Outsourcing and Unionization: A tale of misallocated (resistance) resources.

Abstract.

While many believe unionization has little to gain by recent increases in outsourcing, this question has not been analysed systematically. In this paper, using a new dataset for US manufacturing from 1973 to 1994, we analyse the effect of outsourcing on unionization. Instrumental Variables estimation shows outsourcing contributes to higher quasi-rents and industry employment. We find the union wage premium of substitutable workers is not affected by the extent of outsourcing. However, unionized workers in jobs that are not substitutes of the tasks being outsourced gain from outsourcing. Finally, we find no support for the claim that outsourcing reduces unionization.

> "The largest employer in America is a temp agency now. So we have to figure out how to organize this segment, what the glue is... Not in my lifetime." A former organizing director of the American Federation of Labor-Congress of Industrial Organizations (AFL-CIO), cited in Herzenberg (2000).

Two major institutional changes are occurring under our eyes, namely the rapid dismantling of work organizations and the evolution of the boundaries of the firm. In U.S. private manufacturing the union membership density has more than halved, dropping from 38.9 to 18.2 percent from 1973 to 1994, and similar though less dramatic changes have been observed in Europe, Australia and Japan (Blanchflower and Freeman, 1992). Many observers have argued it is market competition that is mainly responsible for undercutting union labor in the wealthy OECD countries (Wood, 1994). Employers have contributed to this trend by investing heavily in avoiding unions (Freeman, 2005; Farber, 1990; Freeman, 1986). Indeed, there is little doubt that the pressure of the world economy has forced wholesale changes in the internal organization of the firm (Piore and Sabel, 1984).

A few of the most used strategies to face the increasing product market competition and the workers' organizations have been the substantial changes in work rules, the partial dismantling of internal labor markets with the exclusion of some activities and workers from the firm and the remarkable growth in the use of market-mediated employment arrangements, such as temporary labor and outsourcing (Autor, 2003;

Kochan, Katz and McKersie, 1994). According to this general argument the emergence of flexible work organization has hampered union organizing activities. While the diffusion of employment arrangements that are mediated through the market rather than through the firm (and the unions) poses tough challenges of how best to organize workers in non-standard employment relationships, there is still very little understanding of the way outsourcing threatens, if truly it does, the future of unionism. In a time in which there is a widespread feeling that US unionism needs additional knowledge to come out with new forms of unionism (Freeman, 2005), this paper aims to contribute to such a purpose.

We analyze if outsourcing is associated with the decline in unionization using a comprehensive data set for US three-digit manufacturing industries between 1973 and 1994. Because the decline occurred over decades, we require compatible data available annually over the whole period.[1] The data has been used elsewhere to capture important insights about the evolution of trade unionism (see Magnani and Prentice, 2003; Magnani and Prentice, 2006). The U.S. manufacturing sector over the last three decades provides a particularly good case study. Starting from the late 1960s the US manufacturing sector has witnessed substantial growth in the use of outsourced labor services, especially compared with total employment (see table 1). While in general outsourcing has grown at a brisk pace in all manufacturing industries, sizeable differences in outsourcing both across industries and across time remain and it is such variation that the empirical literature has exploited (e.g., Bartel el al., 2005; Magnani, 2006). To many observers the use of outsourced labor services has greatly contributed to the productivity recovery in US manufacturing in the late 1980s and 1990s (Siegel, 1995, ten Raa and Wolff, 2001). These stylized facts call for an evaluation of the effects of outsourcing on industry quasi-rents, labor productivity, employment, the union wage premium and unionization.

Some of the key findings of our study are the following. Outsourcing has con-

[1] This precludes the use of relatively detailed, but infrequently published data, such as that used by Bartel et al. (11).

tributed to higher quasi-rents and increased quasi-rents per plant. However it has not increased quasi-rents per employee because outsourcing has been accompanied by increased use of industry labor, which, with a visible increase in quasi-rents, has kept quasi-rents per employee stable. Despite the apparent lack of relationship between outsourcing and quasi-rents per employee, we find interesting differences in the way outsourcing impacts upon the union wage premium of workers with jobs similar to the task being outsourced and the union wage premium for other workers. While the premium of substitutable workers is not affected by the extent of outsourcing, we find evidence that unionized workers employed in jobs that are not substitutes of the tasks being outsourced gain from outsourcing. Finally, a set of tests on whether there is any *negative* relationship between unionization and the extent of outsourcing fails to find any support to this hypothesis.

These results drive our main conclusions according to which US manufacturing unions have misallocated their resistance resources. To be clearer, our results support those views in favor of an an alliance between unionized in-house employees and external workers (e.g., Hiatt and Jackson, 1997; Cobble, 1991) to share the increase in quasirents from outsourcing.

I. Labor organizing institutions and reorganized work.

There is widespread belief that from the 1970s the combination of globalization, increased domestic competition and a more volatile macroeconomic environment has created a demand by firms for much greater labor market flexibility than during the postwar boom of the 1950s and 1960s in all major industrialized countries, including the US, the European nations, Canada and Australia (Abraham, 1996; Segal and Sullivan, 1997; Blanchard *et al.* 1995).

Before proceeding, it is worthwhile expanding on what is meant by flexibility. Labor market flexibility is a multidimensional concept that in general measures the ability of the labor markets to rapidly respond and adjust to shocks. In recent times firms' demand for flexibility has translated into a demand for new work practices and

patterns, which aim to increase numerical flexibility i.e. ease in adjusting numbers and hours of employees, and functional flexibility, i.e. ease in adjusting the tasks performed by the organization or even individual workers, so to increase productivity while relaxing job security regulation (Osterman, 1999; Kalleberg, 2001). One of the ways in which firms have responded to competitive challenges to increase flexibility has been by changing the mix of employment arrangements. Tasks that were previously performed by workers directly hired by the firm were increasingly done under contract with firms in the business service sector and through employment arrangements that involved temporary workers and outsourcing (Autor, 2003).

The extent of the increase in the use of alternative employment arrangements is evident if we look at the striking performance of the US business service industry (Standard Industrial Classification code 73) in general, and by the performance of the Temporary Help Supply industry (SIC 736) in particular (reported in Magnani, 2006, Table xx). Magnani (2006) documents that between 1949 and 1998, the cost share of purchased services (outsourcing) grows from 4 percent to 12 percent. Interestingly, two studies find links between the rise of outsourcing and productivity growth. First, Siegel (1995) argues that improvements in manufacturing productivity cannot be explained by measurement errors but rather by outsourcing, an increase in the rate of investment in computers, and unmeasured changes in the quality of output and the labor force. Similarly, ten Raa and Wolff (2001), relate the recovery of standard TFP growth in manufacturing during the 1980s to an increased use of outsourcing of inputs from service industries as well as to technical change.

The ability of unions to cash part of these productivity gains depends largely on whether outsourced labor services and labor services provided by the internal permanent workforce are substitutes or complements. If there is substitutability between internal workers and outsourced labor services, outsourcing may affect internal workers' productivity by acting like a "worker's discipline device". Again, if the two labor inputs are substitutes, outsourcing may raise industry quasi-rents

but it will have a limited impact on the share of rents accruing to union members. In fact it could even be that employers use outsourcing to limit unions' wage demands — a variation on the outsourcing to limit labor costs hypothesis often explored in the literature (Abraham and Taylor, 1996). Kalleberg (2001) reviews the existing literature to find little consensus on the relationship between numerical and functional flexibility strategies firms have adopted in recent times. According to Lindbeck and Snower (2001), increased functional flexibility and reduced task specialization *among workers* within a firm has gone hand in hand with increased specialization in production *among firms*, a down-sizing process that involves more narrow focus on a firm's "core competencies" in production and the outsourcing of "non-core competencies".

These two sets of empirical evidence, the ones relating market-mediated employment arrangements to increased manufacturing productivity, and the ones confronting functional and numerical flexibility lead us to two overlooked aspects of the debate. First,to what extent union members (part of the stable component of the labor force) can benefit, if at all, from the firm's decision to outsource part of its activities. Second, to what extent unions as institutions are affected, or can affect, the use and effects of outsourcing.

A. What is Labor Organizations' Attitude Towards Work Reorganization? An Overview of the Evidence.

As highlighted earlier, one of the characteristics of the previous workplace organization in manufacturing was its high unionization - which has declined considerably since the 1970s (for a review of this issue see Magnani and Prentice (2003)). Where workplaces have remained unionized, these changes have posed considerable challenges to trade unions. Although it is not possible to summarize the complex findings of a large literature, it is important to stress that studies on the unions' reaction to the introduction of innovative workplace arrangements have greatly contributed to question the view, prevailing in the industrial relation system since World War II, according to which "management manages and the union grieves".[2]

Much less known is the unions' attitude towards the reorganization of the workplace that involves the use of market-mediated employment arrangements such as outsourcing. One approach has focussed on the threat to union power. As Perry (1997) clearly states, at the macro level the dimension of union power heavily depends on its degree of success in "taking labor out of competition" (*from outsourced*

[2]For instance, the reader is referred to Eaton and Voos (1989) who witness a variety of American union attitudes to "team production systems". There is evidence of mainstream unions having to innovate in contributing to the competitive advantage of the firms. For instance in the US steel industry the unions played a key role in the implementations of HPWO work systems (Osterman, 1999; p. 173).

labor services). If internal unionized labor services and outsourced labor services are highly substitutable, the long run effects of outsourcing may be reduced union wages, particularly if there are reductions in employment as well.

Rather different is the view that comes from seminal contributions on outsourcing. If we understand outsourcing, as Drucker (1995) and Quinn and Hilmer (1994) do, as a process of turning over a part or all of those functions (or skills) that fall outside the organization's chosen core competencies to an external supplier whose core competencies and skills are the functions being outsourced, outsourcing involves highly specialized activities. Since cost factors are not the only long term determinants of outsourcing and given the complementarity existing between core functions and non-core outsourced functions, unions should be able, at least in the short-medium run, to cash sizeable shares of the benefits from outsourcing. If unions are rent-extracting institutions, they should favor any change in the internal organization of the firm that leads to an increase in the quasi-rents produced.

Given the abundance of case studies in which outsourcing has led to legal confrontations between unions and management (reviewed in Miscimarra and Schwartz (1997)) it is obvious that there is much more at stake in the use of outsourced labor than simple efficiency gains at no cost for union members. The issue of how unions actually benefit if at all from the productivity gains, reflected in increased quasi-rents, made possible by the reorganization of the firm towards outsourcing is the object of investigation of the present study. In the next section we propose a theoretical framework to think about it.

II. Unionization and Outsourcing: A Theoretical Framework.

In this section we review the unions as rent-extracting institutions framework of Abowd and Farber (1990) and introduce and analyze the effects of outsourcing. For an industry with employment, N, and union membership, L, unionization, U, is the proportion of industry employment that are union members, $U = L/N$. In the standard model, unions maximize the share $Qh(U)$ of industry quasi-rents accruing to union members less organizing costs, where Q is industry quasi-rents and $h(U)$, with $0 < h(U) < 1$, is the function that yields the bargaining power of the union. Organizing costs are equal to $Lg(U, S)$. The per worker cost of organizing the industry, $g(U, S)$, depends positively on both unionization U and employer resistance S.[3]

[3] Abowd and Farber (1990) do not specify a functional form for $h(U)$ and $g(U, S)$.They assume the organization cost function $g(U, S)$ is increasing and convex in U and increasing and concave in S. Furthermore, they assume that the union bargaining power function $h(U)$ is increasing and concave in U. They also assume bargaining between the union and firm is strongly efficient. This

The definition of industry quasi-rents adopted here is both standard and suitable for estimation. As in Abowd (1989) and in Abowd and Allain (1996) industry quasi-rents is expressed as the sum of two items: union members' and shareholders' returns. Union members' returns is the excess of union labor costs over labor costs using a non-unionized work force, or $L(W - w)$, where W is the bargained wage, and w is the wage rate received if the workers were not unionized. Shareholders' returns is defined as profit (excluding capital costs), $[R - WL - w(N - L)]$, where R is total revenues. Thus, as in Abowd (1989) industry quasi-rents are $Q = [R - WL - w(N - L)] + L(W - w) = R - wN$, the value of revenues minus labor costs valued at the opportunity cost of a non-unionized worker's time.[4]

We now add outsourcing to this framework. Denote O as the share of workers that are outsourced. Both quasi-rents and organizing costs are assumed to have a positive relationship with outsourcing. The effect of outsourcing on union bargaining power will depend on the nature of outsourcing. If there is extensive outsourcing of substitute workers (which is the usual case considered), union bargaining power will fall. If complementary workers are outsourced, there may be no effect or may even increase the bargaining power of complementary workers (if they become more essential as a result of outsourcing). Formally, we write the problem that unions faced with outsourcing have to solve as:

$$\max_{U} Q(O)h(U, O) - NUg(U, S, O) \tag{1}$$

A union will have a benevolent attitude towards outsourcing if outsourcing increases quasi-rents without significantly decreasing union strength or increasing organizing costs. Abowd and Farber (1990) show that under certain conditions there is a positive relationship between unionization and quasi-rents. Thus, by increasing

implies that bargaining does not reduce the size of the total surplus i.e. the size of firm quasi-rents (Brown and Ashenfelter, 1986).

[4]Obviously the time dimension here is important, since in the very short run, most normal returns are quasi-rents. In other words, quasi-rents include the normal competitive return to the fixed assets in an industry if, as in the short/medium run, employers do not have the chance to protect the normal return component of the quasi-rents by transferring the assets to other industries. This is the time frame assumed in the analysis that follows as well as in Abowd (1989) and Abowd and Allain (1996).

quasi-rents, outsourcing may indirectly provide trade unions with growth opportunities.

Obviously a very different case arises if outsourcing increases industry quasi-rents but also reduces union bargaining power, $h(U, O)$, because outsourcing represents an implicit threat to regular, full time employees or because it increases organizing costs, reducing unionization. Union bargaining power may decrease because of the implicit (or explicit) threat to substitute away from regular full-time employees towards outsourced workers. Organizing costs may rise, as the workforce becomes more dispersed, less localized and less full-time. In these cases while outsourcing may increase the potential gains to union members by increasing quasi-rents Q, the ex-post realized gains $L(W-w)$ are reduced because of a smaller L or W or both. To see the effect on W, we start from the definition of the share of quasi-rents accruing to the union, $h(U, O)Q = L(W - w)$, and employing the definition of quasi-rents, $Q = R - wN$, the union wage W set by efficient bargaining can be written as:

$$W = w + h(U, O)\frac{R - wN}{L} \tag{2}$$

By (2) W increases with the bargaining power $h(U, O)$, lowering the share of quasi-rents accruing to the employer. Expression (2) makes it clear that if outsourcing sufficiently reduces unions' bargaining power, larger quasi-rents, through greater revenue or larger overall employment, may not lead to a higher union wage rate.

Finally, as has been highlighted in the theoretical literature on efficient bargaining (e.g. McDonald and Solow (1981)) unions can also be concerned about employment. While we will not formally consider this possibility, it is also possible that unions may wish to negotiate for higher employment as well as higher wages.

A. A Few Testable Empirical Implications on the Relationship between Outsourcing and Unionization.

The review of the literature and the model of the relationship between unionization, outsourcing and the outcomes of union bargaining suggests five relationships to investigate.

First, as any positive effects on unionization depend on outsourcing increasing

quasi-rents, we first test if there is any significant positive relationship between the two. Assuming that outsourcing has no direct impact on the price of output p or on the non-unionized wage w, outsourcing may increase quasi-rents by improving productivity resulting in increased output, Y. Employment, N, may rise or fall depending on whether the outsourced labor inputs are complements or substitutes for in-house labor services. In either case, quasi-rents will rise. The reduced form equation determining industry quasi-rents, denoted Q, is summarized below:

$$Q = f(p_x, w, C, T, O) \tag{3}$$

where, as suggested by the definition of quasi rents, we include p_x is the price of other inputs and w is the wage rate received if the workers were not unionized. Furthermore, economic theory suggests that quasi-rents also vary with competition, measured by the set of variables C, technological change over time, measured by the set of variables T, and outsourcing, measured by O.[5] We also consider two more measures of quasi-rents — quasi-rents per plant and quasi-rents per employee. While both of these variables are functions of the same variables as industry quasi-rents, each enables focussing on a particular aspect of the problem. Quasi-rents per plant is probably a more appropriate measure for analyzing the effect of competition, whereas quasi-rents per employee, q_e, is a more appropriate measure of what is bargainable for the union.

Second, to analyze the origins of any effect of outsourcing on quasi-rents we analyze the relationships between outsourcing, productivity and employment. Average labor product, AP, is modeled, as suggested by economic theory, as a function of capital, K, the non-unionized wage and the price of other inputs. As a substantial empirical literature suggests productivity is influenced by unionization, U, competition and technology so we include controls for these effects. The reduced form equation determining average product is summarized below:

$$AP = f(K, w, p_x, U, C, T, O) \tag{4}$$

[5]The variables we use to measure competition, technological change and outsourcing are discussed in detail in the data section.

Similarly economic theory and previous empirical work suggests employment, N, is related to capital, the price of output and inputs, including the non-union wage, as well as unionization, competition and technology, so a similar reduced form is summarized below:

$$N = f(K, p, w, p_x, U, C, T, O) \tag{5}$$

where p is the output price. We will test if outsourcing is significantly positively correlated with productivity or not, and whether there is a significant negative or positive relationship with employment. This effect of outsourcing on the industry employment level should not be apparent if outsourcing reduces unions' power for reasons other than the substitutability hypothesis.

In addition, we examine the effects of outsourcing on unionization. First, we consider the union wage premium $(W - w)/w$. If outsourcing does not affect bargaining power, then the wage premium will be a function of quasi-rents per employee but not outsourcing. In addition, we also include measures of unionization, and competition, to control for the effects these variables have on bargaining power. Note that if outsourcing has led to a reduction in unionization through increased organizing costs, then this will be picked up through the unionization variable. The general relationship is summarized below:

$$(\frac{W - w}{w}) = f(q_e, U, C, O) \tag{6}$$

where q_e is quasi-rents per employee. Finally, we examine if changes in outsourcing are directly correlated with unionization. To test this, we follow Magnani and Prentice (2003) and model unionization as a function of worker characteristics, domestic and international competition, quasi-rents per employee, technological change, with the addition of a measure of outsourcing. This reduced form relationship is summarized below:

$$U = f(WC, C, q_e, T, O) \tag{7}$$

where WC is a set of worker characteristics identified in the literature as being correlated with unionization.

To summarize, the results of regressions based on equations (3) - (7) will provide some indication of the effects outsourcing is having on the returns to unionization. The results of regression (3) -(5) suggest whether and how outsourcing is increasing the size of the pie to be bargained over - a source of a potential gain for the union. The results of regressions based on equation (6) and (7) suggest whether unions have been successful in bargaining for improvements in wages as a result of (or despite) outsourcing. The results of regression (7) indicate whether there is a direct relationship between unionization and outsourcing, controlling for other determinants of unionization.

III. The Data and Identification Issues.

The dataset for this paper is an unbalanced panel of three-digit US manufacturing industries observed annually from 1973 to 1994 (excluding 1981-1982). It is collected by the authors, mostly from five sources: (1) NBER Productivity Database (Bartelsman and Gray, 1996); (2) Current Population Survey (CPS); (3) Employment and Earnings (Bureau of Labor Statistics, various); (4) County Business Patterns (U.S. Census Bureau) and (5) KLEMS data set (Bureau of Labor Statistics). The reader is referred to Magnani and Prentice (2003)) and Magnani and Prentice (2006) for details on the data. Here suffice to say that no other dataset exists that would enable an analysis of outsourcing and unionization across a wide set of manufacturing industries. For this purpose we have construct a single compatible data set from different sources using different industry classification schemes that change over time. These problems are overcome in two steps. First, a single encompassing three-digit industry classification - the Extended Census Industry Classification (ECIC) - is constructed. Then, we construct, using concordances, aggregates compatible with the ECIC for variables over time across all sources, wherever possible.[6] With the three-digit ECIC as the unit of observation, we obtain an unbalanced panel of 1439 observations for roughly 72 industries per year from 1973 to 1980 and 1983 to 1994.

[6]For more details on the construction on the dataset see Appendix A of Magnani and Prentice (2003) or Magnani and Prentice (2001).

All variables used are defined, with descriptive statistics in Table 3. In what follows we discuss the construction of dependant variables and explanatory variables.

A. Dependant Variables.

In the various stages of the regression analysis we have used three sets of dependent variables that were not immediately available, or easily calculable, from the data collected, namely industry quasi-rents, union wage premiums and unionization.

Industry Quasi-Rents.

We use three versions of the quasi-rents variable. First, we estimate industry quasi-rents, $QUASI\text{-}RENTS_{jt}$, for industry j at time t as follows:

$$QUASI-RENTS_{jt}=\begin{matrix}Price*Shipments\text{-}(Cost\ of\ Materials\ and\ Energy)\ \text{-} \\ Employment*\widehat{w}_{jt}\end{matrix} \quad (8)$$

where $\widehat{w_{jt}}$ is the estimated non-union wage of the workers employed in industry j at time t.[7] All of the variables used to calculate industry quasi-rents except $\widehat{w}$, are obtained from the NBER Manufacturing Productivity Database (Bartelsman et al., 1996). We obtain the estimated industry specific non-union wage $\widehat{w}$ by running hourly wage regressions using CPS data of personal characteristics for all workers (both union and non-union members) X_{it} and a union coverage dummy variable $(coverage)_{it}$:

$$\log(hourly\ wage)_{it} = BX_{it} + C(coverage)_{it} + error\ term_{it} \quad (9)$$

where B and C are vectors of coefficients of variables that refer to individual i at time t.[8] We follow Card (1996) in the choice of the relevant individual specific variables X_{it}, which are race, gender, education (completed some college, did not complete high school), experience, experience squared (some of these are described in more detail below). We also add occupational dummy variables among the explanatory

[7] Note that this definition is consistent with Abowd (1989) and with the first definition of quasi-rents introduced by Abowd and Allain (1996).

[8] Reported hourly wages are used in the majority of cases. When the CPS individual does not report this, the ratio between weekly earnings and average weekly hours is used.

variables as the empirical literature shows occupation has a large impact on union-nonunion wage differentials (Lewis, 1986).[9] The vector of estimated coefficients $\widehat{B}$ for personal characteristics is used to predict individual specific non-union wages

$$\widehat{w}_{ijt} = \exp(\widehat{B}X_{ijt}) \tag{10}$$

The estimated $\widehat{w}_{ijt}$ is the wage individual i employed in industry j at time t would earn were trade unions absent. We compute average non-union wages, by industry, using the estimated individual $\widehat{w}_{ijt}$ of workers employed in each three-digit industry, weighted by their individual CPS weights.

We estimate QUASI-RENTS PER PLANT by dividing *QUASI-RENTS* by *NUMBER OF PLANTS*. QUASI-RENTS PER EMPLOYEE, is estimated by dividing *QUASI-RENTS* by 10,000**EMPLOYMENT*.

Union Wage Premium.

This is constructed as follows:

$$UNION\ WAGE\ PREMIUM_{jt} = \frac{W_{jt} - \widehat{w}_{jt}}{\widehat{w}_{jt}} \tag{11}$$

where W_j is the actual hourly union wage in industry j, calculated from the hourly wages reported for all workers covered by a union agreement from the CPS and $\widehat{w}_j$ is the estimated non-union wage for the workers covered by union agreement in industry j as described in the previous subsection. Individual CPS weights are again used to compute industry average rates from individual rates.

We also re-estimate separate union wage premiums, following the same steps, for two groups of workers, divided by occupation. The first group, referred to as the substitute workers, are those working in manufacturing whose occupations involve performing tasks similar to those that are outsourced such as cleaners and personal and protective service workers. The second group, referred to as the complement workers, are workers in all other occupations.[10] As before industry average rates for

[9] Dummy variables for industry of employment are not included in the wage regression. This choice is motivated by the fact that industry premiums may reflect rents and we aim to estimate opportunity cost wages net of rents.

[10] The two digit occupations classified as substitute workers are listed in the Appendix.

each group are calculated for each year. Estimates based on less than 30 observations are discarded - which means about 200 industry-year combinations are lost - with more lost before 1983.

Unionization.

The unionization rate variable in industry j at time t, $UNIONIZATION_{jt}$, is defined as the ratio of the number of workers covered by a trade union agreement over the total industry work force. This variable, and worker characteristics, are calculated from the CPS. We use the outgoing rotations for 1983-1994 and the May CPS for 1973-1980. The year 1981 is excluded because union status was asked only of a CPS May quarter sample. Furthermore, 1982 is also excluded because there were no union status questions in the CPS that year. To compute both the numerator and denominator of this ratio we use CPS individual weights ($weight_{ijt}$) for each individual i employed in industry j at time t. Thus

$$UNIONIZATION_{jt} = \frac{\sum_i (coverage)_{ijt} * weight_{ijt}}{\sum_i weight_{ijt}} \tag{12}$$

where $(coverage)_{ijt}$ is a dummy variable that takes value one if individual i employed in industry j at time t is covered by union contract, and zero otherwise. Because the NBER CPS extract only includes the union coverage variable from 1978 (though collected from 1977), we estimate unionization for 1973 to 1977 by using the ratio of union coverage to union membership in 1978 to scale up annual union membership rates, estimated from CPS data.[11]

B. The Explanatory Variables.

In this subsection, we discuss four sets of explanatory variables that require additional details on their construction: (1) Outsourcing; (2) Measures of Domestic and International Competition; (3) Technological Change; (4) Worker Characteristics.

Outsourcing.

Data on purchased services by manufacturing industries are drawn from the US

[11] There are very small differences in between the unionization rates published by the BLS and ours due to slight differences in sampling method (we select based on a valid union coverage variable). A table comparing the two over 1983-1997 is available from the authors upon request.

Bureau of Labor Statistics KLEMS dataset. Outsourced services fall into one of the following categories: Communication, Finance and Insurance, Real Estate and Rental, Personal and Repair Services, excluding autos, Business Services, Auto Repair and Services, Amusements, Medical and Education Services, Government Enterprises. For the US Information Technology has historically been the most important input acquired (OECD, 1986). The empirical specification uses a industry-level panel data set of 2-digit manufacturing industries (SIC 20–39) for which outsourced services are known between 1949 and 1999. The specific measure of outsourcing we use is the ratio of the value of purchased services to the value of output, denoted *OUTSOURCING SHARE*. By using this outsourcing measure merged with 3-digit manufacturing dependent variables, it is reasonable to assume that workers treat these measures of outsourcing as measures of risk of outsourcing rather than as resulting from endogenously determined strategies. This allows us to solve an important methodological difficulty often encountered in this type of exercises, namely the issue of how to identify the direction of causation between union density and outsourcing.

Measures of Competition.

To measure the extent of domestic competition, we use the industry-specific number of plants, *NUMBER OF PLANTS*, available on an annual basis from the County Business Patterns (coded following the SIC). Economic theory suggests that one reason for oligopoly is economies of scale. This suggests an inverse relationship between *NUMBER OF PLANTS* and concentration and indeed the two measures are negatively correlated (with $\rho \approx$ -0.45 for each year in which the concentration ratios are calculated).

The extent of foreign competition is estimated using trade penetration variables, calculated from the NBER Trade database. The industry-specific import penetration variable, *IMPORT SHARE*, is defined as the ratio of imports over the sum of imports and domestic production by industry. The export variable, *EXPORT SHARE*, is the ratio between export and domestic production (Feenstra, 1996; Feen-

stra, 1997).

Technological Change.

We use the share of scientists and engineers over total industry employment, Share of scientists, to proxy for technological change. Berman, Bound and Machin (1998) report strong evidence of pervasive skill-biased technological change in OECD countries. Table 3 confirms this view for the US manufacturing. Between 1973 and 1994 the share of scientists has risen by 109%. To compute the variable, *SHARE OF SCIENTISTS*, over the industry workforce, we use CPS weighted data on occupation.

Worker Characteristics.

CPS data and weights are used to estimate the share of black workers employed in industry j at time t, *SHARE OF BLACK*, the average age of the industry work force, *AVERAGE AGE*, the share of female employees, *SHARE OF WOMEN*, the share of employees younger than 30, *SHARE OF YOUNG*, the share of employees older than 40, *SHARE OF OLD*, the share of the work force with a college degree, *SHARE WITH COLLEGE*, the share of high school dropouts, *SHARE WITH* $<$ *HIGH SCHOOL*. Table 3 demonstrates that the main changes in worker characteristics are the increased share of female employees, the increased share of college educated workers and a slight rise in average age, which reflects the rise in the number of middle aged workers.

C. Identification Issues.

To ensure identification of our empirical specifications, we address three issues. First, in all specifications we attempt to control for two sources of unobservable variables - those that are industry specific (which we control through fixed effects), and those that vary over time (using time dummies). To assess the role these play in identification, for each equation we estimated four specifications, namely Specification I (Explanatory variables only); Specification II (Explanatory variables and industry dummy variables); Specification III (Explanatory variables and year

dummy variables); Specification IV (Explanatory variables and year and industry dummy variables).

In the end we report only the full set of specifications for the unionization regressions, but complete sets of results are available from the authors on request. All specifications in all tables are estimated using instrumental variables regression. Note that the regression on *UNIONIZATION* is estimated using weights so to yield an estimate for the average worker. Industry employment weights are calculated using CPS earnings weights for all individuals allocated to each industry.

Secondly, because the extent of outsourcing is likely to be correlated with unobservable factors that determine quasi-rents, employment, and possibly, unionization and the union wage premium, we use the outsourcing share at the two-digit rather than the three digit level. Industry wide outsourcing will be correlated with the extent of outsourcing in a particular industry but less likely to be correlated with unobservable shocks to the particular industry.

Thirdly, quasi-rents are unlikely to be exogenous when used in the unionization and union wage premium regressions (equations (6) and (7)). In addition, in equation (6), unobservable determinants of the wage premium are likely to be correlated with the extent of unionization. Furthermore, in the employment and productivity regressions (equations (4) and (5)), both *UNIONIZATION* and *ESTIMATED NON-UNION WAGE* are also likely to be correlated with unobservable shocks to textitEMPLOYMENT and *PRODUCTIVITY*. We deal with each of these issues by selecting appropriate instruments. We use the following instruments for quasi-rents: the prices of raw materials, energy and non-union labor and, following Ramey (1989), a set of instruments to capture macroeconomic driven fluctuations in rents: the real crude petroleum price, a set of political dummy variables (Republican government, first two years of government let by Democrats, first two years of government led by Republicans), real defense expenditure and real defense contracts. In addition we use import and export shares interacting with the prices of energy, raw materials and non-union labor. The same set of instruments, average worker characteristics, are

used for instrumenting for *UNIONIZATION* in the Union wage premium regression and the estimated non-union wage in the employment and productivity regressions.

IV. Results and Analysis.

Table 3, which is constructed using the data we use for the analysis, reports a set of striking changes affecting the US manufacturing sector from 1973 to 1994. First, there is the well known decline of unionization, from 46% to 20%. Simultaneously, the outsourcing share has risen from 7% in 1973 to 10% in 1994. The data also suggests striking increases in the extent of both domestic and international competition, with a 37% increase in the number of plants, a 146% increase in the import share and a 97% increase in the export share. Despite increased competition, quasi-rents per employee have increased substantially - especially during 1983-1994, a fact that may be due to improved productivity growth after the 1970s.[12]. Employment has remained roughly constant over this period, but, strikingly, there has been an increase in the unionization premium. With a substantial decline in the unionization rate, this could reflect either that only the strongest unions have survived over this period, or a reflection of the reorientation of unions to contribute to competitive advantage as suggested in Section II.

A. Did Outsourcing Increase Quasi-rents?

To address this question, we run three versions of equation (3) as described in section III.A. Selected results for the quasi-rents, quasi-rents per plant and quasi-rents per employee regressions are reported in columns two, three and four of Table 4, respectively. First, we review the effects of the controls and then discuss the relationship between outsourcing and the different measures of quasi-rents.

Across all three equations, the price variables and interactive terms are mostly insignificantly different from zero, with the exception of the estimated non-union wage for unionized workers. A statistically significant and positive coefficient of this

[12] A decomposition of quasi-rents in its components along the lines suggested by equation (8) shows that in spite of rising costs, primarily due to rising prices of raw materials and energy, it is the value of output, and specifically the volume of production, that drives quasi-rents upward.

variable in the quasi-rents regression (and again in the quasi-rents per employee regression) is consistent with the view that competitively determined higher non-unionized wages are associated with higher productivity and therefore quasi-rents. While the measure of domestic competition, *NUMBER OF PLANTS*, is positively correlated with *QUASI-RENTS*, it significantly reduces *QUASI-RENTS PER EMPLOYEE* in the entire range of variation of this variable. It is possible that the positive correlation could result from increased specialization across plants. Strikingly the measures of international competition are all statistically significant. *EXPORT SHARE* is positively correlated with quasi-rents while *IMPORT SHARE* is negatively correlated with quasi-rents — consistent with competitive importing. Finally the control for technological change, *SHARE OF SCIENTISTS*, is significantly positively correlated with *QUASI-RENTS* and *QUASI-RENTS PER EMPLOYEE*, but not *QUASI-RENTS PER PLANT*. This result and the result for *ESTIMATED NON-UNION WAGE* suggests that industries with a higher share of research workers expand the number of plants (and possibly increase plant specialization) until the increase in quasi-rents is dissipated.

Given that the above mentioned variables have the expected impact on quasi-rents we now turn to the outsourcing variable. Remarkably, Table 4 shows that *OUTSOURCING SHARE* is significantly positively correlated with *QUASI-RENTS* and *QUASI-RENTS PER PLANT*, but insignificantly related to *QUASI-RENTS PER EMPLOYEE*. A possible explanation of such a result is that the increase in quasi-rents is dissipated through a rise in employment, an hypothesis that we examine in the next section.

B. Did Outsourcing Affect Productivity and Employment?

To address this question, we review the results of regressing *PRODUCTIVITY* and *EMPLOYMENT* on outsourcing and a set of controls, as specified in equations (4) and (5). The results are summarized in Table 5. First, reviewing the controls reveals input price effects across the two regressions are consistently as expected. For example, the sign on the *ESTIMATED NON-UNION WAGE* is negative (though

insignificantly different from zero) and there is a significant positive relationship between this price and *PRODUCTIVITY*, suggesting *PRODUCTIVITY* rises as employment falls. Although the raw materials and energy prices have opposite effects on *PRODUCTIVITY*, negative and positive respectively, *PRICE OF RAW MATERIALS* has the expected positive impact on *EMPLOYMENT*, implying raw materials and labor are substitutes. *PRICE OF SHIPMENTS* is surprisingly negatively correlated with *EMPLOYMENT*, a result that cannot be easily attributed to changes in the market structure as we control for domestic and foreign competition. The *IMPORT SHARE* is significantly negatively correlated with both *EMPLOYMENT* and *PRODUCTIVITY*. *EXPORT SHARE* and *PRODUCTIVITY* (though not *EMPLOYMENT*) are significantly positively correlated. This is consistent with exporting taking place from high productivity industries, and imports gaining share from low productivity industries. As expected *CAPITAL* has positive significant effects on both *EMPLOYMENT* and *PRODUCTIVITY*. *UNIONIZATION* does not significantly affect *EMPLOYMENT* but does have a mildly significant positive relationship with *PRODUCTIVITY*. This is consistent with the view according to which "Unionism per se is neither a plus nor a minus to productivity" (Freeman, 2005).

As discussed in section II.A above, if there is complementarity rather than substitutability between in-house labor services and outsourced labor inputs, outsourcing should increase quasi-rents by increasing revenues rather than by reducing employment. Table 5 shows that *OUTSOURCING SHARE* has a significant positive effect on *PRODUCTIVITY*, consistent with the effects on quasi-rents, but (more surprisingly) it also *increases EMPLOYMENT*. This result, not only denies support to the hypothesis of substitutability between the internal and the external labor services, but it also suggests that outsourcing enables the firms to hire more labor. This raises the following important question.

C. Did Outsourcing Affect the Returns to Unionization?

The results for the effects of outsourcing on the returns to unionization are con-

tained in Table 6. First we consider the effect on the union wage premium for all workers in the second column of this table. Strikingly, there is a statistically significant positive correlation between the *UNION WAGE PREMIUM* and *OUTSOURCING SHARE*, after controlling for the size of the quasi-rents. We then re-estimate the equation using as a dependant variable *UNION WAGE PREMIUM* for substitute workers and complement workers. These results are reported in the third and fourth columns. Remarkably, and consistently with our expectations, a *OUTSOURCING SHARE* is significantly positively correlated with *UNION WAGE PREMIUM* for the complementary workers but not for the substitute workers. Before discussing this result in detail, we test the reliability of these results by discussing the effects of the controls.

For the all-workers regression, surprisingly *UNIONIZATION* has no significant effect on *UNION WAGE PREMIUM*. However for both the two sub-samples, *UNIONIZATION* does have an effect. For substitute workers, at unionization rates below 38%, greater unionization is associated with lower wage premiums, suggesting the union trades off wages for other benefits in bargaining. At unionization rates, above 38% *UNIONIZATION* has the expected positive effect. For other workers, *UNIONIZATION* has a significant positive relationship with the wage premium over almost the entire range of variation of the union variable, as the turning point occurs at a unionization rate of 90%. Notably, these findings are consistent with Blanchflower and Bryson (2004)'s finding according to which there is no single union wage effect, but a set of effects that depend on worker and sectoral characteristics. *QUASI-RENTS PER EMPLOYEE* have a positive effect on the wage premium of substitute workers and a positive (at a declining rate) effect on the wage premium of other workers. While in the aggregate *IMPORT SHARE* has no effect, this variable is positively correlated with the union wage premium in the two subsamples. Such results could indicate the existence of a reverse causation effect, from high union wage premiums to high import share or that this variable is picking up the greater returns from using imported inputs, in addition to the effects on quasi-rents. It is

important to note that the literature has found considerable variation in the relationship between union wage premiums and import competition (Blanchflower and Bryson, 2004).*EXPORT SHARE* is only significantly positive at the aggregate level - although it is not for the two subsamples. *NUMBER OF PLANTS* also has a positive effect on the union wage premium (except at very high plant numbers).

Undoubtly, the most striking result is the positive relationship between *OUTSOURCING SHARE* and the union wage premiums, in both the all worker regression and the complement workers regression. There are two possible interpretations for this result. First, outsourcing reduces the bargaining power of unionized substitute workers, but not for unionized complement workers. Second, outsourced labor increases the marginal productivity of complement unionized labor, who bargain for higher wages. Clearly, we cannot easily discriminate between these two, not necessarily, conflicting explanations, because we do not observe the output or the productivity of these groups of workers. However, this set of results challenge us to address the following question.

D. Did Outsourcing Affect Unionization?

The results for the *UNIONIZATION* regressions, reported in Table 7, are organized in four columns, which refer to four different specifications of the regression equation. Interestingly, the full specification, with industry fixed effects and time dummy variables (Specification IV in the fifth column), suggests that there is no significant relationship between *UNIONIZATION* and *OUTSOURCING SHARE*. Before discussing this striking result, we first review the effects of the industry and time dummies. Without industry and time dummies, the variables selected to reflect quasi-rents and international competition are significantly related (in varying degrees) with *UNIONIZATION*. However, the inclusion of both sets of dummies rendered the coefficients of these variables and the coefficient of the outsourcing share insignificantly different from zero. For other variables, such as the *NUMBER OF PLANTS*, technological change and worker characteristics variables, the signs and (to a lesser extent) significance vary across specifications. In specification IV,

the *NUMBER OF PLANTS* is negatively correlated with *UNIONIZATION* but the *NUMBER OF PLANTS SQUARED* is significantly positively correlated with *UNIONIZATION*, suggesting a U shaped relationship. The signs of the worker characteristics variables, are in most cases, consistent with their effects in individual unionization regressions (see Magnani and Prentice (2003) for details). *SHARE OF SCIENTISTS* has a significantly negative effect on *UNIONIZATION*, suggesting falling (or always low) unionization in the more research-intensive sectors of manufacturing. The main conclusion we draw from this set of results is that, although the preceding results showed some gains from outsourcing, these gains do not appear to have been utilized to preserve unionization. Furthermore, it confirms that, unlike the popular perception, outsourcing has not been behind the decline of unionization in U.S. manufacturing. The decline cannot, as argued in Magnani and Prentice (2003), be explained as a simple function of a small number of changes. Neither globalization or domestic outsourcing are unambiguous causes.

V. Conclusions.

While unions have been actively involved in the substantial reorganization of the workplace in the late twentieth century, the widespread evidence suggests that there has been union resistance to firms adopting outsourcing. And this strategy would seem sensible if outsourced workers were substitutes rather than complementary to the permanent unionized labor. Using a newly compiled dataset, we demonstrate that outsourcing has been associated with higher quasi-rents per plant but not with higher quasi-rents per employee, which is suggestive of greater employment per plant. Outsourcing is (robustly) positively associated with a rise in the wage premium to union membership, a result consistent with outsourcing increasing the productivity of the unionized permanent workforce following the outsourcing of complementary services. Furthermore, we demonstrate no statistically significant relationship between unionization and outsourcing — neither positive or negative.

The substantial decline in unionization over the period of interest suggests some

qualifications to these conclusions. In particular, it could be the case that where unions survived, outsourcing was restricted to complementary services. Possibly elsewhere outsourcing substituted for the workers no longer represented by the union. The results on employment though suggest that outsourcing was positively associated with employment levels and changes in industry employment, which reduces the likelihood of the latter story.

Our analysis of the gains to unionization suggest that union resistance to outsourcing may have been misplaced. While we fail to find any correlation between union and outsourcing, our results warrant that there is space for an alliance between unionized internal workers and external workers to share the quasirents that outsourcing increases. This would go in the direction that US unions seem already interested in taking. This is not to say that organizing the contingent workforce segment of the labor force is an easy task. In fact it may imply the full consideration of what material conditions numerical flexibility implies, namely income uncertainty, precariousness and skill flexibility, aspects that our study is unable to address.

APPENDIX - Occupations selected as substitutes for outsourced services

Table A lists all of the two-digit Census occupations classified as, in manufacturing, being substitutes for outsourced services. All other occupations are classified as being complementary. There are two features to note about this list. First, while we classified all occupations in the CPS, for programming convenience, it is clear that only some occupations will be represented in our sample. This is because we only consider employees in manufacturing, where some of the listed occupations, such as college and university teachers, are absent. Second, note that in general, the 1980 classification is more detailed than the 1970 classification. However, the 1970 classification contains several classes that appear to be more detailed that the 1980 match. For example, the 1970 class"Other professionals" includes the more detailed 1980 class of "College and university teachers".

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Table 1: Employment levels in the US business service sector and its sub-sectors in 1972 and 2000 and percentage rate of change between 1972 and 2000

Industry	1987 SIC	Employment		% Change
		1972	2000	
Business Services	73	1491	9858	561.2
Advertising	731	122	302	147.5
Credit Reporting and Collection	732	76	158	107.9
Mailing, Reproduction and Stenography	733	82	328	300.0
Services to buildings	734	336	994	195.8
Personnel Supply Services	736	214	3887	1716.4
Computer and Data Processing Services	737	107	2095	1857.9
Engineering and Architectural Services	871	339	1017	200.0
Accounting, Auditing and Bookkeeping	872	204	669	227.9
Total Employment - Services		50007	106050	112.1
Total Employment - Nonfarm		73675	131759	78.8

Source: Data are in thousands and come from the Bureau of Labor Statistics.
SIC= Standard Industrial Classification code.

Table 2: Cost share of purchased services in US manufacturing, 1949-1998

Year	1949	1957	1967	1972	1979	1982	1988	1992	1998
Cost share	0.044	0.055	0.072	0.073	0.079	0.080	0.096	0.11	0.12

Source: Bureau of Labor Statistics (KLEMS data set).

TABLE 3: THE DATA— DEFINITIONS

Name of Variable	Definition
UNIONIZATION	Share of employees covered by collective bargaining agreement (CPS)
SHARE OF BLACK	Share of employees that are black (CPS)
AVERAGE AGE	Average age of all employees (CPS)
SHARE OF WOMEN	Share of female employees (CPS)
SHARE OF YOUNG	Share of employees with age less than 30 (CPS)
SHARE OF OLD	Share of employees with age more than 40 (CPS)
SHARE WITH COLLEGE	Share of employees with a college degree (CPS)
SHARE WITH < HIGH SCHOOL	Share of employees with less than high school degree (CPS)
NUMBER OF PLANTS	Number of plants (CBP)
EXPORT SHARE	Exports/domestic output (NBER Trade)
IMPORT SHARE	Imports/(domestic output + imports) (NBER Trade)
SHARE OF SCIENTISTS	Share of employees scientists or engineers (CPS)
EMPLOYMENT	Number of employees (in 10000s) (NBER)
PRODUCTIVITY	Real shipments divided by Employment (NBER)
OUTSOURCING SHARE	Ratio of values of purchased services to output (KLEMS)

(a) CBP denotes County Business Patterns, NBER MP and Trade denotes NBER Manufacturing Productivity and Trade Databases respectively. CPS data is from outgoing rotations (1983-1994) and May CPS (1973-1980).

TABLE 3A: THE DATA— SUMMARY STATISTICS(a)

	Whole Sample				1973 Only		1983 Only		1994 Only	
	Mean	Std.dev	Min	Max	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev
UNIONIZATION	0.31	0.17	0.02	1	0.46	0.17	0.31	0.14	0.20	0.12
QUASI-RENTS(b)	923.5	881.4	36.6	5762.0	778.5	693.0	828.4	762.1	1181.0	1198.1
QUASI-RENTS PER EMPLOYEE(c)	4.6	4.2	1.0	49.5	3.6	2.3	4.2	3.0	6.2	5.9
QUASI-RENTS PER PLANT(d)	67.1	136.5	1.51	1541.5	57.0	89.5	58.8	111.1	80.8	171.0
NUMBER OF PLANTS	4469.2	6841.1	76	55628	3708.8	5052.7	4463.9	6813.7	5085.9	8216.9
EXPORT SHARE	0.09	0.08	0.0002	0.41	0.06	0.06	0.08	0.07	0.12	0.09
IMPORT SHARE	0.11	0.11	0.0003	0.71	0.06	0.06	0.09	0.08	0.16	0.15
SHARE OF SCIENTISTS	0.04	0.05	0	0.37	0.03	0.04	0.05	0.05	0.06	0.07
OUTSOURCING SHARE	0.08	0.04	0.02	0.50	0.07	0.03	0.08	0.04	0.10	0.05
EMPLOYMENT	240.8	237.2	19.5	1251.1	250.1	243.8	231.5	229.4	234.2	238.5
ESTIMATED NON-UNION WAGE ($\widehat{w}$)	758.0	267.2	259.7	1580.3	359.6	44.1	774.7	97.5	931.2	77.8
UNION WAGE PREMIUM	0.10	0.16	-0.45	1.03	0.07	0.14	0.11	0.15	0.28	0.20
PRODUCTIVITY	155.2	169.79	5.6	1703.8	122.8	122.7	141.9	137.7	206.6	219.1
SHARE OF WOMEN	0.30	0.16	0	0.90	0.27	0.17	0.30	0.16	0.30	0.14
AVERAGE AGE	38.3	2.1	30.1	48.5	38.4	2.40	38.3	1.90	38.9	1.89
SHARE WITH COLLEGE	0.29	0.14	0	0.77	0.20	0.10	0.29	0.12	0.41	0.14

(a) For all variables there are 1439 observations.

(b) Units for *QUASI-RENTS* is $10 million dollars (real)

(c) Units for *QUASI-RENTS PER EMPLOYEE* is $10,000 per employee (real).

(d) Units for *QUASI-RENTS PER PLANT* is $100,000 per plant (real).

Table 4: Instrumental Variables Regressions of Quasi-rents
Quasi-Rents Per Plant and Quasi-rents Per Employee

Selected explanatory variables *(a)*	Quasi-rents	Quasi-rents per plant	Quasi-rents per employee
PRICE OF RAW MATERIALS	-41.559	14.569	-0.326
	(125.923)	(23.979)	(0.766)
PRICE OF ENERGY	-111.707	49.565	1.113
	(160.317)	(30.528)	(0.975)
ESTIMATED NON-UNION WAGE	0.405**	-0.046	0.0019*
	(0.166)	(0.032)	(0.001)
NUMBER OF PLANTS	0.081***	-0.0032	-0.0003***
	(0.017)	(0.0032)	(0.0001)
NUMBER OF PLANTS SQUARED	1.11e-07	6.27e-08	4.11e-09***
	(2.05e-07)	(3.90e-08)	(1.25e-09)
IMPORT SHARE	-1748.267***	-353.118***	-9.501***
	(537.015)	(102.260)	(3.268)
EXPORT SHARE	2090.883***	393.052***	9.858***
	(498.449)	(94.916)	(3.033)
SHARE OF SCIENTISTS	756.804**	-25.927	70.344***
	(311.120)	(59.245)	(1.651)
OUTSOURCING SHARE	1925.698***	2367.559***	1.171
	(271.398)	(51.681)	(1.893)
CONSTANT	-1065.299***	-110.281***	0.649
	(201.660)	(38.401)	(1.227)
Number of observations	1439	1439	1439
F-Test	212.42***	137.72***	125.40***

All regressions include time and industry fixed effects, and use annual observations from 1973-1980 and 1983-1994. Standard errors are in parentheses.
*, **, *** indicate statistical significance at the 10%, 5% and 1%, respectively.
Notes: *(a)* Interactions between import share and input prices as well as export share and input prices are included among the explanatory variables.
These results are available upon request.

Table 5: Instrumental Variables Regressions of Productivity and Employment

	Productivity	Employment
ESTIMATED NON-UNION WAGE	0.11**	-0.078
	(0.051)	(0.049)
UNIONIZATION	-451.759	-319.422
	(290.803)	(282.025)
UNIONIZATION SQUARED	518.973*	215.908
	(305.208)	(295.995)
CAPITAL	0.003***	0.003***
	(0.0005)	(0.0005)
PRICE OF SHIPMENTS	-9.297**	-31.778***
	(4.721)	(4.579)
PRICE OF RAW MATERIALS	-144.831***	47.260**
	(25.289)	(24.719)
PRICE OF ENERGY	73.957**	-33.806
	(30.470)	(29.550)
IMPORT SHARE	-71.187**	-317.105***
	(29.880)	(28.978)
EXPORT SHARE	107.798*	10.787
	(61.709)	(59.845)
NUMBER OF PLANTS	-0.019***	0.022***
	(0.004)	((0.004)
NUMBER OF PLANTS SQUARED	1.65e-07***	-9.21e-08**
	(4.38e-08)	(4.25e-08)
SHARE OF SCIENTISTS	-34.498	22.637
	(64.623)	(62.673)
OUTSOURCING SHARE	233.881***	99.246*
	(57.781)	(56.037)
CONSTANT	297.64***	-70.008
	(56.499)	(54.793)
Number of observations	1439	1439
F-Test	302.37***	449.66***

All regressions include time and industry fixed effects, and use annual observations from 1973-1980 and 1983-1994. Standard errors are in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1%, respectively.

Table 6: Instrumental Variables Estimation of Union Wage Premiums
For all workers, substitute workers and complement workers

Explanatory Variables	All	Substitute workers	Complement workers
UNIONIZATION	0.171	-0.689**	1.849***
	(0.726)	(0.309)	(0.297)
UNIONIZATION SQUARED	0.285	0.903***	-1.179***
	(0.704)	(0.316)	(0.249)
QUASI-RENTS PER	0.028	0.037***	0.041***
EMPLOYEE	(0.022)	(0.011)	(0.010)
QUASI-RENTS PER	-0.002***	-0.0004	-0.001***
EMPLOYEE SQUARED	(0.0006)	(0.0003)	(0.0003)
IMPORT SHARE	0.077	0.305***	0.158**
	(0.117)	(0.083)	(0.076)
EXPORT SHARE	0.647***	-0.047	0.062
	(0.230)	(0.143)	(0.137)
NUMBER OF PLANTS	4.96e-06	0.00002***	0.00002***
	(0.00001)	(7.56e-06)	(7.00e-06)
NUMBER OF PLANTS SQUARED	-5.36e-11	-3.35e-10***	-2.63e-10***
	(1.61e-10)	(9.28e-11)	(8.12e-11)
OUTSOURCING SHARE	4.737***	-0.633	1.295**
	(1.420)	(0.688)	(0.642)
CONSTANT	-0.105	0.073	-0.309**
	(0.258)	(0.109)	(0.130)
Number of observations	1439	1217	1296
F-Test	9.90***	19.47***	36.76***

All regressions include time and industry fixed effects, and use annual observations from 1973-1980 and 1983-1994. Standard errors are in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1%, respectively.

Table 7: Weighted Instrumental Variables Estimation of Unionization

Explanatory variables	No Fixed Effects	Industry Fixed Effects Only	Year Fixed Effects Only	Industry and Year Fixed Effects
QUASI-RENTS PER EMPLOYEE	0.081***	-0.033***	-0.006	0.014
	(0.020)	(0.009)	(0.023)	(0.014)
QUASI-RENTS PER EMPLOYEE SQUARED	-0.001	0.001***	-0.001	-0.0003
	(0.0009)	(0.0003)	(0.0008)	(0.0004)
SHARE OF BLACK	-0.409***	-0.096	0.321*	0.079
	(0.120)	(0.072)	(0.181)	(0.049)
AVERAGE AGE	0.017	0.012***	0.030**	0.011***
	(0.015)	(0.004)	(0.012)	(0.003)
SHARE OF WOMEN	-0.315***	-0.140***	-0.376***	-0.117**
	(0.038)	(0.053)	(0.040)	(0.047)
SHARE OF YOUNG	0.550**	0.150**	-0.907***	-0.063
	(0.273)	(0.072)	(0.304)	(0.067)
SHARE OF OLD	0.843**	0.032	-0.558	-0.219***
	(0.332)	(0.084)	(0.361)	(0.067)
SHARE WITH COLLEGE	-1.273***	-0.086	-0.229	-0.162***
	(0.218)	(0.056)	(0.267)	(0.043)
SHARE WITH < HIGH SCHOOL	0.124	0.393***	-0.347***	-0.052
	(0.131)	(0.045)	(0.126)	(0.055)
NUMBER OF PLANTS	-4.82e-07	-0.00001***	-6.19e-06***	-4.05e-06
	(1.94e-06)	(3.84e-06)	(1.71e-06)	(2.99e-06)
NUMBER OF PLANTS SQUARED	6.85e-11*	1.07e-10***	4.81e-11**	5.68e-11*
	(3.71e-11)	(4.08e-11)	(2.31e-11)	(3.04e-11)
IMPORT SHARE	0.273***	-0.182***	0.147***	-0.005
	(0.063)	(0.059)	(0.055)	(0.046)
EXPORT SHARE	0.026	0.153**	-0.398***	0.035
	(0.084)	(0.072)	(0.098)	(0.063)
SHARE OF SCIENTISTS	1.111***	-0.329***	-0.610	-0.193**
	(0.318)	(0.115)	(0.402)	(0.080)
OUTSOURCING SHARE	-0.238	-1.098***	2.207***	0.046
	(0.707)	(0.218)	(0.663)	(0.381)
CONSTANT	-0.555	-0.308**	-0.035	-0.029
	(0.609)	(0.149)	(0.455)	(0.116)
Number of observations	1439	1439	1439	1439

Annual observations from 1973-1980 and 1983-1994 are used. Standard errors in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1%, respectively.

Table A: Census Occupations classified as equivalent to those in outsourced services.

1970 Classification		1980 Classification	
Two Digit Code	Name	Two Digit Code	Name
01	Engineers	03	Management related occupations
02	Physicans etc.	04	Engineers
03	Health workers	05	Mathematical and computer scientists
04	Teachers, excl college	06	Natural scientists
05	Engineering and science technicans	07	Health diagnosing occupations
		08	Health assessment and treating occupations
06	Other professionals (salaried)	09	College and university teachers
		10	Teachers, excl college and university
07	Other professionals (self employed)	11	Lawyers and judges
		12	Other professional speciality occupations
14	Bookkeepers	13	Health technologists and technicans
15	Office machine operators	14	Engineering and science technicans
16	Stenographers etc.	15	Technicans excl health, engineering and science
17	Other clerical workers	23	Secretaries etc
23	Mechanics - auto	24	Financial records, processing occupations
24	Mechanics excl auto	25	Mail and message distributing
37	Cleaning services	26	Other administrative support occupations
38	Food service	27	Private household service occupations
39	Health service	28	Service occupations excl. protection and household
40	Personal service	29	Food service occupations
41	Protective service	30	Health service occupations
		31	Cleaning and building service occupations
		32	Personal service occupations
		33	Mechanics and repairers