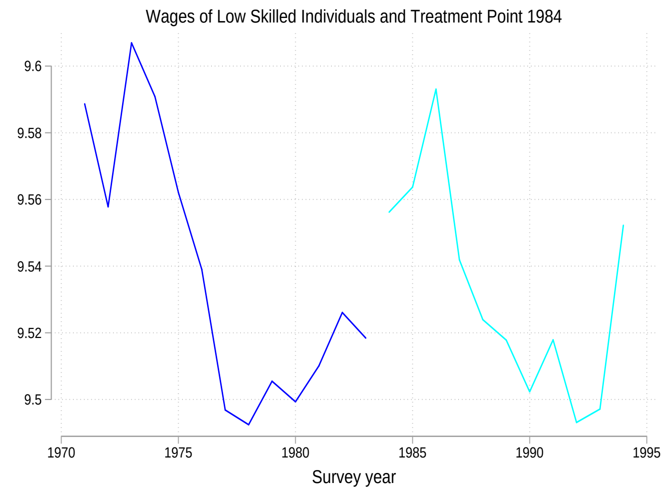


(b) Low Educated

Figure 33: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1983

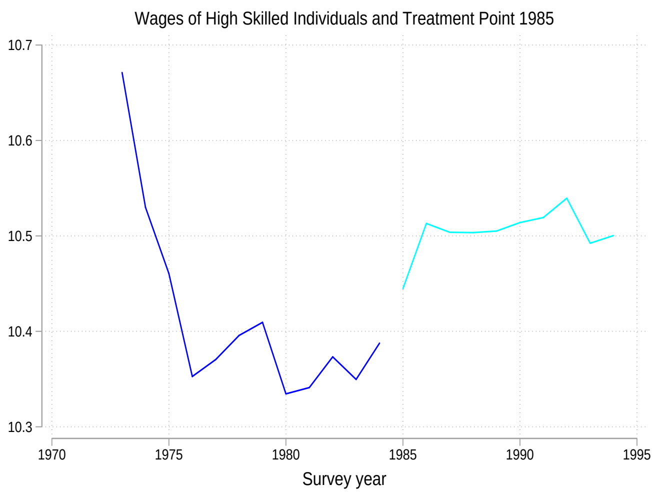


(a) High Educated

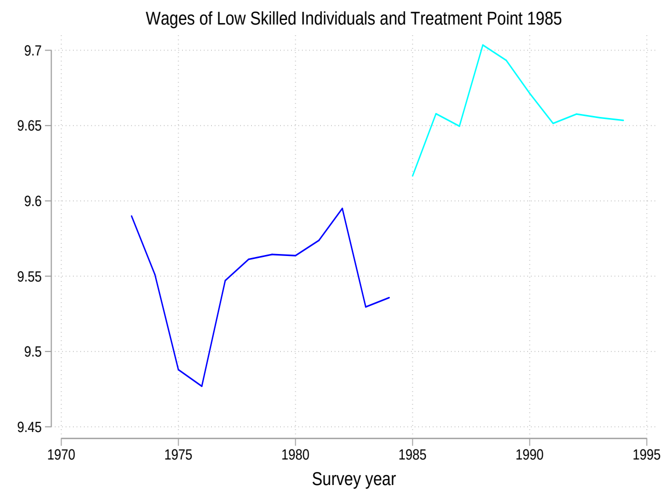


(b) Low Educated

Figure 34: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1984

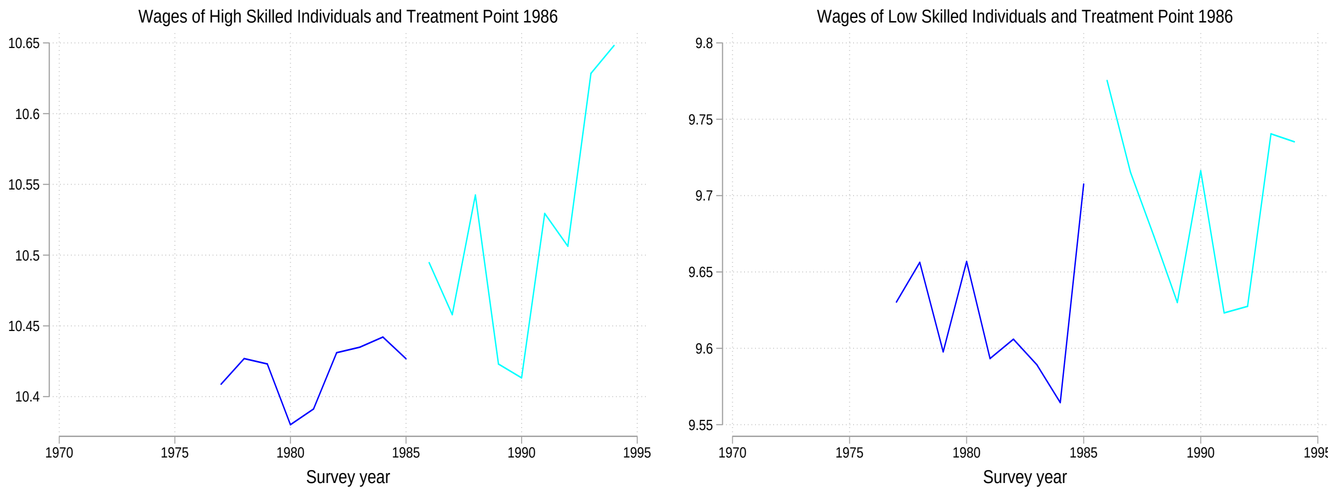


(a) High Educated



(b) Low Educated

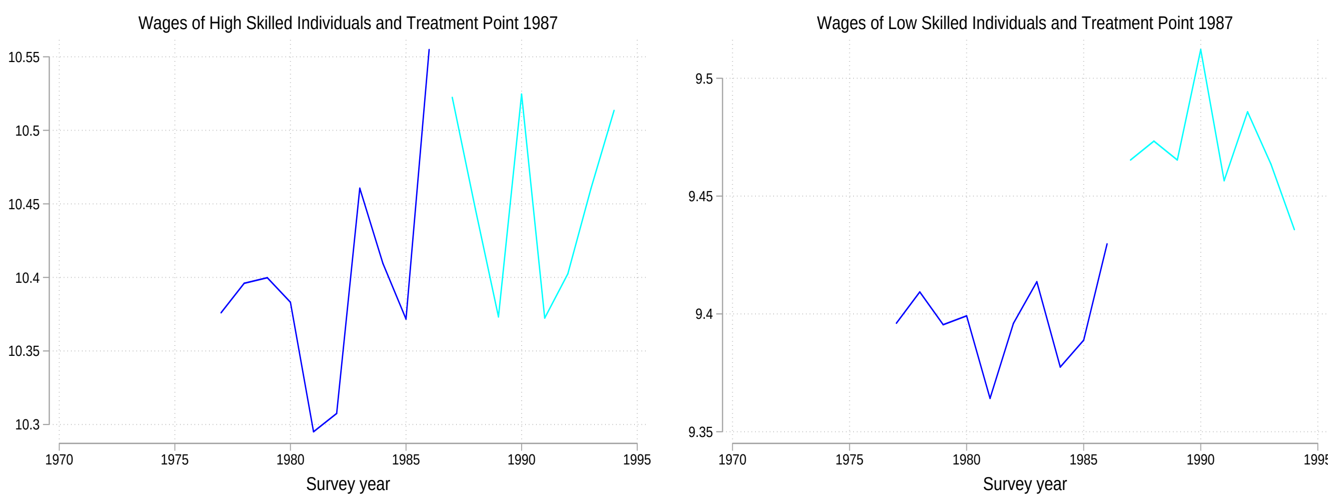
Figure 35: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1985



(a) High Educated

(b) Low Educated

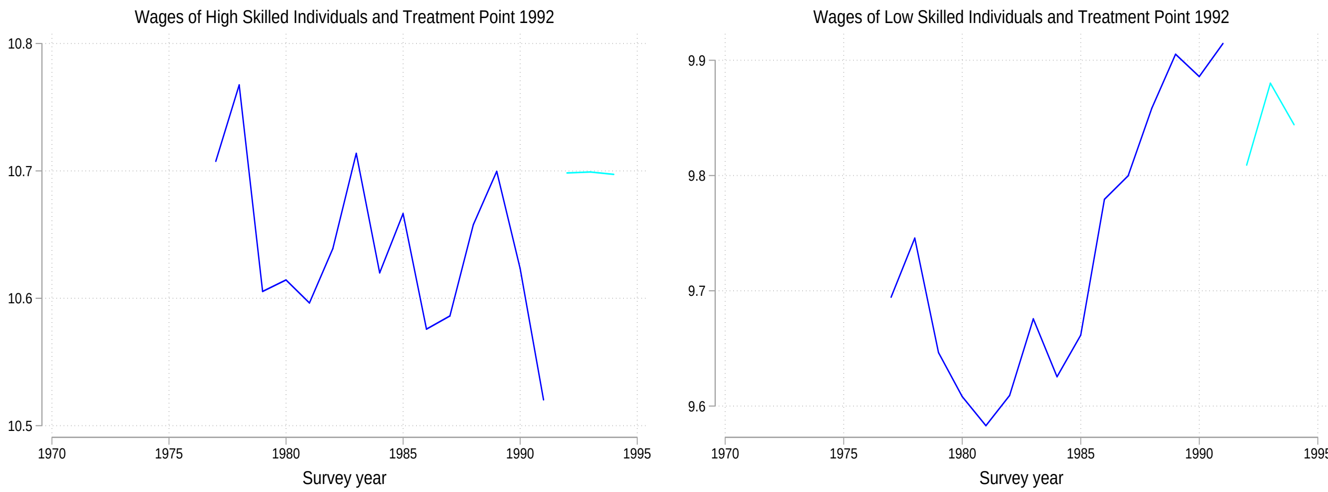
Figure 36: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1986



(a) High Educated

(b) Low Educated

Figure 37: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1987



(a) High Educated

(b) Low Educated

Figure 38: **Evolution of the wages across States in the United States**
The graphs presents the average evolution of the wages across states pre and post treatment for those states that started the treatment 1992

E Example Model (5)

id	year	Tcal	Tpenn	A_cal	A_penn	Tcal*A_cal	Tpenn*A_penn
california	1	0	0	1	0	0	0
california	2	1	0	1	0	1	0
california	3	1	1	1	0	1	0
new york	1	0	0	0	0	0	0
new york	2	1	0	0	0	0	0
new york	3	1	1	0	0	0	0
pen	1	0	0	0	1	0	0
pen	2	1	0	0	1	0	0
pen	3	1	1	0	1	0	1

Table 14: **Example Computations of Model (9)**