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Deunionization in the US: A panel data analysis from 1973 to 1999

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Abstract

There are four different hypotheses analyzed in the literature that explain deunionization, namely: the decrease in the demand for union representation by the workers; the impact of globalization over unionization rates; technical change and changes in the legal and political systems against unions. This paper aims to test all of them. We estimate a logistic regression using panel data procedure with 35 industries from 1973 to 1999 and conclude that the four hypotheses can not be rejected by the data. We also use a variance analysis decomposition to study the impact of these variables over the drop in unionization rates. In the model with no demographic variables the results show that these economic(tested) variables can account from 10% to 12% of the drop in unionization . However, when we include demographic variables these tested variables can account from 10% to 35% in the total variation of unionization rates. In this case the four hypotheses tested can explain up to 50% of the total drop in unionization rates explained by the model.

1 Introduction

In the late 70's, the rate of unionized workers was 30% in the U.S. while in 2000 it was only 14% (Farber and Western, 2000). Regarding the UK, this rate was above 55% and then it dropped to below 30% in the same period (Machin, 2000, 2002). There are several empirical as well as theoretical studies that have attempted to test the causes of this decline.

The literature has been using different hypotheses to explain this reduction of unionization. One hypothesis relates this deunionization to changes in the legal and political system. These changes would create an economic environment more hostile to union's activities. Key facts related to this are the 1981 air-traffic controller strike, the Reagan's National Labor Relations Board(NLRB) appointments in 1983 for the US, and the Thatcher government in the UK.

Farber and Western (2000,2001) find little evidence that changes in the administration of the National Labor Relations Act(NLRA) by the NLRB adversely affect union organization. The authors also make an empirical analysis on monthly elections time series and show the sharp decrease in union elections preceded these political events. In

their conclusion they claim that changes in the economic environment that made union representation of less value or more costly to employees may be the cause of deunionization. They believe the drop in union election activities is a marginal contributor to deunionization.

In Farber and Western (2000) the increase in global competitiveness and capital mobility are mentioned to be other possible hypotheses for deunionization. However, Farber and Krueger(1992) point out the drop in the workers demand for union representation as a key factor explaining the union membership decline in the US.

Another possible explanation for deunionization relates technological advance and the decision of union members to leave the union due to the action of market forces, which increase the tensions among workers inside the unions and beyond its breaking point.

Acemoglu, Aghion and Violante (2001) pointed out this technological hypothesis. They analyze unions as rent-seeking agents imposing a contract on the firm or as efficiency-enhancing unions, where the union induces training to the workers, or provides insurance to themselves. Their study makes use of the skill biased technical change as the driving force that generates deunionization because it increases the outside option of skilled workers.

This paper intends to contribute to the existing literature for the following reasons. First, it builds a panel data with 35 industries from 1973 to 1999 containing data on US union rates and other variables that may explain deunionization. Second, it tests at the same time the four different hypotheses presented in the literature to explain deunionization. They are: the decrease in the demand for union representation by the workers; the impact of globalization over unionization rates; technical change and changes in the legal and political systems against unions. Third it evaluates the impact of these hypotheses on the decline of unionization rates through a variance analysis decomposition.

This paper uses a panel data to identify empirically which of the above factors are relevant and also to measure their contribution in the drop of unionized workers in the US. We test the four hypotheses mentioned above using a panel data estimation based on logistic regressions in which we encompass these four hypotheses. We estimate two different models: one with only the variables that represent the hypotheses being tested and other with the addition of demographic variables. Both estimations give us similar results. We conclude that the four hypotheses we have tested, namely: the decrease in the demand for union representation by the workers; the impact of globalization over unionization rates; technical change and changes in the legal and political systems against unions can not be rejected by the data.

We also use a variance analysis decomposition to study the impact of these variables over the drop in unionization rates. Once more, we analyze two different models: one that does not include demographic variables and other that does include it. In the model without demographic variables, we find that the economic(tested) variables can account for 10% to 12% in the decline of unionization while industry specific effects (random and/or fixed) account for around 80% of the total variation.

In the model that includes demographic variables, the tested and demographic variables explains up to 63.3% of the total variation in the unionization rates while industry

specific (random and/or fixed) effects can account for around 35%. The tested variables accounts from 10% to 35%. In this case the four hypotheses tested can explain up to 50% of the total drop in unionization rates explained by the model.

This paper is organized as follows: the next section presents a review of the literature, section 3 describes the data sources, the methodology used and describes the data series. Section 4 presents the model and the methodology used to estimate it. In section 5, reports our empirical finds and discuss them. Section 6 contains a variance analysis decomposition that measures the impact of each factor in the unionization rates decline; and section 7 sums up with the concluding remarks.

2 Review of the Literature

The impact of unions on the wage structure is one of the most explored subjects on unions studies. Works in this area range from studies concerned about the effect of the unions on wages and the existence of wage premium to the union impact on wage distribution.

The first studies about the union effect on wages argue that unions would increase wage inequality in the U.S. On the one hand Friedman(1956) argues that craft unions would be more efficient in raising wages than industrial unions. Therefore, the wage of more skilled workers would be even higher. Rees(1962) follows the same idea based on the fact that union membership at the 50's was concentrated among the top of the earnings distribution. On the other hand, Reynolds and Taft(1956) analyze the wage structure in different industries and conclude that unions have not increased wage inequality. They claim that it was even possible that unions decreased wage inequality.

Lewis(1963) studies the correlation between union wage differential and wage levels. He says that unionism increased inequality across industries by two to three per cent. On the contrary, Stafford(1968), Rosen(1970) and Johnson and Youmans(1971) concluded that unions compress wages because it raises the low skilled wages relatively more than the high skilled wages.

In a very influential survey where he examined approximately 200 studies on the effects of unions on wages, Lewis(1986) concludes that methodologically the best way to estimate the size effect of unions on wages is to run OLS equations with wages on the left side, as dependent variables, and union status and other control variables on the right side, as independent variables. He also concluded that the impact of unions on wages in the US economy creates a wage differential around 15% and it is very stable in the period between 1967 and 1979.

Subsequent works confirm the conclusion of Lewis(1986). Hirsch and Schumacher(2002), Hirsch and Macpherson(2002) and Hirsch et al(2002) analyze wage gap over time and along with the confirmation of its stability over time, conclude that it has experienced a decline in recent years. Bratsberg and Ragan(2002) analyze the private sector wage gap between 1971 and 1999. They reassure the stability of the union wage premium over time and also notice the decline in recent years.

Card(1996) uses Current Population Survey(CPS) data from 1987 and 1988 to study the effects of unions on the wage structure. He uses a technique that accounts for mis-

classification errors, potential correlations between union status and unobserved productivity. His analysis separate different skill groups and results suggest that unions raise wages more for unskilled groups than for skilled groups. He observes two different patterns of bias selection between high and low skilled groups. He discovers that there is a positive selection among low skilled workers(of unobserved ability) and a negative selection among high skilled workers.

Raphael(2000) uses the CPS displaced workers supplement files from 1994 to 1996 to study the effects of union membership on weekly earnings. His conclusion supports Card(1996). He finds a positive selection for low skilled workers and a negative selection for high skilled workers.

The union membership rates are dropping steadily since the 70's in the US. There are many studies connecting this fact to another well known in the US economy: the increase in wage inequality. Others try to find and explain the causes of this decline on union representation in the US.

Card(2001) uses the CPS micro data for 1973, 1974 and 1993 to study the effect of union membership changing on trends in male and female inequality, for the public and private sector. He realizes unions act in the same way in the private and public sector and unionization rates fell for men and women. He also finds that even after controlling for unobserved skills there is a wage premium for union workers. Finally, he concludes that the decrease in unionized workers can account for 15-20% of the increase in male wage inequality.

Di Nardo, Fortin and Lemieux(1996) use CPS data from 1979 to 1988 and point out that shifts in unionization can explain 15-20% of the increase in wage inequality for men, and 3 % for women.

Freeman(1993) uses the CPS longitudinal matched for men from 1978 to 1988 and says that 20% of the increase in the male log earnings in the period is due to deunionization.

Farber(1990) uses May CPS data from 1973 to 1984 to show that the rate of unionized workers drops sharply. He points out two possible reasons for this decline. The first is an increase in employer resistance due to increase in market competition; the second is a decrease in the demand for union representation by the workers.

Farber and Krueger(1992) use the May CPS data for 1977 and the merged outgoing rotation group data from the CPS(morg-CPS) for 1984 and 1991 in order to analyze the decline in union membership rate in the US and the difference in unionization rates between the US and Canada. They conclude the decline in the US is due to a drop in the worker's demand for unions. What's more, that very little of this drop can be explained by shifts in the composition of the labor force. Finally, the differences between US and Canada are due to demand and supply differences.

Farber and Western(2000) examine monthly data on NLRB union representation elections to determine if changes in the administration of the NLRA cause a reduction in the level of union organizing activity. They also tried to reconcile the drop in the union organization activity with key political events, like the PATCO strike of 1981 and the Reagan majority in the NLRB in 1983. They show the drop in union organizing activity happened before these political events. They also point out the drop in union organizing activity accounts only for a small fraction of the drop in unionization rates.

They indicate changes in economic environment that made union representation of less value to worker or more costly to employers; and the increase in global competitiveness and capital mobility as important factors explaining the drop in unionization rates.

Farber and Western(2001) make an empirical time series analysis of NLRB monthly organizing elections. They conclude that sharp decline in the number of organizing elections preceded the PATCO strike of 1981 and the Reagan majority in the NLRB in 1983.

Acemoglu, Aghion and Violante (2001) analyze unions as rent-seeking agents imposing a contract on the firm or as efficiency-enhancing unions, where it induces training to the workers, or it provides insurance to themselves. They use skill biased technical change as the driving force that generates deunionization. This also generates an increase in wage inequality.

The above studies may bring us a conclusion that unions compress wages differentials in the U.S. It happens because the union effect on wages is higher for low skilled workers(in the bottom of income distribution) than for high skilled workers. We can also say that there is a union membership premium. Therefore, we may think that union membership is a good to be purchased, and this wage gap is the good offered by a union.[1]

3 The Data

We use different data sources to construct the series used in this paper. For the unionization rate, wage premium and the demographic variables, the CPS is used. For the openness index, we use the Center of International Data(CID) at UCD directed by Robert Feenstra, OECD and Bureau of Economic Analysis(BEA) data. The series that measure technological progress are from the BEA and Cummins and Violante(2002). These series cover the period between 1973-2002 and are at an industry level.

Unfortunately, not all the industries or sectors appear in the different data sources that we have. Consequently, the analysis is carried on only with the 35 industries that show up in all the different sources and allow to have a balanced panel. The 35 different industries in our data follow a Standard Industry Classification(SIC)[2].

3.1 Unionization Rate

The CPS is the most important source of information to construct union membership series. Questions about union membership were regularly included in this survey in 1973. This data is reported in the mayCPS between 1973 and 1981. The CPS provides data on a very comprehensive set of variables. The union membership series constructed here is based on wage and salary workers 16 years old and over, in order to make it compatible with the sample from 1983 to date. In the year of 1982 there is no data on union membership available[3]. In 1983 the data on union membership starts being released in the outgoing rotation groups of the CPS(CPSmorg). The

[1] Unions can provide different services to its members and the wage gap is one of them. In our analysis we use it because it has more accurate available data.

[2] The sic classification is presented in the appendix.

[3] Therefore we interpolate the years of 1981 and 1983.

CPSmorg reports results on wage and salary workers that ages 16 and over. The data is collected in the following way: an individual is interviewed during 4 months consecutively and then ignored for 8 months. If the individuals move, they are not followed, rather the new occupants are interviewed. Since 1979 the individuals in months 4 and 8 were asked questions about earnings, union membership and so on. The mayCPS data was downloaded from the NBER web site from 1973-1981. The CPSmorg data was obtained in a CD-ROM acquired from the NBER and contains the years between 1979-2003.

In order to obtain the correct statistics to the US economy, both samples contain weights that are used to compute the unionization rate and also the wage gap[4].

The unionization rate and the wage gap were computed in an industry specific way.

The unionization rate was computed using the following formula:

$$UN_i = \frac{\sum_{j=1}^{M} (WE_j) s_{ij} d_{ij}}{\sum_{j=1}^{M} (WE_j) s_{ij}} \tag{1}$$

In this expression WE_j is the weight associated with each observation j, s_{ij} and d_{ij} are dummy variables. These take value one if the observation is from sector i for s_{ij} and if the worker is a union member for d_{ij} and zero otherwise.

3.2 Wage Premium

The wage premium is the "premium" received by union members as a higher wage, because as unions are well known as rent extractors, they are able to obtain higher wages from firms. Therefore, we expect a high wage premium to have a positive impact in the rate of unionized workers.

The wage premium is measured as the ratio between union and nonunion wages. We call union wage by w_u and the nonunion wage by w. We computed the wage premium in two different ways.

The first is a naive one: we measure the average wages received by unionized and non-unionized workers and take the ratios. In order to compute it, we proceed in the following way:

$$w_i = \frac{\sum_{j=1}^{M} e_j (EW_j) s_{ij} (1 - d_{ij})}{\sum_{j=1}^{M} (EW_j) s_{ij} (1 - d_{ij})} \tag{2}$$

$$w_{ui} = \frac{\sum_{j=1}^{M} e_j (EW_j) s_{ij} d_{ij}}{\sum_{j=1}^{M} (EW_j) s_{ij} d_{ij}} \tag{3}$$

[4] There are specific weights associated with each interview. One weight for the population value and other for the earnings.

In equations 2 and 3 e_j represents the earnings received, EW_j represents the earnings weights, s_{ij} represents the sector and d_{ij} is the union dummy variable. The wage premium is given by the ratio:

$$WG_N = \frac{w_u}{w} \tag{4}$$

Equation 4 represent the wage gap obtained by the naive measure(the subscript N indicates naive). This naive measure does not necessarily represent the wage premium received by a union member because it does not control for individual characteristics that can influence wages and union selection. Then, a measure that take this characteristics into account is necessary.

In order to have a wage premium associated only with the fact that the worker is a union member, we need to control for the observed abilities. Therefore, we separate the sample in gender, education level, age and race. High skilled workers are those with a high school degree. The sample was divided into workers older and younger that 35; white and nonwhite. We have created 16 different groups then.

All the workers in an industry were classified into one of this 16 groups. Each group have its dummy variable G_{gi}, being i the industry and $g = 1, ..., 16$ represents the group.

$$w_{gi} = \frac{\sum_{j=1}^{M} e_j(EW_j)G_{gi}(1-d_{ij})}{\sum_{j=1}^{M}(EW_j)G_{gi}(1-d_{ij})} \tag{5}$$

$$w_{ugi} = \frac{\sum_{j=1}^{M} e_j(EW_j)Gd_{ij}}{\sum_{j=1}^{M}(EW_j)Gd_{ij}} \tag{6}$$

In equations 5 and 6 e_j represents the earnings received, EW_j represents the earnings weights, G_{gi} represents the classification group and d_{ij} is the union dummy variable.

We use the union and the nonunion wage received by each group in each industry to calculate the wage gap within each group:

$$WG_{gi} = \frac{w_{ugi}}{w_{gi}} \tag{7}$$

After obtaining the wage gap within each classification group, we need each group weight to obtain the wage gap in that industry. The classification group weights are obtained in the following way:

$$DG_g = \frac{\sum_{j=1}^{M}(WE_j)s_{ij}G_{gi}}{\sum_{g=1}^{16}\sum_{j=1}^{M}(WE_j)s_{ij}G_{gi}} \tag{8}$$

Obviously we have $\sum_{g=1}^{16} DG_g = 1$. Then, we obtain the industry specific wage gap:

$$WG_i = \sum_{g=1}^{16} (DG_g)(WG_{gi}) \tag{9}$$

3.3 Openness Variable

The data are from the Center of International Data(CID) , the OECD and the Bureau of Economic Analysis(BEA) websites. The input-output matrix obtained from the OECD cover the period from 1972 to 2002. Unfortunately, this series do not cover all years. The input-output matrix covers the years of 1972, 1977, 1982, 1987, 1992, 1997-2002. The missing observations are filled with interpolation among the existing ones. The OECD and the BEA data are used to obtain the total GDP per industry.

The Feenstra data is used to obtain the total imports and exports per industry.

We use two different measures of openness: the import penetration and external trade industry share.

The import penetration index is measured in the following way:

$$IP_i = \frac{M_i}{GDP_i} \tag{10}$$

As it can be seen it measures the share of imported goods in each industry. The external trade industry share is measured by:

$$ETIS_i = \frac{(X_i + M_i)}{GDP_i} \tag{11}$$

The ETIS measures the transactions with the rest of the world that an industry has as a share of its GDP.

3.4 Institutional Index

This variable tries to measure the impact of anti-union legislation that supposedly happened in the US, in the beginning of the 80's.

Since there is no variable that measures directly the institutional change against unions, we use the number of recognizing elections hold each year as a proxy of this movement against unions. As this is a wide economy effect, this index is not industry specific. This data is obtained from NLRB.

3.5 Technological Measures

The idea behind the effect of technology on unions occurs in two different ways. The first one is caused because an increase in technology creates an incentive among skilled workers to leave a union because the new technology benefits this group vis-à-vis the other. The second aspect relates the technological gap. We expect industries that are far away from the technological frontier to be less competitive. As these firms are less competitive, unions can not extract high rents and therefore it affects unions negatively.

The variables that measure technological advance are obtained from the BEA website and from Cummins and Violante(2002).

We obtain the multifactor productivity, the labor productivity and the capital productivity from the BEA website.

The other two technological measures used are the technological gap and a measure of non neutral technological advance, that we call skill biased technical change(SBTC).

3.6 Demographic Variables

All the six demographic variables used are obtained from the mayCPS from 1973 to 1999 and from the morgCPS from 1983 to 1999. The demographic variables chosen are ratio of white, male, married and full time workers and years of education and experience per industry, once more using the Standard Industry Classification(SIC).

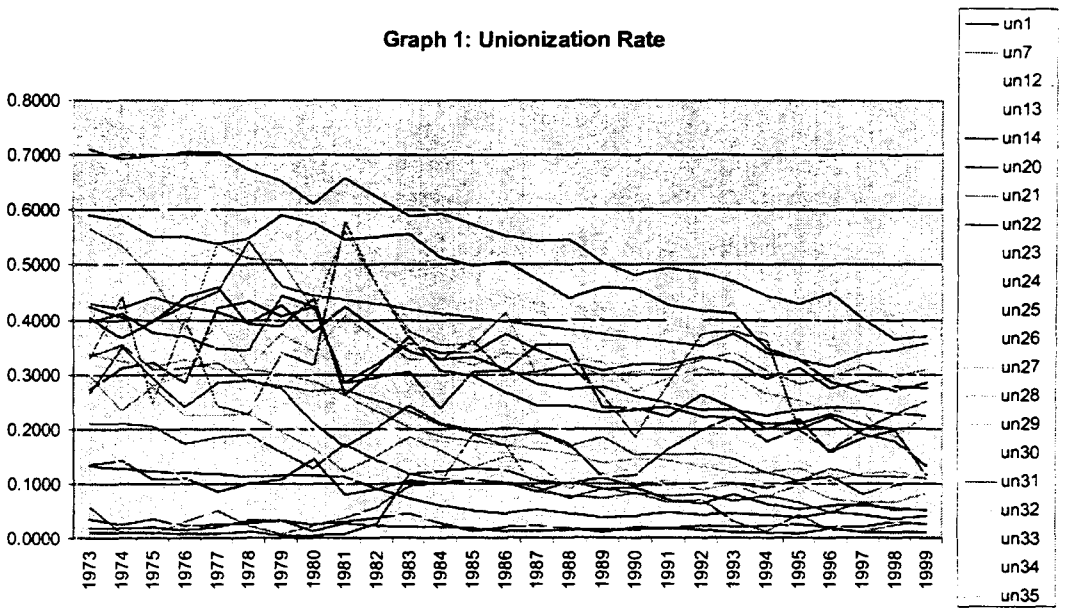
3.7 Data Description

The variables used in the estimation procedure are measured in an industry specific basis. As mentioned before, we use 35 industries selected using the Standard Industry Classification(SIC). The variables we will use are the following: unionization rate(UN_{it}), wage premium(WG_{it}), technology(A_{it}), import penetration$\left(\frac{IP_{it}}{GDP_{it}}\right)$, external trade sectorial share$\left(\frac{X_{it}+M_{it}}{GDP_{it}}\right)$ and number of union recognition elections(El_t). Despite this variables we also make use of several demographic variables like: education, marital status, experience, race, sex and full time ratios. The education variable measures the average years of education per industry. Experience is measure in average years and follow a standard measure in the literature: experience equals age minus years of education minus five. We also use the ratio of white employees per industry, the ratio of married employees and full time workers in each industry.

Before presenting the model, we describe the data.

3.7.1 Unionization Rate

As expected, the unionization rate presents a decline in all but one of the sectors under study between 1973 and 1999. It can also be observed that this decline has a stable and long pattern, as seen below.



The graph helps to observe that there are two distinct groups in this data sample. The firs: one that lost a huge part of its members but remained with relatively high unionization rates. The second one that kept it low unionization rate, even losing part of its members.

It is .nteresting to observe that despite the union losses over the period, the fifteen sectors that had a higher unionization rate in 1973 remain the same in 1999 but for one sector, as can be seen in the following table.

Table 1: Union rates by Industry per Year								
	1973		1981		1990		1999	
1	coal mining	74.68%	motor vehicle	65.77%	motor vehicledes	48.19%	motor vehicle	36.91%
2	motor vehicle	70.99%	tobacco	57.82%	telephone	45.72%	Elet. light and Power	35.59%
3	Primary metal.	61.63%	water transp	55.99%	Primary metal.	41.21%	Primary metal.	35.39%
4	telephone	59.03%	telephone	54.67%	coal mining	37.86%	water transp	30.92%
5	water transp	56.53%	Primary metal.	53.98%	paper and all.prod	37.38%	coal mining	28.85%
6	paper and all.prod	56.41%	coal mining	50.25%	Elet. light and Power	36.56%	aircraft and part	28.45%
7	stone clay	50.70%	Elet. light and Power	43.59%	aircraft and part	31.86%	telephone	27.30%
8	rubber and misc	46.40%	paper and all.prod	43.51%	gas & steam	30.83%	paper and all.prod	26.30%
9	food	42.93%	food	42.35%	water transp	30.44%	tobacco	24.81%
10	Fab. Met. Product	42.79%	Pet. and Coal prod.	40.73%	stone clay	27.96%	gas & steam	23.83%
11	Elet. light and Power	42.42%	gas & steam	36.70%	Pet. and Coal prod.	26.88%	Pet. and Coal prod.	22.49%
12	Pet. and Coal prod.	42.22%	stone clay	35.57%	food	25.91%	food	22.42%
13	Transp. and Storage	40.28%	Fab. Met. Product	34.74%	Fab. Met. Product	23.82%	stone clay	20.60%
14	aircraft and part	39.53%	aircraft and part	28.48%	Nonmet. Mining	23.66%	Transp. and Storage	19.96%
15	gas & steam	36.31%	Nonmet. Mining	28.42%	Transp. and Storage	23.35%	rubber and misc	16.36%
16	apparel and other text	34.87%	chemical	28.16%	tobacco	18.32%	Fab. Met. Product	15.71%
17	Mach. & comp.	33.70%	Elec. mach. and sup.	27.08%	rubber and misc	16.23%	leather and prod	13.12%
18	Elec. mach. and sup.	33.51%	apparel and other text	26.54%	chemical	15.42%	radio and tv	12.23%
19	tobacco	32.84%	Mach. & comp.	26.29%	apparel and other text	15.09%	Nonmet. Mining	11.44%
20	Lumber wood	30.12%	Transp. and Storage	26.15%	Elec. mach. and sup.	15.08%	Elec. mach. and sup.	10.92%
21	Misc. Man. ind.	29.95%	Lumber wood	25.90%	Mach. & comp.	14.39%	Mach. & comp.	10.67%
22	chemical	28.27%	rubber and misc	24.94%	Lumber wood	12.82%	chemical	10.33%
23	Nonmet. Mining	27.20%	Furniture and fix.	24.27%	radio and tv	12.30%	rest and hot	9.94%
24	leather and prod	26.41%	prof. ph	17.22%	Furniture and fix.	12.27%	Lumber wood	8.74%
25	Furniture and fix.	24.84%	leather and prod	16.73%	leather and prod	11.42%	apparel and other text	8.47%
26	print, pub and all	24.27%	print, pub and all	15.68%	print, pub and all	11.05%	print, pub and all	8.25%
27	prof. ph	20.96%	Misc. Man. ind.	12.23%	Misc. Man. ind.	9.90%	Misc. Man. ind.	8.16%
28	radio and tv	17.83%	durable	11.23%	rest and hot	9.49%	Furniture and fix.	6.94%
29	text mill prod	13.52%	radio and tv	9.84%	text mill prod	9.12%	prof. ph	5.14%
30	durable	13.26%	text mill prod	7.86%	agr.serc	8.21%	text mill prod	5.09%
31	pet. and nat. gas	7.48%	pet. and nat. gas	5.01%	prof. ph	8.19%	durable	3.92%
32	agr.serc	5.61%	agr.serc	3.63%	pet. and nat. gas	5.07%	agr.serc	3.11%
33	agr	3.53%	agr	3.08%	durable	4.04%	pet. and nat. gas	2.87%
34	banking	1.63%	banking	2.65%	agr	1.90%	agr	2.46%
35	rest. and hotels	0.98%	rest and hot	0.69%	banking	1.40%	banking	0.91%

The fabricated metallic products industry loses one position and the tobacco industry become one of the top 15 in unionization rates. It is important to notice that the tobacco industry already have a high unionization rate in 1973, 32.84%. It become one of the top 15 in 1999 with 24.81% due to the fact that it suffer smaller losses than others that were ahead in 1973.

Table 2: Drop in unionization rates between 73 and 99				
Absolute			Relative	
1	Coal Mining	-45.83%	apparel and other text	-75.71%
2	Motor vehicle	-34.09%	Prof. ph. and Eq.	-75.47%
3	Telephone	-31.74%	Misc. Man. Ind.	-72.77%
4	Paper and All. Prod.	-30.11%	Furniture and fix.	-72.06%
5	Stone and clay	-30.11%	Lumber Wood	-70.99%
6	Rubber and misc.	-30.04%	Durables	-70.45%
7	Fab. Met. Prod.	-27.08%	Mach. & Comp.	-68.33%
8	Apparel and other te:	-26.40%	Elec. Mach. and Sup	-67.41%
9	Primary Metal.	-26.24%	Print, Pub and all.	-66.01%
10	water transp	-25.61%	rubber and misc	-64.73%
11	Mach. & Comp.	-23.03%	Chemical	-63.46%
12	Elec. Mach. and Sup	-22.59%	fabmetal	-63.29%
13	Misc. Man. Ind.	-21.80%	Text. mill prod.	-62.34%
14	Lumber Wood	-21.38%	Pet. and Nat. gas	-61.57%
15	food	-20.50%	Coal Mining	-61.37%
16	Transp. and Storage	-20.31%	stone clay	-59.38%
17	Pet. and Coal prod.	-19.73%	Nonmet. Mining	-57.92%
18	Chemical	-17.94%	Telephone	-53.76%
19	Furniture and fix.	-17.90%	Paper and All. Prod.	-53.38%
20	Print, Pub and all.	-16.02%	Transp. and Storage	-50.43%
21	Prof. ph. and Eq.	-15.82%	Leather and Prod.	-50.31%
22	Nonmet. Mining	-15.76%	Motor vehicle	-48.02%
23	Leather and Prod.	-13.29%	food	-47.76%
24	Gas & Steam	-12.48%	Pet. and Coal prod.	-46.73%
25	Aircraft and Parts	-11.08%	water transp	-45.30%
26	Durables	-9.34%	agr.serc	-44.47%
27	Text. mill prod.	-8.43%	Banking	-44.35%
28	Tobacco	-8.03%	primetal	-42.57%
29	Elet. light and Power	-6.84%	Gas & Steam	-34.37%
30	radio and tv	-5.60%	radio and tv	-31.40%
31	Pet. and Nat. gas	-4.61%	agr	-30.28%
32	agr.serc	-2.49%	Aircraft and Parts	-28.03%
33	agr	-1.07%	Tobacco	-24.45%
34	Banking	-0.72%	Elet. light and Power	-16.12%
35	Rest. and Hotels	8.96%	Rest. and Hotels	916.34%

The industry that suffer the higher absolute losses of unionized workers are also the industries that have higher rates of unionized workers, as can be seen in the table above. However, if you compare the unionization rates to the 1973's unionization rates, the industries that had a higher percentage reduction in unionization rates are the ones that have a lower unionization rate. Therefore, despite the huge losses of unionized workers across the different industries observed, the high unionized ones protected themselves relatively better than the low unionized industries.

The losses of union members range from 16.1% to 75.7% of the 1973 union members.

3.7.2 Wage Premium

The two measures of wage premium used in this work present a similar pattern: a small decline in the wage premium between 1973 and 1999. Both series can be divided into two different groups. One with the industries presenting a wage premium for union

members and another including industries that do not have a wage premium.

In the naive measure, 17 industries did not pay a wage premium in 1973 and this number increases to 19 in 1999. In the controlled measure, the number of industries not paying a wage premium in 1973 is 14 and this number increases to 18 in 1999.

Another difference between the two measures is in the level. The adjusted measure is lower than the unadjusted for 24 of the 35 sectors studied. The majority of the sectors present a very stable declining path, but there are few sectors that present a great instability, specially from 1973 to 1981.

The adjusted wage premium series have a lower variance across industries than the naive measure for 17 of the 27 years. And this variance is lower in 14 of the last 15 years.

We can say the adjusted series is less volatile than the unadjusted one and the two series show a slow decline in the wage premium from 1973 to 1999.

3.7.3 Import Penetration and External Trade Industry Share

Both this series present the same pattern: a low level in the period between 1973 and the middle 80's, when a small increase can be observed in both measures and both had a huge increase in the late 90's.

The import penetration series IP_{it} presents an increase in all but five sectors, whereas the external trade industry share($ETIS_{it}$) presents an increase in all but three sectors. The last difference between these series is in their level, where we have the latter variable with a higher level.

3.7.4 Technology

The technology variables used in the analysis are the technological gap, the SBTC, the multifactor, labor and capital productivity. The technological gap and SBTC have observations for all 35 industries while the multifactor, labor and capital productivity data have respectively 26, 27 and 24 industries available.

The technological gap shows a steady increase under the period of analysis. There are only two sectors that present a drop in the technological gap. In the others the increase in the technological gap range from 32.2% to 355% of the original 1973 technological gap.

The SBTC shows a slightly increase under the period of analysis. There are eight sectors that present a drop. In the others the increase in SBTC range from 0.6% to 94.8% of the original 1973 SBTC.

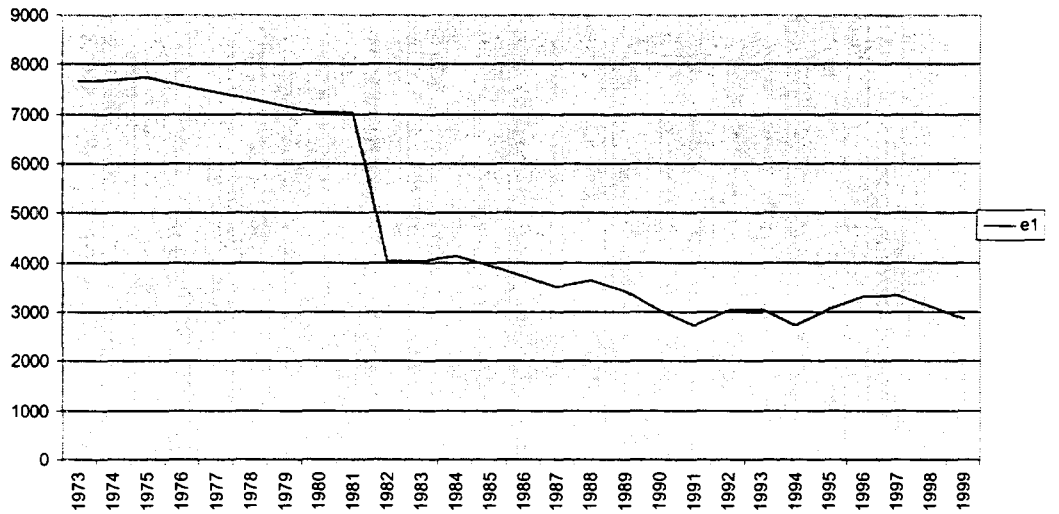
The multifactor productivity shows an increase from 1973 to 1999 in all but 4 industries. This increase ranges from 0.1% to 161.1%. The labor productivity presents an increase for all 27 industries. This increase ranges from 5.8% to 541.8%. Differently the capital productivity present a decrease in 18 among the 24 industries available.

3.7.5 Union Recognition Elections

This is the only variable that is not industry specific in our analysis. This variable is an economy wide effect. In the graph below we can observe the number of elections

drop 62.5% in the period from 1973 to 1999 and a discontinuity in 1981. Before 1981, there is a steady decrease in the number of union recognition elections held. This same stable decrease in observed in the sample after 1981. In 1981 there is a discontinuity represented by the fierce drop in the number of elections held.

Graph 2: Union Recognition Ellections



3.7.6 Demographic Variables

We use different demographic variables in order to understand their influence under the rate of unionized workers per industry. The demographic variables used here are measured in two different ways. The first one is the ratio of individuals with this characteristics inside each industry. The variables that are measured in this way are: ratio of male, white , married and full time employees per industry. The second way is the measure of average years of education and experience in each industry.

The ratio of males variable is very stable between 1973 and 1999. We have that all but five among the 35 industries had more than 50%of males among its employees in 1973. In 1999, all but three have more than 50% of males. It is important to notice that, despite the increase in the number of industries with more than half of males in its labor force, there is a decrease in the ratio over the period for 24 of the 35 industries.

In all the sectors the ratio of white workers in each industry is above 60%. However it had a small decrease over the period for 25 of the 35 industries studied here. Despite this changes, the ratio of white workers is pretty stable in the majority of the industries.

The rate of married workers in each industry is very high but decreasing over the period of analysis. In 1973, all the sectors had this ratio above 60%. In 1999, some industries have this ratio below 50%.

The rate of full time workers is very stable between 1973 and 1999. In 1973 all but the restaurants and hotels industries had the full time workers ratio above 60%, while restaurants and hotels had only 34% of its employees as full time workers. In 1999, all the industries have the ratio of full time workers above 70%.

The experience variable reports average years of experience per industry. This variable is slightly increasing. In 1973 all the industries had an average experience over 13 years, In 1999, this average increased to 17. Among the 35 industries 26 presented an increase in experience while 9 presented a decrease.

The education variable is a very stable one. We observe that 22 industries faced an increase in the average years of education while 13 observed a decrease. It is important to notice that every industry but agriculture has an average education over ten years.

3.8 Caveats

The use of several data sources made the data manipulation a very complex work. We use the different standard industry classification (SIC) tables available in order to correct the changes of this classification over the years. Three different SIC that also cover three periods: 1971-1982; 1983-1991 and 1992-2002 are used.

Putting together all different data sources used here(CPS, CID, BLS and OECD) data is a challenge. The CPS data is used to compute the union rates, the wage premium and demographic variables. The CID, BLS and OECD data are used to construct the openness variables. We made them compatible using the table that can be found in the appendix.

The data on technology are already in SIC terms. The data on elections are an economy wide effect not in industry terms. However, we agree that the compatibility procedure may not be perfect. Some criticism and caution with the data must be observed. We believe the compatibility of the data is made in such a way that minimizes potential problems caused by different data sources.

4 The Model

This study aims to test which of the causes pointed out in literature to explain the decline in union membership in the US, have empirically influenced in this process. We test the influence of the wage premium, globalization, technological change and institutional change over the unionization rates.

4.1 Wage Premium

There are several studies that analyze together the wage premium and union membership. As mentioned in section 2, these studies focus on the effect of union membership(independent variable) on wages(dependent variable). In this paper, we go into a different direction, we analyze how the wage premium affects union membership.

As Blanchflower and Bryson(2003) point out workers join unions not only because of "desire" or "ideological commitment". We can think of a union membership as a good. In this case the good being provided is the wage gap. We are interested to know how this wage premium obtained by union members affects the rate of unionized

workers.

A positive coefficient on the wage premium fits the possible explanation that the drop in unionization in the US is due to a decrease in demand representation, presented in Farber(1990) and Farber and Krueger(1992). We see the wage premium obtained by the unions as a good, moreover, a normal good. The wage premium of unions is expected to be positive related with the rate of unionized workers, despite the fact that free riding is possible[5].

4.2 Globalization and Competitiveness

Another important point is the impact of "globalization" on unionized workers. We assume that the more open an industry is, the more competitive is its environment. Therefore, unions have fewer rents to extract from firms. Hence, it is harder for unions to organize because unions have fewer benefits to offer.

Farber(90) and Farber and Western(2000) point out increase in market competition, in global competitiveness and in capital mobility due to globalization, a possible explanation for the drop in unionization rates. Delaney(2003) poses globalization as an issue for unions to overcome in order to keep their place.

In this paper we use two different measures of openness: the import penetration $\left(\frac{M_i}{GDP_i}\right)$ and the external trade sector share $\left(\frac{X_i+M_i}{GDP_i}\right)$. We expect them to have a negative coefficient indicating a very competitive environment that makes union activities very hard.

4.3 Technological Changes

Acemoglu, Aghion and Violante (2001) show skill biased technical change can explain deunionization because high skilled workers can obtain higher wages outside of the unions, known as wage compressors.

We expect that the variable SBTC is negative related with unions. This expectation is based on the assumption that when workers get more productive, they may be better off out of the unions known as wage compressors.

The technological gap variable that measures the distance in an industry from the technological frontier is a variable that we expect to be negatively related with the unionization rate. This expectation comes from the fact that the far away the frontier an industry is the less competitive it is. Therefore, it is harder for a union to extract rents from the industries. With lower rent extraction, it is harder for unions to act successfully. Thus, we believe that a high technological gap causes a low union rate.

4.4 Institutional Changes

Another explanation for the decline in the rate of unionized workers is the institutional and the political changes against unions that happened in the 1980's(Farber and Western, 2001).

[5] It is important to note that in the US there is no close shop, what means that the benefits earned by a union are extended for all workers, inside and outside the unions.

As a measure of institutional and political changes we adopt the number of union recognition elections. We expect a small number of union recognition elections to be associated with a lower unionization rate. Thus, we expect this variable to have a positive coefficient.

4.5 Econometric Methodology

Our econometric model is based on the Logit model. Let the worker decision be expressed by the Y_i variable, so as, $Y_i = 1$ if worker i is a union member and 0 if he is not. Thus, define $P_i = \Pr[Y_i = 1]$. The logit model assumes the logistic function such as

$$P_i = E(Y = 1|X_i) = \frac{1}{1 + \exp\left(-\beta^T X_i\right)}$$

where $\beta^T X_i = \beta_1 X_{i1} + \ldots + \beta_k X_{ik}$ and X_i is a group of explanatory variables. It is easy to see that,

$$L_i \equiv \ln\left(\frac{P_i}{1 - P_i}\right) = \beta^T X_i$$

However, we are using aggregate data for unions, by industry level. Therefore,we estimate P_i as the probability that a worker in industry i is a member of the union, where u_i is the number of workers that belong to the union in industry i and N_i is the total number of workers in that sector.

$$\hat{P}_i = \frac{u_i}{N_i}$$

Replacing $\hat{P}_i$ on the previous equation, we have:

$$\hat{L}_i = \ln\left(\frac{\hat{P}_i}{1 - \hat{P}_i}\right) = \beta^T X_i + u_i \tag{12}$$

In order to use the industry level information available, we use a panel data estimation.

4.6 A Panel Estimation

The data used in this work is on an industry specific basis. In order to use the extra structure provided by this format of the observations, a panel data estimation is used. Our panel has a 35 industry dimension and studies the period between 1973 to 1999. The panel is:

$$\begin{aligned} y_{it} &= X_{it}\beta + \epsilon_{it} \\ \epsilon_{it} &= c_i + u_{it} \end{aligned}$$

Where y is the dependent variable $\left(\ln\left(\frac{\hat{P}_j}{1-\hat{P}_j}\right)\right)$, X is the independent variable and the error term ϵ is composed of two different factors: u that is the error term and c that is the so called individual effect. The errors have the following structure:

$E[u] = 0$
$E[uu'] = \sigma_u^2 I_{nT}$
$E[c_i c_j] = 0, for\ i \neq j$
$E[c_i c_j] = \sigma_c^2$
$E[c_i u_{jt}] = 0$
$E[c_i] = 0$

As can be seen in the above structure it is assumed that the error term u has no correlation with the explanatory variables. In a later analysis we relax this assumption and allow the presence of endogenous variables requiring the use of instrumental variables.

In general, there are several different procedures to estimate a panel, but only the random and fixed effect estimators use the extra structure provided by the multi time cross section data. When you estimate a panel, you might be able to assume two different structures about the individual effect. The first option is to consider the case the individual effect is not correlated with the other explanatory variables X. In this case we say that we have random effects model.

$$E[c_i X_{it}] = 0 \tag{13}$$

The second case occurs when the individual effect and the explanatory variables are correlated, the fixed effects model.

$$E[c_i X_{it}] \neq 0 \tag{14}$$

The fixed effect estimator is consistent even when the true model is the random effects one, but it is not efficient. If the true model is the fixed effect one, the random estimator is not consistent.

The equation 12 encompasses different hypotheses presented in the literature to explain deunionization.

This is a panel with variables W, A, T and El being the explanatory variables and represent the wage premium, the technology, the globalization and institutional changes, respectively. We also use six demographic variables as explanatory variables. The variable c_i is an unobservable random variable and u_{it} is the error term. As it can be seen c is assumed constant over time and represents an individual industry specific effect.

4.7 Caveats

The estimation procedure of the model takes into account only the wage premium as an endogenous variable. However, we agree that at first glance all the variables may have some degree of endogeneity. This happens because some one can argue technology, trade and the number of elections can affect and be directed affected by the industry specific union rate. For that, some explanation about this choice must be given.

The number of elections held in the economy is a variable that affects all the industries at once. Despite the fact that it can also be affected by some individual industry, we believe this effect is just a marginal one and the number of elections can be considered an exogenous one.

The two trade variables used here as a measure of openness, the import penetration and the external trade industrial share may also be affected by the unionization rate in some industry. We agree that some unions may try to impose some imports restriction in some industries to protect jobs and union rents. However, we see this event much more as an employer pressure than an employee one. If you join this criticism the import penetration variable may have endogeneity. The external trade industrial share includes the exports in its measure. We do not know of any industry specific union movement that is against exports in that industry. Thus, we see this variable as an exogenous one.

The technology variable is another one that some may argue it is affected by union activity. However, as this variable is a result of investments that are made by employers, we do not see endogeneity as a problem here, either.

The relation between wages and union rates is a direct one and by no means avoidable. Therefore, we use instruments for this variable to correct for some endogeneity problems.

5 Results

We run two different sets of equations, one that does not include demographic variables and other that includes it.

The first set of results present the coefficients with no demographic variable. We observe that the openness variables, import penetration and the external trade industry share are always negative and significant. The number of union recognition election are also always significant and positive. However, its value is very small.

We also make use of other variables like: inventories and gdp measures per industry in order to study the cyclical effects over unions and the number of injuries in each sector.

The union wage premium variable was measured in two different ways. One that controls for individuals characteristics and other that does not. The uncontrolled measure is always positive and significant in the absence of demographic variables while the controlled one is always not significant despite of being positive. We also use wage premium lags to instrument these two variables. The results with instruments are the same obtained without it.

The second set of results is the one obtained with demographic variables in the logit regressions. These results change very little when compared with the ones without demographic variables.

The union wage premium is still positive for the controlled and uncontrolled measure. However, here, the controlled measure is always significant while the uncontrolled is always significant, a different result of the first set of results.

The two different openness measures used remain always significant and negative.

Another variable that is very robust across estimation methods is the number of union recognition election held each year. This variable is always positive and significant. However, its coefficient is still very small, being very close to zero.

The ratio of white workers per industry gives us evidence that higher ratio of white

workers affect unions negatively. The same happens with years of education, which is always negative and significant. However, its coefficient is very small.

The ratio of male, full time and of married employees is always positive and significant despite of the estimation procedure used.

The experience coefficients are also positive and significant. However, the coefficient is also very small like we observe with education.

The estimated coefficients on injuries, inventories and GDP are very small, and only the inventories coefficient is significant.

We use five different variables that measure technological change. We use technological gap, a SBTC variable, a multifactor productivity measure, labor and capital productivity.

The technological gap is always negative and significant. The multifactor productivity is also negative and significant, like the labor and the capital productivity. The SBTC, however, is never significant.

5.1 Logistic Results with no Demographic Variables

In the tables below we test the impact of different variables on unionization rates.

The variables used are the following: uwg represents the uncontrolled union wage premium, cwg the controlled wage premium, uinst the instrument for uncontrolled wage premium and cinst the instrument for controlled wage premium. We use five different technological measures: the technological gap in a sector(gap), skill biased technical change(sbtc), multifactor productivity(A), labor productivity(AL) and capital productivity(AK). We have two different measures of openness given by the external share$\left(\frac{X-M}{GDP}\right)$ (ext) and the import penetration(imp). We have a variable the measures the number of union recognition elections per year. .

The tables below we present for different groups. Group 1 includes wage premium, technological gap, external trade share and the number of union recognition elections. Group 2 includes wage premium, technological gap, import penetration and the number of union recognition elections. Group 3 includes wage premium, SBTC, external trade share and the number of union recognition elections. Finally, group 4 includes wage premium. SBTC, import penetration and the number of union recognition elections. On the top of each table we have 4 columns. The odd columns present the results with a random effect estimation while the even ones present the results with a fixed effect estimation. In the tables we also present the estimated coefficients and its marginal effect.

Table 3: Regression results with only economic variables.

	1		2		3		4	
group 1	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect
UWG	0,278*	0,320	0,285*	0,330				
	(0,086)		(0,086)					
UINST					0,279	0,322	0,296	0,344
					(0,140)		(0,141)	
GAP	-1,172*	-0,690	-1,202*	-0,699	-1,336*	-0,737	-1,375*	-0,747
	(0,172)		(0,172)		(0,182)		(0,182)	
EXT	-0,481*	-0,382	-0,486*	-0,385	-0,458*	-0,367	-0,463*	-0,371
	(0,070)		(0,070)		(0,069)		(0,069)	
EL	0,000*	0,000	0,000*	0,000	0,000*	0,000	0,000*	0,000
	(0,000)		(0,000)		(0,000)		(0,000)	
group 2								
UWG	0,277*	0,319	0,285*	0,330				
	(0,086)		(0,086)					
UINST					0,268**	0,307	0,285*	0,330
					(0,141)		(0,141)	
GAP	-1,220*	-0,705	-1,251*	-0,714	-1,338*	-0,738	-1,428*	-0,760
	(0,171)		(0,171)		(0,181)		(0,181)	
EXT	-0,666*	-0,486	-0,674*	-0,490	-0,639*	-0,472	-0,646*	-0,476
	(0,098)		(0,098)		(0,098)		(0,098)	
EL	0,000*	0,000	0,000*	0,000	0,000*	0,000	0,000*	0,000
	(0,000)		(0,000)		(0,000)		(0,000)	
group 3								
UWG	0,254*	0,289	0,260*	0,297				
	(0,088)		(0,089)					
UINST					0,235	0,265	0,250**	0,284
					(0,144)		(0,145)	
SBTC	-0,042	-0,041	-0,029	-0,029	-0,244	-0,217	-0,23	-0,205
	(0,410)		(0,410)		(0,441)		(0,441)	
EXT	-0,581*	-0,441	-0,588*	-0,445	-0,561*	-0,429	-0,568*	-0,433
	(0,070)		(0,071)		(0,070)		(0,070)	
EL	0,000*	0,000	0,000*	0,000	0,000*	0,000	0,000*	0,000
	(0,000)		(0,000)		(0,000)		(0,000)	
group 4								
UWG	0,252*	0,287	0,258*	0,294				
	(0,089)		(0,089)					
UINST					0,22	0,246	0,234	0,264
					(0,145)		(0,146)	
SBTC	-0,082	-0,079	-0,069	-0,067	-0,287	-0,249	-0,272	-0,238
	(0,412)		(0,412)		(0,442)		(0,442)	
EXT	-0,788*	-0,545	-0,799*	-0,550	-0,760*	-0,532	-0,772*	-0,538
	(0,100)		(0,100)		(0,100)		(0,100)	
EL	0,000*	0,000	0,000*	0,000	0,000*	0,000	0,000*	0,000
	(0,000)		(0,000)		(0,000)		(0,000)	

The (*) means that the coefficients are significant at 5%. The (**) means that the coefficients are significant at 10%.

The table above shows the uncontrolled wage premium and the number of union recognition elections are always positive and significant. However, the latter has a very small impact, with a marginal effect close to zero.

Both measures of openness are negative and significant in all estimates.

The technological measures have a very distinct impact. The technological gap is always significant and negative while the SBTC is always insignificant.

Table 4: Regression results with only economic variables.

	5		6		7		8	
group 1	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect
CWG	0,015 (0,072)	0,015	0,022 (0,072)	0,022				
CINST					-0,003 (0,137)	-0,003	0,016 (0,136)	0,016
GAP	-1,148* (0,173)	-0,683	-1,180* (0,173)	-0,693	-1,320* (0,182)	-0,733	-1,360* (0,183)	-0,743
EXT	-0,483* (0,070)	-0,383	-0,487* (0,070)	-0,386	-0,456* (0,069)	-0,366	-0,461* (0,069)	-0,369
EL	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000
group 2								
CWG	0,019 (0,023)	0,019	0,026 (0,072)	0,026				
CINST					-0,002 (0,137)	-0,002	0,017 (0,137)	0,017
GAP	-1,197* (0,172)	-0,698	-1,228* (0,172)	-0,707	-1,372* (0,182)	-0,746	-1,413* (0,182)	-0,757
EXT	-0,669* (0,099)	-0,488	-0,676* (0,099)	-0,491	-0,638* (0,098)	-0,472	-0,645* (0,098)	-0,475
EL	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000
group 3								
CWG	0,011 (0,074)	0,011	0,017 (0,074)	0,017				
CINST					-0,044 (0,141)	-0,043	-0,026 (0,141)	-0,026
SBTC	-0,084 (0,413)	-0,081	-0,070 (0,412)	-0,068	-0,271 (0,442)	-0,237	-0,255 (0,442)	-0,225
EXT	-0,580* (0,070)	-0,440	-0,588* (0,070)	-0,445	-0,588* (0,070)	-0,445	-0,566* (0,070)	-0,432
EL	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000
group 4								
CWG	0,015 (0,074)	0,015	0,022 (0,074)	0,022				
CINST					-0,043 (0,141)	-0,042	-0,026 (0,141)	-0,026
SBTC	-0,124 (0,414)	-0,117	-0,110 (0,413)	-0,104	-0,311 (0,443)	-0,267	-0,295 (0,443)	-0,255
EXT	-0,787* (0,100)	-0,545	-0,799* (0,100)	-0,550	-0,759* (0,100)	-0,532	-0,771* (0,100)	-0,537
EL	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000

The (*) means that the coefficients are significant at 5%. The (**) means that the coefficients are significant at 10%.

The above table replaces the uncontrolled wage premium measure showed in the previous one for a controlled measure. This replacement causes only one difference: the controlled wage premium is always insignificant despite its positive sign.

All the other coefficients remain with the same sign and significance.

5.2 Logistic Results with Demographic Variables

In the tables below we also test some demographic variables: percentage of whites(wh), percentage of full time workers(full), percentage of males(male), percentage of married workers, years of education(edu) and years of potential experience(exp). Finally we use the industry gdp and inventories to see how unionization rates responds to business cycles.

Once again the table shows the coefficients estimated and its marginal effects. Here, we also use more technological measures in order to observe the robustness of the results.

Table 5: Regression results with economic and demographic variables.

	1		2		3		4	
	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect
UWG	0,064	0,066						
	(0,132)							
CWG			0,127*	0,135	0,141*	0,151		
			(0,062)		(0,062)			
CINST							0,458*	0,581
							(0,114)	
GAP	-0,319**	-0,273	-0,329**	-0,280				
	(0,191)		(0,192)					
AL					-0,402*	-0,331	-0,529*	-0,411
					(0,206)		(0,263)	
EXT	-0,831*	-0,564	-0,825*	-0,562	-0,854*	-0,574	-0,840*	-0,568
	(0,108)		(0,107)		(0,107)		(0,109)	
EL	0,000*	0,000	0,000*	0,000	0,000*	0,000	0,000*	0,000
	(0,000)		(0,000)		(0,000)		(0,000)	
MALE	1,935*	5,924	1,967*	6,149	1,934*	5,917	1,940*	5,959
	(0,246)		(0,241)		(0,248)		(0,251)	
WH	-1,164*	-0,688	-1,032*	-0,644	-1,028*	-0,642	-1,095*	-0,665
	(0,324)		(0,330)		(0,033)		(0,338)	
EDU	-0,118*	-0,111	-0,120*	-0,113	-0,131*	-0,123	-0,132*	-0,124
	(0,037)		(0,037)		(0,038)		(0,040)	
EXP	0,018*	0,018	0,018**	0,018	0,018**	0,018	0,027*	0,027
	(0,009)		(0,010)		(0,010)		(0,010)	
MAR	1,079*	1,942	1,014*	1,757	1,162*	2,196	1,110*	2,034
	(0,202)		(0,206)		(0,182)		(0,183)	
FULL	1,015*	1,759	1,015*	1,759	0,961*	1,614	0,976*	1,654
	(0,283)		(0,278)		(0,271)		(0,272)	
GDP	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
	(0,000)		(0,000)		(0,000)		(0,000)	
INV	0,000*	0,000	0,000*	0,000	0,000*	0,000	0,000*	0,000
	(0,000)		(0,000)		(0,000)		(0,000)	

The (*) means that the coefficients are significant at 5%. The (**) means that the coefficients are significant at 10%.

The table above show that the openness, the number of union recognition elections and the technological measures behave in a very similar way as they do with no demographic variables.

The openness variables remain negative and significant, the number of union recognition elections are still positive and significant. However its marginal effect is virtually zero. Finally, the technological gap is once more negative and significant while the SBTC is again insignificant. The other technological measure used, the labor productivity, is negative and significant. The union wage premium shows a different pattern in the presence of demographic variables. In this case, only the controlled wage premium is significant while the uncontrolled one is not.

The ratio of white workers per industry gives us evidence that higher ratio of white workers affect unions negatively. The same happens with years of education that is always negative and significant. However, its coefficient is very small. The ratio of male, full time and of married employees is always positive and significant despite of the estimation procedure used. The experience coefficients are also positive and significant. However, the coefficient is also very small like we observe with education. The estimated coefficients on inventories and GDP are very small, and only the inventories coefficient is significant.

Table 6: Regression results with economic and demographic variables.

	5		6		7		8	
	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect
CINST	0,430* (0,114)	0,537	0,405* (0,113)	0,499	0,419* (0,113)	0,520	0,418* (0,113)	0,519
GAP								
SBTC							0,416* (0,313)	0,516
A	-1,164* (0,360)	-0,688	-1,112* (0,356)	-0,671				
AK					-0,296* (0,143)	-0,256		
IMP			-1,280* (0,155)	-0,722	-1,273* (0,156)	-0,720	-1,298* (0,156)	-0,727
EXT	-0,840* (0,109)	-0,568					-0,026* (0,007)	-0,026
EL	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000
MALE	1,934* (0,247)	5,917	1,998* (0,245)	6,374	2,031* (0,247)	6,622	2,080* (0,248)	7,004
WH	-1,067* (0,336)	-0,656	-1,095 (0,331)	-0,665	-1,129 (0,332)	-0,677	1,111 (0,334)	2,037
EDU	-0,013 (0,039)	-0,013	-0,150* (0,038)	-0,139	-0,154* (0,039)	-0,143	-0,141* (0,038)	-0,132
EXP	0,027* (0,010)	0,027	0,021* (0,010)	0,021	0,019** (0,010)	0,019	0,022* (0,010)	0,022
MAR	1,206* (0,186)	2,340	1,349* (0,174)	2,854	1,267* (0,172)	2,550	1,264* (0,173)	2,540
FULL	1,018* (0,270)	1,768	1.136* (0,259)	2,114	1,152* (0,260)	2,165	1,137* (0,261)	2,117
GDP	0,000 (0,000)	0,000	0,000 (0,000)	0,000	0,000 (0,000)	0,000	0,000 (0,000)	0,000
INV	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000	0,000* (0,000)	0,000

The (*) means that the coefficients are significant at 5%. The (**) means that the coefficients are significant at 10%.

This last table confirms the results presented in the previous tables.

We observe once more that the wage premium has a positive impact on union rates, all technological measures but SBTC are significant and all have a negative impact on union rates.

Both openness measures show a negative impact on unions despite the estimation method or other variables interaction.

The number of union recognition elections has a positive, significant but virtually zero effect on the unionization rates.

The demographic variables showed that the ratio of white and years of education have a negative impact on unions. However, the marginal impact of the ratio of white workers is higher than the average years of study on the union rate.

The ratio of male, married and full time workers have a positive impact on unions. Their marginal impact is also significant.

The number of years of experience has also a positive impact on the unionization

rates, However, its marginal effect os small.

Finally, unions do not appear to be affect by cycles. The impact of GDP and inventories on unionization rates is virtually zero.

6 Variance Analysis Decomposition

This section presents a variance decomposition analysis of the data to evaluate how much of the change in unionization rates can be explained by each variable.

This variance decomposition analysis is made by using the partial sum of squares of the variables in the model. First we obtain, the total that can be explained by the model. After that, we obtain how much each independent variable can explain of the change in the dependent one.

A summary table(shown below) reports the interval that each variable could account in the union membership decline.

6.1 Model without Demographic Variables

The table below shows the variance analysis decomposition for the model in the absence of demographic variables. As the table below shows the economic variables used can account for only a small part of the variance. The economic variables of the model explain between 10.7% to 12.1% of the variance in the unionization rate from 1973 to 1999.

Table 7: Variance Decomposition:Max and Min.

	exter		imp	
	min	max	min	max
Wages	0,388%	0,454%	0,388%	0,454%
Tech.	1,009%	2,460%	1,166%	2,620%
Election	7,869%	8,731%	8,138%	8,937%
External	0,822%	0,848%		
Import			0,459%	0,471%
Model	10,721%	12,084%	10,716%	12,147%

As it can be observed in the table above, the variables under study are able to account for only a small part of the decline in union membership in the US. The wage premium is the variable that has the smallest impact on it. Then we have the openness variables that also account for less than 1% of the change and is followed by the technological measure that accounts for a maximum of 2.6%. The union recognition elections held can account for a maximum of 8.9%.

Most of this decline is explained by the fixed and/or random effects that the panel analysis allow to bring to the table. This extra power provided by the panel analysis comes from the fact that now industry specific information is being used in the analysis. This can be observed in the very high R^2 obtained in the estimations when compared with R^2 obtained in pool ols regressions that do not take industry specific information into account.

So what is happening in a sectorial level that explains a larger part of the decline of unions? Unfortunately, we do not have an answer right away. We believe that a behavioral change against unions or other services provided by unions that are different across industries are good starting points.

6.2 Model with Demographic Variables

Due to the low explanation of the model without demographic variables, we also estimated the model with demographic variables in order to see if these variables can help account the unionization rate variance. The variables tested and the demographic variables can account for at least 60% of the total variance while industry specific effects account for less than 35%. This improvement is obtained from all variables but the wage premium. The four variables that represent the hypotheses tested in the previous section can account up to 38% of the total variation in the drop of the unionization rate. This represents more than 50% of the total variance that all variables in the model can account.

Table 8: Variance Decomposition:Max and Min.

	exter		imp	
	min	max	min	max
Wages	0,001%	0,788%	0,001%	0,788%
Tech.	5,255%	22,569%	5,255%	21,753%
Election	2,559%	10,603%	2,957%	11,163%
Male	15,488%	20,922%	16,989%	22,558%
White	2,459%	2,964%	2,654%	3,077%
Education	0,265%	0,865%	0,106%	0,448%
Experience	9,475%	13,044%	9,345%	12,569%
Married	1,773%	4,930%	2,022%	5,327%
Full	0,486%	1,657%	0,439%	1,665%
Inventories	0,618%	1,626%	0,557%	1,584%
External	1,145%	3,576%		
Import			0,524%	2,544%
Model	60,010%	62,332%	61,184%	63,270%

The addition of demographic variables also helped to increase the explanation power of the early variables. The wage premium explains a maximum of 0.8% of the variance. The number of union recognition elections explains a maximum of 11.2%. The technological variables can explain up to 22.5%, being the variable that explains most of this variance. The openness variables explain very little. The external trade share explains a maximum of 3.6% while the import penetration accounts for a maximum of 2.5%.

Among the demographic variables, the ratio of male and years of experience are the variables that explain the most with 20.9% and 13%, respectively. The ratio of married, white and full time workers and years of education also contributed in explaining the drop in unionization rates over the period. The same happened with the variation in

inventories.

In conclusion, the addition of demographic variables increased the power of the model in accounting the drop of union rates.

7 Conclusion

We have tested four different hypotheses suggested by the literature that try to explain the decline in union membership in the US. We estimate logistic regressions using a panel data estimation procedure. We estimate two different models: one with only the variables that represent the hypotheses being tested and other with the addition of demographic variables. Both estimation give us similar qualitative results. We conclude that the four hypotheses we have tested, namely: the decrease in the demand for union representation by the workers; the impact of globalization over unionization rates; technical change and changes in the legal and political systems against unions can not be rejected by the data.

We also use a variance analysis decomposition to study the impact of these variables over the drop in unionization rates. Once more, we analyze two different models: one that does not include demographic variables and other that does include it. We conclude that the amount of the change in unionization these economic(tested) variables can account is between 10% and 12% in the model without demographic variables while industry specific effects (random and/or fixed) account for around 80% of the total variation.

The model that includes demographic variables explains up to 63.3%. of the total variation in the unionization rates while industry specific (random and/or fixed) effects can account for around 35%. The tested variables accounts for between 10% and 35%.. In this case the four hypotheses tested can explain up to 50% of the total drop in unionization rates explained by the model.

Further research is needed in order to explain and account the deunionization in the US since industry specific factors seems to be important to account for the decline in rate of unionization observed in the data.

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Appendix A. Appendix A

We use the standard industry classification(SIC) to put all the different data sources in a compatible format. Since the SICs have changed along the years, we use three different SIC's to make all the data sample compatible. The different SICs cover the following periods: 1971-1982; 1983-1991 and 1992-2002.

The table below illustrates how the numbers indicated in each of the 35 industries used in our analysis have changed over the years.

Table A: Standard Industry Classification

Sic	Ind. Names	Morg. 92-02	Morg 83-91	Morg 71-82
1	Agriculture production	010	010	017
7	Agriculture services	030	020	018
10	Metal mining	040	040	047
12	Coal mining	041	041	048
13	Petroleum and natural gas	042	042	049
14	Nonmetallic mining	050	050	057
15	Construction	060	060	067-078
20	Food and Kindred products	100-122	100-122	268-298
21	Tobacco manufactures	130	130	299
22	Textile mill product	132-150	132-150	307-318
23	Apparel and other textile products	151-152	151-152	319-327
24	Lumber and wood products	230-241	230-241	107-109
25	Furniture and fixtures	242	242	118
26	Paper and allied prod.	160-162	160-162	328-337
27	Printing, publishing and allied ind.	171-172	171-172	338-339
28	Chemical and Allied ind.	180-192	180-192	347-369
29	Petroleum and coal prod.	200-201	200-201	377-378
30	Rubber and miscellaneous plastic product	210-212	210-212	379-387
31	Leather and leather products	220-222	220-222	388-398
32	Stone, clay, glass and concrete products	250-262	250-262	119-138
33	Primary metal ind.	270-280	270-280	139-149
34	Fabricated metal prod..	281-309	281-309	157-169
35	Machinery and computing equipment	310-332	310-332	177-198
36	Electrical mach., equip. and supplies	340-350	340-350	199-209
38	Prof. and photo equip. and watches	371-381	371-381	239-257
39	Misc. manufacturing ind.	391	391	259
41	Transport & storage	410-411	410-411	408-409
44	Water transportation	420	420	419
50	Durable goods	500-532	500-532	507-599
60	Banking	700	700	707
70	Restaurant and hotels	762-770	762-770	
371	Motor vehicles and motor vehicle equipment	351	351	219
372	Aircraft and parts	352	352	227
481	Telephone	441	441	448
483	Radio broadcasting and television	440	440	447
491	Electric light and power	450	460	467
492	Gas and steam supply systems	451	461	469

Source: Industry codes on http://beta.ipums.org/cps/codes/.

The adjustment with the data from the CID, BLS and OECD are done according to the name of the industries and the table above. Some industries in this table are not in the BLS and OECD data, have received the data from a broader industry disposable at the latter data. For example, SIC codes 371 and 372 received the data from transports.

In the construction of the openness variables, we made interpolation to complete the years that were not available. The data available contains the years: 1972, 1977, 1982, 1987, 1997-2002.