Industry Performance and Wages in the Era of Declining Unionization

by

Murat Sokmen

Dissertation

Presented to the University of Dublin, Trinity College

in fulfillment of the requirements for the Degree of

Master of Science in Economics

June 2013

DECLARATION

I hereby declare that the dissertation "Industry Performance and Wages in the Era of Declining Unionization" which is being submitted in partial fulfilment of the requirement of the course leading to the award of Degree of Master of Science in Economics, with Trinity College Dublin is the result of the study carried out by me under the guidance of my supervisor Dr Andrew Somerville.

I further declare that this dissertation has not been summited as an exercise for a degree at this or any other University and it is entirely my own work.

I agree to deposit this dissertation in the University's open access institutional repository or allow the library to do so on my behalf, subject to Irish Copyright Legislation and Trinity College Library conditions of use and acknowledgement.

Murat SOKMEN

ACKNOWLEDGEMENTS

I would like to express my sincerest gratitude to my supervisor, Dr Andrew Somerville, whose expertise, understanding, and patience, added considerably to my graduate experience. I appreciate his vast knowledge and his assistance in writing the dissertation.

To my teachers and classmates, I am grateful for their all instructions and support.

I would also like to thank my family for the support they provided me through my entire life.

SUMMARY

This study examines the rent-sharing hypothesis in the US manufacturing sector from 1990 to 2002, both from a theoretical and empirical perspective. Using a panel database of six-digit NAICS industries, the evidence suggests that the level of profitability in industries plays a major role in wage determination in 1990-2002 despite the declining in its effectiveness compared to 1960s and 1970s. The study also suggests a new instrumental variable approach to overcome the severe underestimation of rent-sharing due to the endogeneity of profits. The final IV estimate of the elasticity of wages with respect to profit per employee is around 0.08, with a Lester range of 50%. Moreover, the impact of unionization on rent-sharing is investigated and evidence is presented that indicates that the impact of unionization on rent-sharing is negligible.

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

Why do workers' wages fail to clear the labour market? Do more profitable firms pay higher wages to their workers? Do firms share their profits with workers? What is the size of the pie for workers out of the total profit? Although these questions have been addressed in the literature, the existence of industry effects on wages is still an unresolved puzzle since it is likely that some unmeasured features of industries, such as a special kind of market structure or technology, increase both profits and wages. Therefore, the effect of firm performance on wages has remained a popular research area in the economic literature. Moreover, changes in labour laws, the end of the cold war, an increase in globalization and the radical changes in production and management systems of firms and industries over the past three decades have maintained interest in this issue.

The last three decades have witnessed striking changes in the legal environment and political climate in which wage bargaining takes place. In particular, this period has seen a sharp decline in union membership and recognition. The election of Margaret Thatcher, who was committed to reducing the power of the unions in the UK, and President Ronald Reagan's reaction to the strike of PATCO (Professional Air Traffic Controller Organizations) in the US are significant events that decreased unions' power drastically.[1] All these events made it more costly for workers to join unions. Union coverage of the total US labour force has fallen from 23.3% in 1983 to 14.3% in 2003 (Figure 1). At the same time, rising globalization has raised the integration of US economy into world economy which in turn has caused a substantial increase of the immigrant / foreign-born labour force as a share of US labour force as seen in Figure 2[2] (Lowell et al., 2006). All these changes in the composition of workforce also have altered the process of wage formation.

[1] The 1981 strike and its aftermath were one of the most prominent events in US labour history. Over 11,000 striking air traffic controllers ignored the order to return to work. They were fired and banned from federal service for life and a large scale of replacement of striking PATCO workers was made.
[2] Bar-chart: total foreign-born labour force, left axis; line: foreign-born as share of total labour force, right axis.

Figure 1: Union Coverage in US Manufacturing Sector

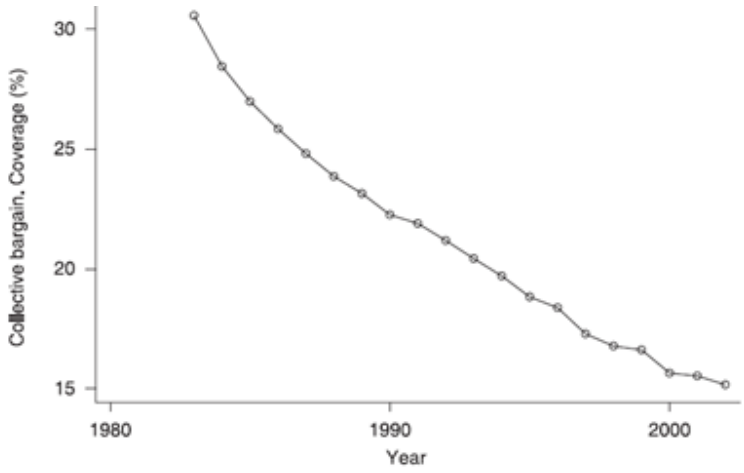
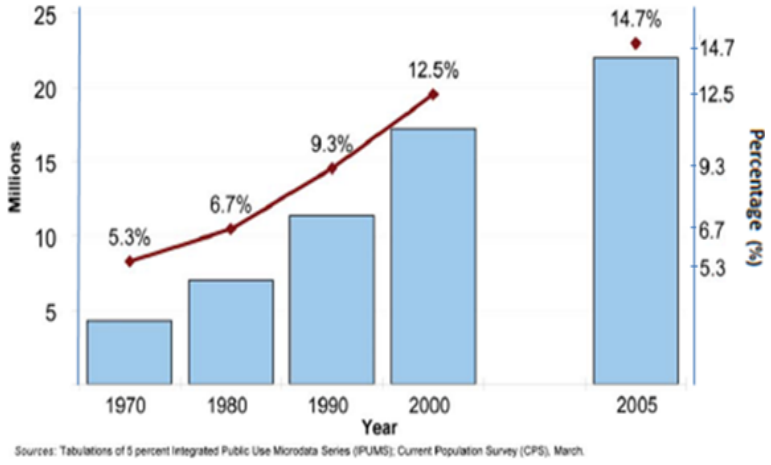


Figure 2: Foreign-Born Labour Force in the US: Size, and Share of Total



Wage determination or the process of wage formation is one of the most important issues in the economy since it has a significant impact on wage differentials, the level of unemployment and employment. Although competitive models attempt to explain labour market conditions and wages by the concept of perfect elasticity of labour supply and the law of one price, inter-industry wage differentials and the empirical observation that homogeneous types of workers are paid significantly differently in different industries

are not explained by a conventional competitive model. In this respect the rent-sharing hypothesis suggesting a positive correlation between wages and ability-to-pay is one of the most popular approaches to address the existence of imperfections in labour markets.

In existing studies that investigate the impact of rent-sharing on wages in the manufacturing industry sector, some have found a large and significant effect, while others have found that the effect is negligible. The main sources of these divergent results are different measures of firm performance, simultaneity between wages and firm performance and differences in the choice of instrumental variables. Furthermore, variation in the results of different studies has also arisen because of differences in data-samples, levels of competition, the role of unions and levels of bargaining across time and countries.

The purpose of the present study is to investigate both econometrically and theoretically the existence and extent of rent-sharing in the US manufacturing sector after controlling employees' personal characteristics in industries. In other words, this study examines the effect of firm performance on wages at industry-level. The simultaneity problem between firm performance and wages is discussed in relation to the previous findings in the literature and addressed by using a new instrumental variable approach. Additionally, it aims to identify the impact of unionization on the wage determination and bargaining processes. After industries are classified with respect to the level of unionization, the wage impact of rent-sharing is estimated separately for more- and less-unionized industries to facilitate a detailed comparison. For these purposes, a panel data of industries (six-digit NAICS) in the US manufacturing sector for the period of 1990-2002 is used. While previous studies generally focused on the 1950s-1990s and mainly use samples that are heavily unionized or less competitive, this study covers the period between 1990 and 2002, the era of declining unionization and increasing globalization, particularly in the manufacturing sector.

2. THE LITERATURE

The law of one price states that in an efficient and perfectly competitive market all identical goods should have only one price. However, in today's world the labour market is far from such an extreme condition. Despite the neoclassical proposition that wage differences in the labour market only result from worker characteristics, Sumner Slichter (who is the pre-eminent labour economist of the 1940s and 1950s) argued that competitive models cannot explain pay differences across similar workers in different industries and found that there is a positive correlation between wages and the employer's ability-to-pay (Slichter, 1950). Since then, many labour economists point to non-competitive features of the labour market such as the existence of unions and strategies of firms in order to explain wage differentials.

In the literature, a number of empirical and theoretical studies have attempted to examine the link between profits and wages in studies of wage differentials in the labour market.

The first theory of wage determination to be considered is *efficiency wage theory*. It proposes that managers have an incentive to pay their employees more than the market clearing wage in order to increase productivity, since high wages facilitate the attraction and retention of higher quality labour and enhance worker effort via motivational effects. Therefore, firms do not prefer to lower wages in the event of a fall in demand, because this causes a negative impact on productivity and profitability. The traditional formalization of the efficiency wage hypothesis is given by the labour turnover model of Salop (1979) and Stiglitz (1974). The labour turnover model proposes that firms hire high quality labour by setting wages above the competitive level and so reduce training labour time and labour turnover costs. In another version of efficiency wage theory Shapiro & Stiglitz (1984) assert that for firms monitoring workers' efforts is costly and not perfect. Therefore, firms prefer to set wage rates above the market equilibrium to combat the possibility of shirking (or "moral hazard") and ensure the required effort is

exerted. In this respect, the unemployment level is used as a threatening device. The other approach of efficiency wage theory is more sociological. Akerlof (1982) argues that excess satisfaction of workers increases efforts. If firms raise wages above the market equilibrium level, workers view that as a gift and increase their effort level in response (gift exchange model). Otherwise, if employers do not pay a share of their profit, workers feel a sense of unfairness and this reduces productivity (concerns for fairness).

A second theory, developed by Lindbeck & Snower (1989), is *insider and outsider theory*. This proposes that incumbent workers (insiders) can be uncooperative with new employees (outsiders). It is likely that incumbent workers have bargaining power since for employers the cost of hiring, providing firm-specific training to a new employee and firing can be high. Moreover, in the case of firing and hiring insiders can threaten to withhold effort. Insiders use this bargaining power to push wages up. Hence, wages may be higher than the market clearing level.

Thirdly, there is the generalized version of the *implicit contract model* of Azariadis (1975) in which firms and workers have symmetric information. This model predicts that there is a positive correlation between wages and profits. While the original model proposes that wages are set to provide efficient insurance against random demand shocks, the generalized model assumes that firms and workers share the same risks and respond to good and bad states in the same way. Risk-sharing gives workers an incentive to increase their efforts since when profits fall, wages also fall.

The last model of wage determination theory to be considered is a Nash bargaining model: *the right to manage model* of Nickell & Andrews (1983) in which firms decide their own labour demand, but bargain over wages with workers (unions). In the optimal contract workers gain some of the firm's surplus. This model suggests that there is a positive partial correlation between wages and profit per employee. Further discussion of this model will follow, in section four.

2.1 Unions and Workers' Bargaining Power in the Era of Deunionization

A trade union is an organization of workers whose purpose is to obtain higher pay and better working conditions. The traditional objective of unions is to extract rents from employers on behalf of all workers. While in neoclassical competitive theory unions are defined as an obstacle to a competitive market, some economists oppose this idea. John Stuart Mill, who challenged this common belief, wrote that unions 'far from being a hindrance to a free market for labour, are a necessary instrumentality of that free market' (Mill, 1909). Despite these different approaches for unions the purpose of traditional unions is common. Unions play a major role in determining workers' bargaining power. The bargaining power of unions may lead to a situation where firms find it more profitable to pay more than competitive wages to unionized workers in order to prevent strikes and maintain to industrial peace (Dickens & Katz, 1987).

Lever & Marquering (1996) find that the existence of unions not only affects members' wages but also indirectly affects non-union wages. First, in the case where a rent-seeking union in a firm is able to increase wages, the labour demand of the firm may be reduced. On the other hand, for non-unionized firms in the market, labour supply may increase since the available labour supply shifts towards them. This lowers wages in non-unionized firms. Secondly, a non-unionized firm may prefer to pay union wages or above to prevent union organization and increase workers' morale. Dickens & Katz (1987) also point out the threat effect due to the existence of unions. Another mechanism is that the profit level of non-unionized firms can increase due to the fact that high labour costs in unionized-firms increase the output price and thus total product demand shifts towards the product of non-unionized firms.

Over the past 30 years in North America and Western Europe the structure of bargaining and unions has changed substantially. While nation-wide and industry-wide collective bargaining consisting of a number of firms and unionized workers in different companies have turned into firm-level collective bargaining, the total member of unions has decreased. In other words, the transition from Fordism to post-Fordism reduced the

incidence of centralized collective bargaining. In this transformation, rising flexible specialization, improving production technology and skill-based technical change are the most common explanations put forward in the literature. Erickson (1990) finds that the positive returns to centralized bargaining decreased from 1979 to 1984. Katz (1993) suggests that in the prevalence of new more flexible work organizations local bargaining is essential. Also, Iversen (1996) emphasizes that cross-class coalitions between workers and employers in strategic sectors may cause decentralization in wage bargaining.

The literature explores the possibility that these changes in the economy also result in changes in the effect of unions on wages. Holmlund & Zetterberg (1991), in a cross country study, suggest that in countries with highly centralized bargaining workers benefit less from rent-sharing than those in countries with relatively decentralized systems. Arguably, this is because at the firm-level bargaining unions can exploit their bargaining power more and obtain a larger split of rents. In this case, workers can get more rents in more profitable firms and rent-sharing varies across firms. However, another hypothesis asserts that unions always favour a compressed inter-industry wage structure since workers demand income insurance and do not like the uncertainties that firms face with respect to the states of economy. Thus, workers are willing to exchange a part of the expected wage to obtain an insured wage structure. Even firm-level bargaining may be influenced by industry-wide or nation-wide unions, and so rent-sharing does not vary with regard to firm-level (or industry-level) profitability and wage growth is sheltered against fluctuations in firm performance (Agell & Lommerud, 1992; Agell, 2002). Guertzgen (2010) investigates these conflicting hypothesises in Germany and finds that unions favour a compressed wage structure across industries and suppress firm-level rent-sharing either because of demand for insurance, or high transaction costs. However, it is important to note that even though flexibility and production differences raised the level of decentralized wage bargaining in Germany, according to the Iversen

index,[3] in Germany wage bargaining is still more centralized than in the US (Iversen, 1998).

Besides the decentralization of collective bargaining there has been a striking fall in unionization in the last 30 years. Acemoglu et al. (2001), Katz (1993) and Iversen (1996) argue that skill-based technological changes and rising specialization widen the productivity differences across industries and the diversity in worker preferences, and increase the outside option for skilled workers. In addition to a changing legal environment and increasing management opposition that together make it more costly to join unions, this increase in the competitive market returns of skilled workers decreases their incentive to join unions. According to Acemoglu et al. (2001), the main role of rent-seeking unions is transferring rents from skilled workers to unskilled workers. Thus the wage premium of union members, and the real wages paid to less skilled workers, decrease since the bargaining power of unions declines dramatically (Gottshalk, 1997). Moreover, Suzuki (1998) and Streeck (1984) argue that productivity differences and decentralization in turn cause a decrease in the unity of workers in unions and change the internal politics of unions**.** Some workers and unions are no longer able to stay out of production-related issues and the rising impact of these workers on union leaderships emasculates unions in wage bargaining and reduces their power.

Acemoglu et al. (2001) find that while for firms where unions are rent-seeking (Oswald, 1985) deunionization may increase efficiency, where unions are efficiency-enhancing deunionization may reduce efficiency since they can improve employer-employee relationship and communication and reduce labour turnover by encouraging training and providing insurance workers (Freeman & Lazear, 1995).

[3] Iversen index is an index of centralization of wage bargaining which combines a measure of union concentration with a measure of the prevalent level of bargaining.

2.2 *Efficiency Wage* Models and *Wage Bargaining* Models[4]

The theories of efficiency wages and wage bargaining are significant for the analysis of wage determination and rent-sharing hypothesis. Even though in the current study the separate impacts of these two models are not investigated, it is important to specify the interaction effect of these two models in order to interpret the rent-sharing coefficient accurately.

Guertzgen (2009) suggests that the positive correlation between wages and rents may represent the fact that unions extract rents for all workers. Alternatively, this author suggests that while efficiency wages increase wages for skilled workers, unions may extract rents for only less skilled workers. Moreover, the interaction between these two phenomena may weaken or strengthen the rent-sharing coefficient. Sanfey (1993), Toulemande (2003), Strand (2003) and Kahn (1997) argue that a link between these two models increases wages more. They propose that a monopoly union in an efficiency wage sector is able to raise wages more than a monopoly union in a competitive wage sector since efficiency wages provide an added steepness. However, Walsh (2012) proposes that if a bargained wage satisfies the efficiency wage constraint, the efficiency wage constraint is irrelevant, but if it does not satisfy the efficiency wage constraint, then the efficiency wage is dominant and the bargaining model is irrelevant.

2.3 Previous Empirical Studies

In the literature, some studies assert that there is a positive and large impact of firm performance on wages while others argue that this effect is positive but not large. As a result, the conclusion in the literature is not certain and is changeable depending on a variety of factors.

There is extensive evidence in the literature that there is a positive impact of rent-sharing on wages. In a panel study consisting of unionized samples of Canadian firms between 1965-1983, Abowd and Lemiux (1991) find that the profit elasticity of wages is 0.25

[4] Including *the right to manage model* of Nickell & Andrews (1983) (see page 5)

after using export and import prices as an instrument for profit while their OLS estimate is equal to 0.025. Their IV result is ten times higher than the OLS result. They argue that price-based measures of foreign competition are valid instruments because while they are correlated with product market conditions, they are uncorrelated with supply shocks. Van Reenen (1996) estimates a rent-sharing coefficient of 0.29 for unionized British firms in the manufacturing sector between 1976 and 1982, using technological innovations as an instrument for profit over the period. For the US manufacturing sector in the period from 1960 to 1994, Estevao and Tevlin (2003) estimate the elasticity at 0.29. They use a new instrumental variable approach which uses a two-digit (SIC) demand shifter sector for each four-digit specific industry in the US manufacturing sector. While their OLS estimate is around 0.03, the IV results show the instrumented elasticity of wages (annual) with respect to value added per worker is nearly ten times higher, 0.29. They conduct their study for value added and profit variables. Moreover, after controlling for year and industry-specific effects they find that the results are not sensitive to human capital differences across industries since the human capital variable only reflects variations that are not captured by time dummies and industry-specific effects. The common findings in these studies suggest that the substantial impact of rent-sharing on wages is underestimated when not controlling for endogeneity.

On the other hand, Denny & Machin (1991) use a dataset of UK manufacturing firms over the period of 1976 to 1986. Their estimate based on using lagged profit per worker variable to deal with the endogeneity problem is 0.01. Blanchflower et al. (1996) find that the elasticity of wages with respect to profit per employee is 0.08 which demonstrates little evidence for the importance of rent-sharing on wages after controlling for workers' characteristics and industry fixed effects. They use data for US manufacturing industries (four-digit SIC) obtained from the NBER Productivity Database and carry out their study in the period 1964 to 1985. The dependent variable and key independent variable in the study are hourly/annual earnings and lagged profit per employee respectively. They argue that when firms become more profitable,

workers' wages increase. Moreover, Du Caju et al. (2009) use a linked employer-employee dataset in Belgium from 1999 to 2005. After instrumenting profitability by its lagged value in order to overcome the simultaneity problem, they conclude that workers earn significantly higher in more profitable firms. They estimate a rent-sharing coefficient of 0.03. Matano & Naticchioni (2011) investigate the role of rent-sharing on wages in Italy from 1996 to 2003. They discuss wage bargaining at two different levels. At the first level, i.e. centralized (national) level bargaining, minimum wages for all occupations are set in all industries; at the second level, i.e. decentralized level bargaining, employer and employees bargain the wages over the constraints imposed by national contracts. After they control for first level bargaining, their estimate is 0.06 for the elasticity of wages with respect to profits per employee. They use lagged values of profits as an instrument. Guertzgen (2009) also estimates the elasticity of wages with respect to profits at around 0.05 in Germany from 1995 to 2001. Martins & Esteves (2012) follow the Blanchflower et al. (1996) methodology for Brazilian manufacturing firms. Their results indicate that rent-sharing is not an important factor in wage determination in Brazil.

Most studies presented so far examine rent-sharing in the case that when a breakdown occurs in wage bargaining, firms earn zero profit since they have no fall-back position. However, Bivens (2006) argues that growing international integration, which has improved firms' fall-back positions, may explain the apparent decline in workers' bargaining power since firms are able to threaten workers by moving production abroad. Rising globalization makes this threat more credible. Therefore, the author modifies Blanchflower et al. (1996) and adjusts firms' profits according to the ease of international transactions, measured by net import shares,[5] and also by relative labour costs. This adjustment is designed to take into account the employers' fall-back positions. They use the U.S manufacturing industries dataset over the period 1967–1996. Their findings establish that when globalization-adjusted rents are used in wage

[5] i.e. the ratio of net import value to the total value of shipments.

determination, the effect of rent-sharing on wages declines relative to the original model, but it is still significant.

3. DATA AND BASIC SPECIFICATIONS

The data for this study are obtained from the *NBER-CES Manufacturing Industry Database*. It includes annual data for six-digit NAICS (North American Industry Classification System) manufacturing industries from 1958 to 2005 while in previous studies four-digit SIC (Standard Industrial Classification) manufacturing industries are used. The fundamental reasons that the data of NAICS manufacturing industries are used are that NAICS codes are based on a more consistent economic approach compared to SIC codes and that establishments that are classified together have more similar characteristics in terms of the process of production and financial condition. For example, firms within NAICS industries are more likely to have similar levels of debt. Additionally, NAICS codes target emerging industries and high technology industries better than SIC codes. NAICS includes 1170 industries. However, SIC includes 1004 industries.

In this study the data are restricted to the period between 1990-2002, the era of deunionization. The real average annual wage per worker in each industry is computed as the ratio of total payroll to employment over CPI (Consumer Price Index). Value added is equal to the value of shipments plus the change in inventories minus material costs. For real value added both shipments and material costs are deflated. The real annual profit per employee at period t for each industry is defined (see Blanchflower et al., 1996):

$$Profit\ per\ employee\ (t) = \frac{\frac{\text{Value added}\ (t) - \text{Total payroll}\ (t)}{CPI} - \text{Real depreciation}(t) - Opportunity\ Cost(t)}{Total\ employment\ (t)}$$

$$Real\ Depreciation\ (t) = \text{Real capital}\ stock\ (\text{t}) - Real\ capital\ stock\ (t+1) + \frac{Investment\ (t)}{Deflator\ for\ investment\ (t)}$$

$$Opportunity\ Cost(t) = Real\ interest\ rate(t) \times Real\ \text{capital stock (t)}$$

In the dataset real capital stock is in real (1987) dollars. Therefore, both CPI and the investment deflator are also based on 1987 prices.

The alternative wage, i.e. a representative worker's wage in case of a breakdown in bargaining, is characterized by three variables in our regression. The first is an industry-specific fixed effect that captures industry-specific fixed factors such as unmeasured labour quality. Secondly, the state of macroeconomic conditions such as the unemployment level in the aggregate economy is captured by time dummies since it also has an important impact on the alternative wage. These dummies do not vary across industries. Finally, in order to capture changes in human capital characteristics across industries and time a human capital variable is constructed from the *Matched Outgoing Rotation Group (MORG)* files of the Current Population Survey (CPS) in the NBER database as a control variable. For this, first the regressions for wage in log form are run for each year from 1990 to 2002 based on education, age, race, gender, full-time/part-time, marital and occupation status and industry characteristics etc. and to compute the predicted wage (see Estevao & Tevlin, 2003). Secondly, the average predicted wage is calculated for each two-digit SIC manufacturing industry by combining individual workers' predicted wages. Since we use NAICS codes the predicted average wages in two-digit SIC industries are matched with three-digit NAICS industries. Then, according to the hierarchical structure of NAICS codes the predicted wages in three-digit NAICS are assigned to six-digit NAICS industries. The method is described in detail in Appendix A.

The data for our instrumental variable, export value, are taken from the *NBER International Trade Database* and matched with NBER manufacturing industry dataset. The data cover the period 1989 to 2005 and include the annual export value of six-digit NAICS manufacturing industries. The export value is classified with respect to the importer countries. In the regression the aggregate export value, the sum of exports to the countries, of six-digit NAICS manufacturing industries is used.

In order to conduct a comparative study between relatively highly unionized firms and others, the *Union Membership and Coverage Database* from the CPS is used. As a measure of union power in each industry the percentage of employees covered by

collective agreements is taken and CIC (Census Industry Classification) codes are matched with NAICS codes. Even though the percentage of union members (union density) may be considered as a proxy for union power, in some cases this does not reflect the number of workers who are affected by collective contracts. For example, in Germany if an employer is a member of the employer's association, all workers are directly covered, regardless of whether they are member of a union or not (Sanne, 2006). Therefore, the union coverage rate is considered as a better indicator of union power.

The data summary is exhibited in Appendix B.

4. METHODOLOGY

The methodology presented here closely follows Estevao and Tevlin (2003) and Blanchflower et al. (1996).

The wage determination equation is derived from a Nash bargaining model, *the right to manage model* of Nickell & Andrews (1983). For an optimal wage contract, employer's and employees' joint utility are maximized, where a firm's utility is represented by its profit. While workers maximize the utility ($u(w)$) derived from their wage (w), the firm maximizes its profits ($\Pi = Af(N) - wN$ where A represents productivity and N represents the level of employment). The source of workers' bargaining power (μ) comes from their ability to act within a group such as a union. In the case of a fall-back or breakdown in bargaining, workers have an outside option which is called alternative wage ($\underline{w}$). A worker also receives the alternative wage in the event that he or she is fired and rehired. On the other hand, in the event of bargaining delay the firm's profit is equal to zero. In this model firms have no fall-back position.

The Nash bargaining problem is expressed by a maximization of the joint utility (Ω) (see Blanchflower et al., 1996):

$$\text{Maximize } \Omega = \Phi^{\mu}\Pi^{1-\mu}, \tag{1}$$

where Φ represents the expected utility of workers and is defined as

$$\Phi = [u(w) - u(\underline{w})]N; \tag{2}$$

$u(\underline{w})$ is the expected utility derived from alternative wage.

For simplicity we can use log-linearization since maximizing Ω is equivalent to maximizing to $\log(\Omega)$:

$$log\Omega = \mu \log([u(w) - u(\underline{w})]N) + (1-\mu)\log\Pi. \tag{3}$$

Differentiating this function, log(Ω), with respect to "*w*", setting the derivative equal to zero and linearizing u by a first-order Taylor series approximation gives

$$w = \underline{w} + \frac{\mu}{1-\mu}\ \frac{\Pi}{N}. \tag{4}$$

In this equation, $\frac{\Pi}{N}$ is profit per worker and $\frac{\mu}{1-\mu}$ is relative bargaining power. If the alternative wage (workers' threat point) increases, the wage increases by the same amount. Also, a rise in the workers' bargaining power causes an increase in wages.

On the other hand, the firm unilaterally determines the level of employment since in reality workers have no impact on *N*. Differentiating the profit function with respect to "*N*" and setting the derivative equal to zero yields

$$Af'(N) = w, \tag{5}$$

where $Af(N)$ is production function and $Af'(N)$ is marginal product of labour.

As seen in equation (5), the firm hires workers until the marginal product of labour equals the wage. This relationship reveals the potential endogeneity problem, giving rise to the possibility that OLS or FE estimations are inconsistent. However, it also gives a hint about how this problem is overcome. An instrumental variable that is correlated with the exogenous productivity parameter, *A*, but not with wages, can help us.

Equation (4) shows that the wage is determined by the alternative wage and profit per worker weighted by relative bargaining power. Though this expression is simple, it encapsulates the rent-sharing hypothesis and is useful for the econometric analysis. In this equation the alternative wage, the outside option of workers, is not observable for an empirical study, thus it can be characterized as a function of w^0, *b* and *U*, where w^0 is the outside option in other industries, *b* (benefits) is the level of income of unemployed workers and *U* is the unemployment level in that industry.

The empirical model of the problem at industry level is derived from equation (4):

$$w_{it} = \alpha_i + \gamma.\frac{R_{it}}{N_{it}} + \beta.X_{it} + e_{it}. \quad (6)$$

In this regression $\frac{R_{it}}{N_{it}}$ is real rent per worker at period *t* and γ is the rent-sharing parameter that captures not only the relative bargaining power, but also captures the elasticity of labour demand and the elasticity of real rents (profit or value added) with respect to the employment level. The industry-specific fixed effect α_i and the variable X_{it} partly determine the alternative wage. The fixed parameter α_i captures industry-specific fixed effects. It controls for unobserved heterogeneity across industries, non-measurable characteristics of industries, and does not vary over time. The variable X_{it}, the human capital in industry *i* at period *t*, controls for the differences in workers' characteristics across time and industries since more profitable industries may attract higher-quality workers. Finally, e_{it} is the error term. Both the wage and the rent-sharing variables may be taken in log form.

In order to eliminate time-invariant effects the fixed effects model is used and to capture common macroeconomic features for all industries, *b* in the alternative wage function, time dummies (D_j) are added.

By the fixed effects model the final equation is:

$$w_{it} - \overline{w_\iota} = \gamma.(\frac{R_{it}}{N_{it}} - \frac{\overline{R_\iota}}{N_\iota}) + \beta.(X_{it} - \overline{X_\iota}) + \sum_{j=1}^{T} \delta_j.D_j + (e_{it} - \overline{e_\iota}). \quad (7)$$

In Equation (7) the alternative wage of a representative worker is captured by the human capital variable, time dummies and an industry-specific fixed effect that is eliminated by the fixed effects model. Because time dummies and industry-specific fixed effects are able to hold a large proportion of human capital differences across industries and time, the human capital variable may be removed. As an indicator of industry rents (industry performance), *R*, profit or value added can be used. In the literature profit is thought as a better measure since it is isolated from the depreciation and the opportunity cost.

However, measuring industry performance by the profit variable causes an endogeneity problem. Profits contemporaneous with the wage cause a downward bias in the "γ" coefficient since profit equals value added minus the sum of total labour cost arising from wages, depreciation and the opportunity cost of capital (Estevao & Tevlin, 2003). Therefore, in this study both value added and profit variables are used as indicators of industry performance separately. How to handle the endogeneity problem is explained in detail in the following sub-section.

4.1 A New Instrumental Variable Approach

In the literature several theories such as the versions of *efficiency wage theory* predict a simultaneity problem between wages and industry performance. Moreover, Equation (5) addresses this simultaneity problem mathematically. In the economic literature, the most popular way to overcome this is to use lagged profit variables to regress wages since past profits are not correlated with current labour market conditions. For example, profits per worker in 1992 can be used in an equation for year 1994 wages. However, this may induce an omission of the immediate effect of profit on wages in annual data. Hence instrumental variable methods are more appropriate to avoid this problem. The most important approaches in which different instrumental variables are used are made by Estevao & Tevlin (2003), Abowd and Lemiux (1991) and Van Reenen (1996). Estevao & Tevlin (2003) use a two-digit SIC demand-shifter industry for each four-digit SIC industry as an instrument. For instance, they argue that the fishing industry instruments reasonably well for the manufactured ice industry. The intuition is that larger commercial catches of fish mean larger purchases of manufactured ice. Therefore, an increase in industry performance in the fishing industry indirectly causes an increase in industry performance in the ice industry since a positive increase in demand for ice occurs. Moreover, since labour costs in the manufactured ice industry do not affect the performance (rents) of the fishing industry, which is measured by profit, profits in the manufactured ice industry can be instrumented with the production in the fishing industry. As another example the explosives industry and the coal mining industry can

be considered. Estevao & Tevlin (2003) state that nineteen percent of the demand in the explosives industry is generated by the coal mining industry and also one percent of the total input cost of the coal mining industry is comprised of the cost of explosives. Therefore, while movements in the industry performance of the coal mining industry affect the demand for explosives and so the exlosives industry performance, the industry performance of the coal industry is not affected by the labour costs in the explosives industry. As a result, they propose that profits (or value added) in the explosives industry can be instrumented with profits (or value added) in the coal mining industry. Abowd and Lemiux (1991) demonstrate that export and import prices can be used as an instrumental variable for profit. For instance, an increase in the price of biological products leads to an upward shock to profits in the biological products industry since this industry is price taker. Van Reenen (1996) proposes that innovations in the past play a major role in today's industry performance. Thus the number of major technological innovations can be used as an instrumental variable.

In this study a new instrumental variable approach is proposed. For the period of 1990-2002 we will instrument industry performance (industry rents) with the total export value of the industry. Our hypothesis is that while the demand-oriented export value of US manufacturing industries goes side by side with the profit and acts as a revenue shifter, labour market conditions do not have an impact on export value. The origin of this idea is the fact that throughout history the US economy has been remarkably dependent on exporting and rising globalization, and consequently on the increase in internationalization of markets and lower trade barriers. In 1990 nearly eighty-four percent of US gross national product (GNP) is accounted for by exports. Moreover, the period since 1990 saw the growth of the widespread use of the internet, a huge tendency to expand American trade and investment overseas in US national political and economic strategy, the establishment of NAFTA and the WTO: therefore exports play a major role in profits. Another reason is that export performance is determined by technological development and productivity. This is discussed for developing countries

by Montobbio & Rampa (2002). Therefore, export value may also be considered as a proxy for the exogenous productivity (technology) parameter ("*A*") in equation (5).

In the era of globalization exports are heavily demand-oriented. An increase in wages may theoretically cause a small decrease in exports as it may affect the competitive power of a firm or an industry in international trade adversely by increasing the price of its products. However, in reality exports of US manufacturing industries, which have a dominating and reputable position in world trade, are insensitive to labour costs. Thus, export value can be considered as a valid instrumental variable.

5. RESULTS

In this section, the rent-sharing hypothesis is examined formally for the six-digit NAICS manufacturing industries in the US for the period 1990-2002, using STATA. Since a fixed effects estimator is more efficient than a first difference estimator when errors are serially correlated, this study follows the fixed effects model (Equation (7)). (The basic OLS results obtained by first differencing are presented in Appendix C.) Moreover, all variables are taken in logarithmic form to compute elasticities. For all cases, an F test is performed to test the significance of the regressions, the null hypothesis being rejected at all significance levels.

For the most part, the industries that face losses in some years in the period of 1990-2002 are excluded since rent-sharing is applied when industries (or firms) have profits, and the panel dataset is balanced for all variables. However, in order to take account of industries that make losses, of newly emerging industries and of industries that disappear during the sample period, the regressions are also run without balancing the dataset (see Table 10).

Table 1 presents the fixed effects estimation results for the period 1990 to 2002. The first column shows the results with the human capital variable. As a proxy for industry performance (industry rents) profit is used. The FE estimate of this regression demonstrates that the rent-sharing variable (profit per employee) is statistically significant[6]. The estimated coefficient (γ) is around 0.023. The human capital variable which controls for changes in worker characteristics over time across industries is insignificant. This may be unexpected, but it was stated before that the major part of variation in worker characteristics is captured by time dummies and industry-specific fixed effects. To test the stability of parameters the predicted and actual wages are compared. It is seen that they are highly correlated. (Figures related to the stability of parameters are presented in Appendix D) In column (2) the regression is performed

[6] In general "significance" will mean significance at the 5% level

without the human capital variable. The rent-sharing parameter is again found to be around 0.023 and statistically significant.

Table 1: The Effect of Profit per Employee on Wages (1990-2002, Time Dummies Are Added)

VARIABLES	(1) *Wage*	(2) *Wage*
Profit per employee	0.0232***	0.0230***
	(0.00506)	(0.00504)
	[6.26e-06]	[7.02e-06]
Human capital	0.0315	
	(0.0208)	
	[0.129]	
Year dummies	Yes	Yes
Observations	4,589	4,589
Adjusted R-squared	0.220	0.220

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

In order to explore whether our human capital variable is significant or not we run the regression without time dummies. The results are shown in Table 2. As expected, the human capital variable is statistically significant. Also, the coefficient of the human capital variable, which represents the alternative wage of workers with industry fixed effects, is positive and therefore consistent with our theoretical approach. An increase in human capital causes an increase in the alternative wage which in turn raises the wage.

For the 1990-2002 period the regressions are run using the lagged rent-sharing variable in order to overcome the simultaneity problem, since the estimations with the contemporaneous profit per worker variable may be invalidated because of endogeneity issues. Table 3 shows the results. As seen, using lagged profit per employee variable causes a decrease in the value of the rent-sharing parameter as lagged variables cannot entirely capture immediate effects for an annual dataset. The elasticity is about 0.01. The

human capital variable is highly insignificant when times dummies are added to the regression, otherwise (column (3)) it is statistically significant.

Table 2: The Effect of Profit per Employee on Wages (1990-2002, Time Dummies Are Excluded)

VARIABLES	(1) *Wage*
Profit per employee	0.0291***
	(0.00476)
	[2.52e-09]
Human capital	0.127***
	(0.00964)
	[0]
Year dummies	No
Observations	4,589
Adjusted R-squared	0.184

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

To make the results comparable with previous studies using valued added per employee as a rent-sharing variable, estimates of rent-sharing using value added per employee are reported in Table 4. With the inclusion of time dummies and the human capital variable, the elasticity of wages with respect to value added per employee is found to be about 0.048, which is almost the same as the result found by Estevao and Tevlin (2003). Estevao and Tevlin (2003) estimate this coefficient at between 0.05 and 0.06 using a dataset for the four-digit SIC industries of US manufacturing from 1980 to 1994. The FE estimates for the value added per employee variable are bigger than those using the profit per employee variable. The downward bias discussed earlier when using profit per employee variable may be suggested as a reason. However, using the value added per employee variable may not be sufficient to handle the endogeneity problem since it is likely that labour inputs can be changed by firms in return for variations in wages.

Table 3: The Effect of Lagged Profit per Employee on Wages (1990-2002)

VARIABLES	(1) *Wage*	(2) *Wage*	(3) *Wage*
(Profit per employee)$_{t-1}$	0.0106**	0.0106**	0.0114***
	(0.00458)	(0.00457)	(0.00439)
	[0.0217]	[0.0210]	[0.00963]
Human capital	0.0262		0.134***
	(0.0209)		(0.00981)
	[0.210]		[0]
Year dummies	Yes	Yes	No
Observations	4,589	4,589	4,589
Adjusted R-squared	0.207	0.206	0.159

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: The Effect of Value Added per Employee on Wages (1990-2002)

VARIABLES	(1) *Wage*	(2) *Wage*	(3) *Wage*
Value added per employee	0.0482***	0.0476***	0.0535***
	(0.00860)	(0.00864)	(0.00816)
	[4.35e-08]	[6.97e-08]	[1.99e-10]
Human capital	0.0379*		0.116***
	(0.0211)		(0.00988)
	[0.0740]		[0]
Year dummies	Yes	Yes	No
Observations	4,589	4,589	4,589
Adjusted R-squared	0.234	0.233	0.195

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

Table 5 exhibits the IV (2SLS) fixed effects estimation results in which profit per employee is instrumented by the export value variable. To establish the validity of the instrumental variable, underidentification and weak identification tests are performed (Appendix E), the null hypothesises being rejected in both cases. The FE estimate of the rent-sharing coefficient presented in Table 1 is about 0.02. It implies that 100% increase in profit per employee results in a 2% positive change in wages. On the other hand, the IV fixed effects estimation result in Table 5 shows that the rent-sharing parameter is 0.085, i.e. about four times higher. This result confirms that rent-sharing is severely underestimated in previous fixed effects estimations that do not take into account the endogeneity problem.

Table 5: The Effect of Profit per Employee with IV Approach (1990-2002)

VARIABLES	IV (1) *Wage*	IV (2) *Wage*
Profit per employee	0.0851** (0.0400) [0.0335]	0.0949** (0.0428) [0.0265]
Human capital	0.0448*** (0.0172) [0.00921]	
Year dummies	Yes	Yes
Observations	4,589	4,589
R-squared	0.104	0.061

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

In table 6 the IV fixed effect estimation results for the value added per employee variable are demonstrated. As seen in column (1), 100% increase in value added per employee leads to 9% increase in wages. These results also confirm the severe endogeneity problem.

Table 6: The Effect of Value Added per Employee with IV Approach (1990-2002)

VARIABLES	IV (1) *Wage*	IV (2) *Wage*
Value added per employee	0.0925**	0.104**
	(0.0381)	(0.0415)
	[0.0153]	[0.0121]
Human capital	0.0483***	
	(0.0170)	
	[0.00447]	
Year dummies	Yes	Yes
Observations	4,589	4,589
R-squared	0.211	0.193

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

Our unionization indicator, the percentage of covered employees, is taken from the *Union Membership and Coverage Database*. Firstly, the sample is broken into two parts: industries that have a high level of union penetration and those that have a low level of union penetration. The results are shown in Table 7. The rent-sharing variable is statistically significant for both industry groups. For industries that have a low level of union penetration the FE and the IV fixed effects estimation results show that the coefficients are around 0.03 and 0.2 respectively. On the other hand, for industries that have a high level of union penetration the rent-sharing coefficient is found to be around 0.02 by the FE estimation, i.e. below the FE estimate of 0.03 for less-unionized industries. However, the IV fixed effects estimation for more-unionized industries suffers from weak identification. Secondly, an interaction variable of union coverage (1 for more-unionized industries, 0 for less-unionized industries) and rent-sharing is added and the regression is run with the whole sample. In columns (5) and (6) the results

demonstrate that the coefficient of the interaction variable is negative, which implies that less-unionized industries share a relatively large proportion of profits.

Table 7: The Effect of Rent-sharing on Wages According to the Level of Union Penetration (Low and High)

	Low	Low, IV	High	High,IV		IV
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	*Wage*	*Wage*	*Wage*	*Wage*	*Wage*	*Wage*
Profit per emp.	0.0320***	0.209***	0.0182***	-0.0920	0.0318***	0.113**
	(0.00832)	(0.0477)	(0.00631)	(0.0581)	(0.00804)	(0.0476)
	[0.000162]	[1.15e-05]	[0.00430]	[0.113]	[9.35e-05]	[0.0176]
Human capital	0.0536	0.0358	0.0173	-0.0309	0.0298	0.0278*
	(0.0351)	(0.0365)	(0.0253)	(0.0323)	(0.0208)	(0.0150)
	[0.129]	[0.327]	[0.494]	[0.339]	[0.152]	[0.0640]
union coverage × *profit per emp.*					-0.0141	-0.091**
					(0.00965)	(0.0454)
					[0.146]	[0.0450]
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,327	2,327	2,262	2,262	4,589	4,589
R-squared	0.230		0.225		0.224	

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

The comparison in columns (1) and (3) in Table 7 is also performed using the lagged profit per employee variable to handle the simultaneity problem (Table 8). The results do not give significant evidence of sectoral heterogeneity: i.e. the rent-sharing coefficients for two different industry groups are not significantly different.

The results in Table 7 and 8 provide us with no evidence for the positive impact of union coverage density on rent-sharing. However, since the IV approach is not performed for the comparison in a satisfactory manner after the sample is split into two parts, the positive impact of union coverage is not completely rejected.

Table 8: The Effect of Rent-sharing on Wages According to the Level of Union Penetration by Lagged Profit per Employee (Low and High)

VARIABLES	Low (1) *Wage*	High (2) *Wage*
(Profit per employee)$_{t-1}$	0.0126 (0.00792) [0.115]	0.00940* (0.00559) [0.0941]
Human capital	0.0532 (0.0356) [0.137]	0.0107 (0.0251) [0.671]
Year dummies	Yes	Yes
Observations	2,327	2,262
Adjusted R-squared	0.206	0.210

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

The impact of rent-sharing on wages is investigated by estimating the regressions separately for two different time periods, 1962-1979 and 1990-2002. Table 9 presents the results for two time period comparison. Only the FE estimation results are reported since the instrumental variable, export value, is not available for the period of 1962-1979. It is important to emphasize that the human capital variable is excluded from the regressions displayed in Table 9 because of lack of data in the past period. However, based on the results presented in Table 1 and Table 3 the human capital variable is very likely to be insignificant because of industry-specific fixed effects and time dummies. As columns (1) and (3) suggests, there is a difference in the results as compared to Table 1 and 3 which can be attributed to the different number of observations taken, the exclusion of the human capital variable and the balancing of the dataset for the variables from 1962 to 2002.

The rent-sharing variable is statistically significant for all cases shown in Table 9. However, for the 1990-2002 (column (1)) period the rent-sharing elasticity of the wage is 0.03 while in the period of 1962-1979 (column (2)) the elasticity is found equal to 0.07, which is remarkably higher than the period of 1990-2002. In columns (3) and (4) the results are obtained by using lagged profit per employee. These comparable results suggest that the impact of rent-sharing on wages has declined over time.

Table 9: The Effect of Rent-sharing on Wages in 1990-2002 and 1962-1979

	1990-2002	1962-1979	1990-2002	1962-1979
	(1)	(2)	(3)	(4)
VARIABLES	*Wage*	*Wage*	*Wage*	*Wage*
Profit per employee	0.0308***	0.0697***		
	(0.00594)	(0.00834)		
	[3.47e-07]	[0]		
(Profit per employee)$_{t-1}$			0.0173***	0.0521***
			(0.00509)	(0.00764)
			[0.000772]	[0]
Time dummies	Yes	Yes	Yes	Yes
Observations	4,875	6,750	4,875	6,750
Adjusted R-squared	0.237	0.412	0.222	0.394

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

The data are so far balanced for all variables. In order to take into account industries that face losses in some years, newly emerging industries and industries that vanished during the sample period, the regressions are performed for the unbalanced data. Table 10 presents the results. The rent-sharing variable is statistically significant in both estimations. The elasticities of wages with respect to profit per employee are around 0.016 and 0.078, respectively, for the FE estimation and the IV fixed effects estimation.

Table 10: The Effect of Rent-sharing on Wages for Unbalanced Dataset

VARIABLES	(1) *Wage*	IV (2) *Wage*
Profit per employee	0.0155***	0.0780***
	(0.00474)	(0.0243)
	[0.00119]	[0.00134]
Human capital	0.0191	0.0377**
	(0.0210)	(0.0170)
	[0.365]	[0.0265]
Time dummies	Yes	Yes
Observations	4,939	4,939
R-squared	0.213	0.070

Notes: Robust standard errors in parentheses. P-values in brackets. All regressions are run in logs.
*** p<0.01, ** p<0.05, * p<0.1

6. CONCLUSION

In this study, in order to investigate the rent-sharing hypothesis and test the competitive market hypothesis in the labour market in US manufacturing industries in 1990-2002, the era of deunionization, a panel study is performed. After controlling for worker characteristics, while the FE estimation results give an elasticity of wages with respect to profit per employee of about 0.02, by using instrumental variable fixed effects analysis the elasticity is found to be around 0.08. This result suggests that rent-sharing has a significant impact on wages, but this impact is not very large. If profits per employee increase 10%, wages only increase around 0.8%. Using value added per worker as a measure of industry rents, while the FE estimation demonstrate that the elasticity is around at 0.05, in the IV fixed effects estimation it increases to 0.09. As seen, the elasticities estimated by using profit and value added as a measure of industry performance are slightly different from each other. The concerns about underestimation of the impact of rent-sharing because of endogeneity issues presented in previous studies are also confirmed by this study. Regarding the human capital variable, the effect of human capital on wages is positive, which validates our expectations. However, it may be identified more precisely in a study using a more disaggregated dataset such as a linked employer-employee dataset.

The Lester range[7] is computed at around 50%, which implies that one half of wage inequality in the US manufacturing sector is due to rent-sharing. The Lester ranges computed in Estevao and Tevlin (2003), Blanchflower et al. (1996), Van Reenen (1994) and Abowd & Lemieux (1993) are 70%, 24%, 120% and 90% respectively (Oswald, 1996). The elasticity results are also comparable with the previous studies examining similar time periods for different countries (Table 11). Du Caju et al. (2009) estimate a rent-sharing coefficient of 0.03 in Belgium from 1999 to 2005 with a Lester range of

[7] The Lester range equals the elasticity of wages with respect to the rent-sharing variable multiplied by four times the standard deviation of rent-sharing divided by mean. It gives us a measure of how much a worker's wage changes if a worker moves from an industry that is at the bottom of profit per employee distribution to an industry at the top of profit per employee distribution.

wage dispersion of 24%-37%. Matano & Naticchioni (2011) estimate an elasticity of wages with respect to profits of 0.06 in Italy from 1996 to 2003. Guertzgen (2009) finds this elasticity to be around 0.05 in Germany from 1995 to 2001. As compared to the previous studies presented in Table 11, variation in the results may partly result from taking into account different countries that have different level of wage bargaining and different time periods. Especially some studies that focus on the period when unions were relatively more effective at the bargaining table, such as the 1960s and 1970s, estimate the effect of rent-sharing on wages to be larger. The results obtained by comparing two periods, 1990-2002 and 1962-1979, present evidence that the role of rent-sharing in wage determination has weakened over time. As expected the profit per employee elasticity of wages in 1962-1979 is found to be higher than in the period of 1990-2002.

In the period 1990-2002, in order to examine rent-sharing in heterogeneous industries in terms of union coverage our samples are broken into two parts, more-unionized industries and less-unionized industries. The results do not provide evidence that the employees of more-unionized industries benefit relatively more from rent sharing. In other words, the results suggest that a positive impact of unions on wage bargaining and rent-sharing on behalf of workers is not observable in this period. As already discussed, a dramatic decrease in union membership and changes in labour laws against union rights have both been facts in the emasculation of the unions. This process combined with rising globalization and improving firms' fall-back positions in wage bargaining (they can credibly threaten to move production abroad), may all be proposed as reasons for these results. This study, therefore, suggests that the efficiency wage theories are able to explain wage determination and rent-sharing in this era. However, the empirical analysis was restricted by data shortage and the impossibility of measuring certain relevant features of industries such as management systems and firms' strategies. To that extent the conclusions should be regarded as provisional.

As for the risk sharing mechanism between firms and workers, this study proposes that firms and workers share the same risks in good and bad states. However, even though firms do not provide full insurance to workers, they largely insulate workers' wages from production uncertainties and so neutralize a significant amount of the risk borne by workers. These arguments rest on the result that the rent-sharing parameter has a small positive value.

To conclude, this study presents evidence that the rent-sharing hypothesis can explain why workers' wages fail to clear the labour market, and that more profitable industries pay higher wages to homogeneous workers. It also suggests that although wage determination and wage differentials in US manufacturing industries cannot be explained only by the traditional competitive theory, this theory is not completely rejected since inward migration of employees into industries that pay high wages may eliminate the wage premium due to rent-sharing in the long-run. Despite being an epilogue to this study, these arguments suggest a new research agenda for analysing wage determination. Due to the limitations mentioned above, the study presents only a preliminary investigation of the rent-sharing hypothesis and wage differentials in US manufacturing labour market. Thus, this study is intended as a prologue to further research.

Table 11: Results from Previous Studies

Study	Elasticity of profits (or quasi rents) per employee w.r.t wages	Lester range	Years / Country
Van Reenen (1994)	IV– 0.29	120%*	1976-1982 / Britain
Abowd & Lemieux (1993)	OLS – 0.025 IV– 0.25	90 %*	1965-1983 / Canada
Estevao and Tevlin (2003)	OLS – 0.009 (0.027) IV– 0.14 (0.29)	70%*	1960-1994 / USA Four-digit SIC
The present study	**FE – 0.02** **IV FE– 0.08**	**50%***	**1990-2002 / USA** **Six-digit NAICS**
Du Caju et al. (2009)	OLS – between 0.02 and 0.04	24% - 37%	for each year from 1999 to 2005 / Belgium
Blanchflower et al. (1996)	OLS – 0.08	24 %	1964-1985 / USA Four-digit SIC
Matano & Naticchioni (2011)	FE – 0.1 IV FE – 0.6	24 %	1996 – 2003 / Italy
Guertzgen (2009)	OLS – 0.05	–	1995-2001 / Germany

Notes: * denotes Lester ranges according to IV estimation results obtained by using something other than lagged values as an instrument. The previous studies except Matano & Naticchioni (2011) use first differencing to eliminate fixed effects.

REFERENCES

Abowd, J. M., & Lemieux, T. (1993). The Effects of Product Market Competition on Collective Bargaining Agreements: The Case of Foreign Competition in Canada. *The Quarterly Journal of Economics vol. 108(4)*, 983-1014.

Acemoglu, D., Aghion, P., & Violante, G. L. (2001). Deunionization, Technical Change and Inequality. *CEPR Discussion Papers 2764*.

Agell, J. (2002). On the determinants of labour-market: rent-seeking versus social insurance. *German Economic Review*, 107-35.

Agell, J., & Lommerud, K. (1992). Union Egalitarianism as Income Insurance. *Economica*, 295–310.

Akerlof, G. (1982). Labor Contracts as Partial Gift Exchange. *Quarterly Journal of Economics, vol. 97*, 543-69.

Azariadis, C. (1975). Implicit Contracts and Underemployment Equilibria. *Journal of Political Economy, vol. 83(6)*, 1183-1202.

Bivens, L. J. (2006). Wages, Profits, and Rent-Sharing in an Open Economy. *International Review of Applied Economics, Taylor and Francis Journals, vol. 20(1)*, 69-83.

Blanchflower, D. G., Oswald, A. J., & Sanfey, P. (1996). Wages, Profits, and Rent-Sharing. *The Quarterly Journal of Economics, vol. 111(1)*, 227-51.

Choi, M. (2001). Threat Effect of Foreign Direct Investment on Labor Union Wage Premium. *Working Papers wp27, Political Economy Research Institute, University of Massachusetts at Amherst*.

Denny, K., & Machin, S. (1991). The role of profitability and industrial wages in firm level wage determination. *Fiscal Studies, vol. 12(2)*, 34-45.

Dickens, W. T., & Katz, L. F. (1987). Inter-Industry Wage Differences and Theories of Wage Determination. *NBER Working Papers 2271*.

Du Caju, P., Rycx, F., & Tojerow, I. (2009). Inter-industry wage differentials : How much does rent sharing matter ? *Working Paper Research 180, National Bank of Belgium*.

Erickson, C. L. (1990). Union Wage Determination In Manufacturing In the 1980s Three Empirical Investigations. *Ph D. diss , MIT*, 10-170.

Estevao, M., & Tevlin, S. (2003). Do Firms Share their Success with Workers? The Response of Wages to Product Market Conditions. *Economica, vol. 70(280)*, 597-617.

Freeman, R., & Lazear, E. (1995). An Economic Analysis of Works Councils. *Works Councils: Consultation, Representation, Cooperation, University of Chicago Press for NBER*.

Gottshalk, P. (1997). Inequality, Income Growth and Mobility: The Basic Facts. *Applied Economics vol. 25*, 1033-1043.

Guertzgen, N. (2005). Rent-sharing: does the bargaining make a difference? Theory and empirical evidence. *ZEW Discussion*, 05-15.

Guertzgen, N. (2009). Rent-sharing and Collective Bargaining Coverage: Evidence from Linked Employer-Employee Data. *Scand. J. of Economics vol. 111(2)*, 323–349.

Holmlund, B., & Zetterberg, J. (1991). Insider effects in wage determination : Evidence from five countries. *European Economic Review, vol. 35(5)*, 1009-1034.

Iversen, T. (1996). Power, Flexibility, and the Breakdown of Centralized Wage Bargaining: Denmark and Sweden in Comparative Perspective. *Comparative Politics vol. 28*, 399-436.

Iversen, T. (1998). Wage Bargaining, Central Bank Independence and the Real Effects of Money. *International Organization, vol. 52*.

Kahn, L. M. (1997). Collective Bargaining and the Interindustry Wage Structure: International Evidence. *Economica vol. 65*, 507-534.

Katz, H. C. (1993). The Decentralization of Collective Bargaining: A Literature Review and Comparative Analysis. *Industrial and Labor Relations Review. vol. 47(1)*, 3-22.

Lever, M. H., & Marquering, W. A. (1996). Union Coverage and Sectoral Wages: Evidence from the Netherlands. *Empirical Economics, vol. 21(4)*, 483-99.

Lindbeck, A., & Snower, D. J. (1989). The Insider-Outsider Theory of Employment and Unemployment. *MIT Press Books, The MIT Press, vol. 1, number 026262074x*.

Lowell, B. L., Gelatt, J., & Batalova, J. (2007, March 15). *Immigrants and Labor Force Trends: The Future, Past, and Present*. Retrieved from www.migrationpolicy.org.

Magnani, E., & Prentice, D. (705-726). "Did globalization reduce unionization? Evidence from US manufacturing. *Labour Economics, vol. 10(6)*, 2003.

Martins, P. S., & Esteves, L. A. (2012). Wages and Profits in Manufacturing Firms: Matched-Panel Evidence from Brazil. *Economia, ANPEC - Associação Nacional dos Centros de Pósgraduação em Economia [Brazilian Association of Graduate Programs in Economics], vol. 13(3b)*, 815-841.

Matano, A., & Naticchioni, P. (2011). Is There Rent Sharing in Italy? Evidence from Employer-Employee Data. *European Journal of Comparative Economics, vol. 8(2)*, 265-279.

Mill, J. S. (1909). *Principles of Political Economy*. New York: Augustus M. Kelley Publishers.

Montobbio, F., & Rampa, F. (2002). The impact of technology and structural change on export performance on nine developing coutries. *Economics and Quantitative Methods qf0219*.

Nickell, S. J., & Andrews, M. (1983). Unions, Real Wages and Employment in Britain 1951-79. *Oxford Economic Papers, vol. 35(0)*, 183-206.

Oswald, A. (1985). The Economic Theory of Trade Unions: An Introductory Survey. *Scandinavian Journal of Economics, vol. 87*, 160-193.

Oswald, A. (1996). Rent-Sharing in the Labor Market. *The Warwick Economics Research Paper Series (TWERPS) vol. 474*.

Salop, S. (1979). A model of the natural rate of unemployment. *American Economic Review, vol. 69*, 117-125.

Sanfey, P. J. (1993). On the Interaction Between Efficiency Wages and Union-Firm Bargaining Models. *Economic Letters, vol. 41*, 319-324.

Sanne, H. (2006). Imperfect goods and labor markets, and the union wage gap. *Journal of Population Economics, Springer, vol. 19(1)*, 119-136.

Shapiro, C., & Stiglitz, J. (1984). Equilibrium unemployment as a worker discipline device. *American Economic Review, vol. 74*, 443-444.

Slichter, P. (1950). Notes on the Structure of Wages. *Review of Economics and Statistics, vol. 32*, 80-91.

Stiglitz, R. (1974). Wage determination and unemployment in LDCs: the labor turnover model. *Quarterly Journal of Economics, vol. 88*, 194-227.

Strand, J. (2003). Wage Bargaining Versus Efficiency Wages: A Synthesis. *Bulletin of Economic Research, vol. 55(1)*, 1-19.

Streeck, W. (1984). Neo-Corporatist Industrial Relations and the Economic Crisis in West. *in Goldthorpe, J. (ed.). Order and Conflict in Contemporary Capitalism. New York: Oxford University Press*, 291-314.

Suzuki, A. (1998). The Impact of the Decentralization of Collective Bargaining on the Internal Politics of Unions. *The Journal of Social Science*, 105-125.

Toulemande, E. (2003). The Interaction Between Efficiency Wage Theories and Labour Turnover Costs. *Bulletin of Economic Research, vol. 55(2)*, 203-208.

Van Reenen, J. (1994). The Creation and Capture of Rents: Wages and Innovation in a Panel of UK Companies. *CEPR Discussion Papers 1071*.

Walsh, F. (2012). Efficiency Wages and Bargaining. *Oxford Economic Papers, Oxford University Press, vol. 64(4)*, 635-654.

APPENDIX A: The Construction of Human Capital Variable

In order to capture the differences in employee quality across industries and time a human capital variable is added to the regression. Because of lack of data regarding industry-based average employee characteristics, the CPS (Current Population Survey) data is used to construct a measure of wages that workers expect to earn based on their characteristics. How to obtain this human capital variable can be explain in three steps.

The CPS data and the wage regression

We use earnings per week as a measure of wages for the dependent variable in the regression. The log of wage is regressed against education, race, age, race dummies, gender, marital status, occupation, full-time / part-time status and industry dummies (Table A-1).

Table A-1: Independent Variables

Independent variables	Measures	Explanations
Education	grade completed	Both variable and its square are used.
Age	age	Both variable and its square are used.
Race	dummy variables	white, black and others
Part-time status	ftpt variable	
Marital status	dummy variable	=1 if a person is married =0 otherwise
Occupation	occupation variable	
Industry	dummy variables	For each two-digit SIC dummies are added.

The average predicted wage

After the wage regression is performed with these regressors, the predicted wage is computed. The predicted wages found for each individual are averaged with respect to two-digit SIC manufacturing industries for each year from 1990 to 2002 since we need a measure for industry-based average worker characteristics for each year.

Matching two-digit SIC codes to three-digit NAICS codes

The average predicted wages obtained for two-digit SIC manufacturing industries match to three-digit NAICS codes since two-digit SIC codes and three-digit NAICS codes represents the same aggregate level for industries and so are appropriate for bridging.

Two-digit SIC manufacturing industries

20 Food and Kindred Products
21 Tobacco Manufacturing
22 Textile Mill Products
23 Apparel and Other Textile Products
24 Lumber and Wood Products
25 Furniture and Fixtures
26 Paper and Allied Products
27 Printing and Publishing
28 Chemicals and Allied Products
29 Petroleum and Coal Products
30 Rubber/Misc. Plastic Products
31 Leather and Leather Products
32 Stone, Clay, Glass and Concrete Products
33 Primary Metal Industries
34 Fabricated Metal Products
35 Industrial and Commercial Machinery and Computer Equip
36 Electrical Equipment and Components

37 Transportation Equipment

38 Measurement Analyzing, Control Instr. and Related Prod.

39 Misc. Manufacturing Industries

Three-digit NAICS manufacturing industries (NAICS 31-33: Manufacturing)

311 Food

312 Beverage & tobacco product

313 Textile mills

314 Textile product mills

315 Apparel

316 Leather & allied product

321 Wood product

322 Paper

323 Printing & related support activities

324 Petroleum & coal products

325 Chemical

326 Plastics & rubber products

327 Nonmetallic mineral product

331 Primary metal

332 Fabricated metal product

333 Machinery

334 Computer & electronic product

335 Electrical equipment, appliance, & component

336 Transportation equipment

337 Furniture & related product

339 Miscellaneous

By this matching process the human capital variable is obtained for each three-digit NAICS manufacturing industry. However, in this study six-digit industries are examined. Therefore, according to hierarchical structure of NAICS codes (Table A-2), the human capital variable based on three digit NAICS industries is assigned to six-digit NAICS industries. For instance the human capital variable for the industry sub sector whose NAICS code is 311 is assigned to the six-digit industries whose NAICS codes are 311111 and 311119.

Table A-2: The Hierarchical Structure of NAICS

XX	Industry Sector (20 broad sectors up from 10 SIC)
XXX	Industry Sub sector
XXXX	Industry Group
XXXXX	Industry
XXXXXX	U.S., Canadian or Mexican National specific

As a conclusion, the human capital variable is obtained for six-digit NAICS industries for 1990-2002.

APPENDIX B: Summary of the Balanced Data, 1990-2002

VARIABLES	(1) N	(2) mean	(3) sd	(4) max	(5) min
Naics[1]	**4589**	**327632**	**8825**	**339999**	**311111**
year	**4589**	**1996**	**3.742**	**2002**	**1990**
emp (thousands)	**4589**	**34.14**	**41.69**	**554.9**	**1**
Pay ($1m)	**4589**	**1140**	**1489**	**16163**	**20.70**
prode	4589	23.97	30.47	441.1	0.700
prodh	4589	48.58	61.60	870.6	1.200
prodw	4589	658.1	837.3	10475	9.800
Vship ($1m)	**4589**	**7630**	**12987**	**215565**	**113.1**
matcost	**4589**	**4059**	**8993**	**180568**	**34.80**
Vadd ($1m)	**4589**	**3579**	**5267**	**83558**	**55.30**
invest	**4589**	**259.8**	**500.8**	**6817**	**0.400**
invent	**4589**	**953.4**	**1935**	**35680**	**7.300**
energy	4589	132.2	352.2	7095	0.700
Capital ($1m)	**4589**	**3447**	**6615**	**95611**	**39.40**
equip	4589	2222	4406	59207	15.40
plant	4589	1224	2356	36404	22.60
piship	**4,589**	**0.973**	**0.0869**	**2.455**	**0.574**
pimat	**4589**	**0.968**	**0.0725**	**1.631**	**0.593**
piinv	**4589**	**0.978**	**0.0459**	**1.290**	**0.781**
pien	4589	0.975	0.0789	1.441	0.812
dtfp5	4589	-0.00415	0.0630	0.402	-0.499
tfp5	4589	0.963	0.102	1.714	0.443
dtfp4	4589	-0.00416	0.0630	0.402	-0.499
tfp4	4589	0.962	0.102	1.717	0.442
share	2823	1.000	0.00253	1	0.963
cpi	**4589**	**1.374**	**0.133**	**1.584**	**1.151**
cpi1987	**4589**	**113.6**	**0**	**113.6**	**113.6**
reint	**4589**	**0.0543**	**0.0125**	**0.0692**	**0.0300**
wage	**4589**	**23550**	**6086**	**49442**	**10597**
lnwage	**4589**	**10.03**	**0.261**	**10.81**	**9.268**
capital_1	**4589**	**3554**	**6824**	**97816**	**39.40**
Profit ($1m)	**4589**	**1417**	**2464**	**43426**	**2.468**
Ppe[2]	**4589**	**45854**	**68137**	**1.723e+06**	**1028**
Vaddpe[3]	**4589**	**113686**	**100888**	**1.439e+06**	**7713**
Linvent	**4589**	**944.6**	**1939**	**35680**	**9.300**
Revadd ($1m)	**4589**	**3583**	**5128**	**64502**	**44.22**

VARIABLES	(1) N	(2) mean	(3) sd	(4) max	(5) min
Lemp	**4589**	**34.55**	**41.88**	**554.9**	**1.300**
depr	**4589**	**160.2**	**311.1**	**4066**	**-294.2**
opcost	**4589**	**186.7**	**371.0**	**6079**	**1.372**
lnppe	**4589**	**10.40**	**0.731**	**14.36**	**6.936**
lnvaddpe	**4589**	**11.45**	**0.557**	**14.18**	**8.951**
Lprofit	**4589**	**1400**	**2383**	**37723**	**2.468**
Llnppe	**4589**	**10.38**	**0.728**	**14.36**	**7.030**
yd1990	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1991	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1992	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1993	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1994	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1995	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1996	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1997	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1998	**4589**	**0.0769**	**0.266**	**1**	**0**
yd1999	**4589**	**0.0769**	**0.266**	**1**	**0**
yd2000	**4589**	**0.0769**	**0.266**	**1**	**0**
yd2001	**4589**	**0.0769**	**0.266**	**1**	**0**
yd2002	**4589**	**0.0769**	**0.266**	**1**	**0**
HC[4]	**4589**	**5.985**	**0.420**	**6.771**	**4.570**
export	**4589**	**1285**	**2939**	**39065**	**0**
_merge	4589	3	0	3	3
Number of naics	353	353	353	353	353

Notes: Variables written in bold type indicates the variables used in this study

1. Six-digit NAICS industries
2. Profit per employee (thousands)
3. Real value added per employee (thousands)
4. Human capital

APPENDIX C: OLS Results by First Differencing

Table C-1: The Effect of Profit per Employee on Wages by First Differencing

VARIABLES	OLS (1) *Wage*	OLS (2) *Wage*
Profit per employee	0.0218*** (0.00348) [3.85e-10]	0.0197*** (0.00317) [5.03e-10]
Human capital	0.00259 (0.00993) [0.795]	
Year dummies	Yes	Yes
Observations	4,536	5,531
Adjusted R-squared	0.133	0.136

Notes: Robust standard errors in parentheses. P-values in brackets. The data is unbalanced. All regressions are run in logs. *** p<0.01, ** p<0.05, * p<0.1

APPENDIX D: Figures

In this section the figures associated with Table 1 are presented. The red line represents 45° line (tan45°=1) in all figures. Both predicted and actual wages are in logs.

Figure D-1: Predicted Regression Values – Actual Values for Year 1990

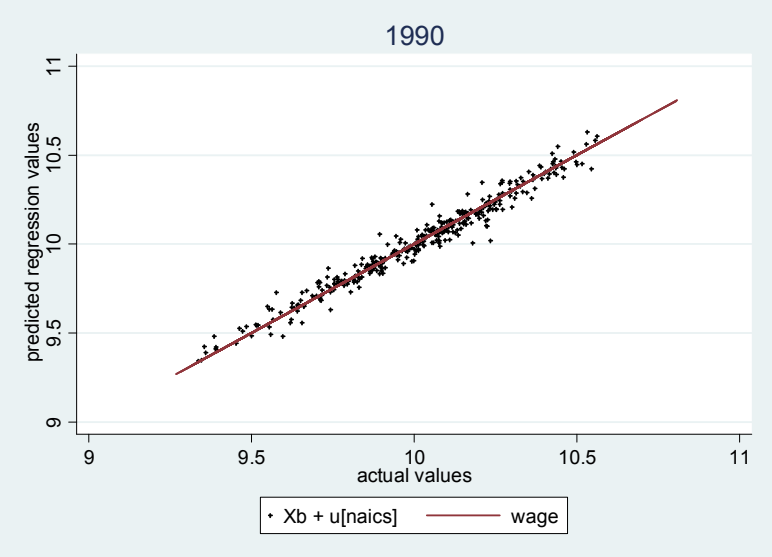


Figure D-2: Predicted Regression Values – Actual Values for Year 1991

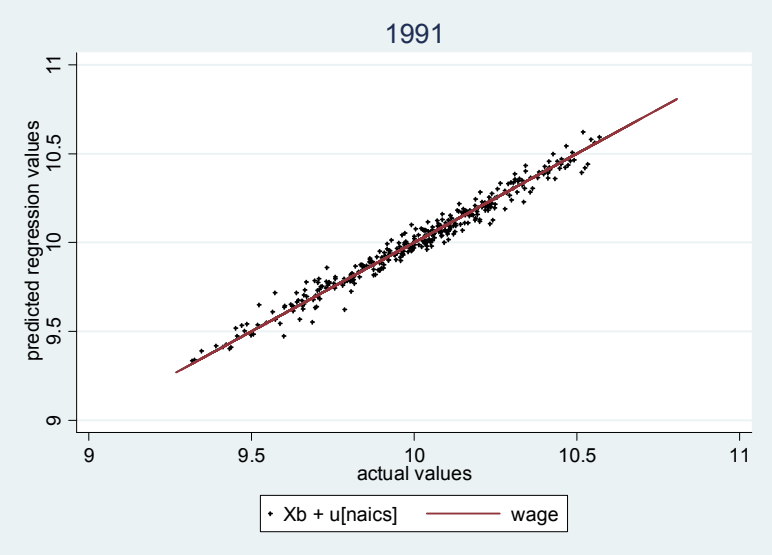


Figure D-3: Predicted Regression Values – Actual Values for Year 1992

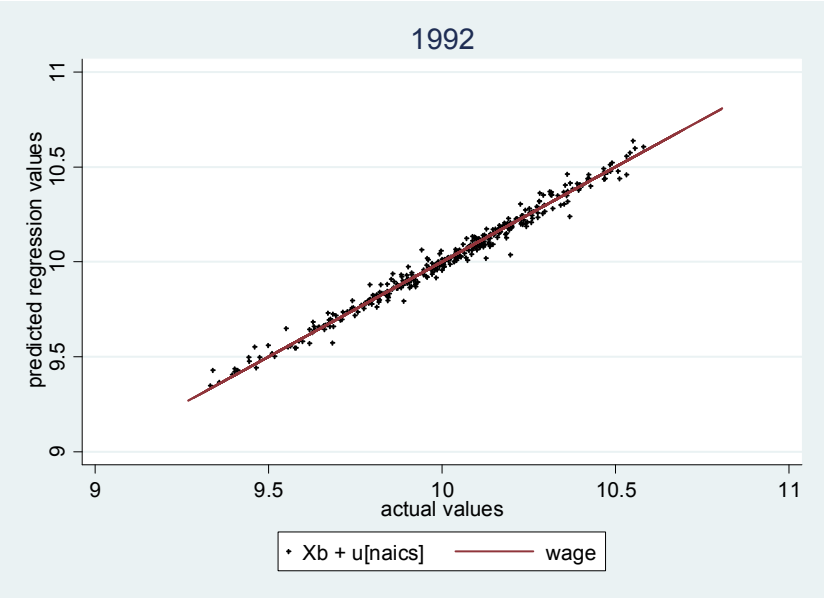


Figure D-4: Predicted Regression Values – Actual Values for Year 1993

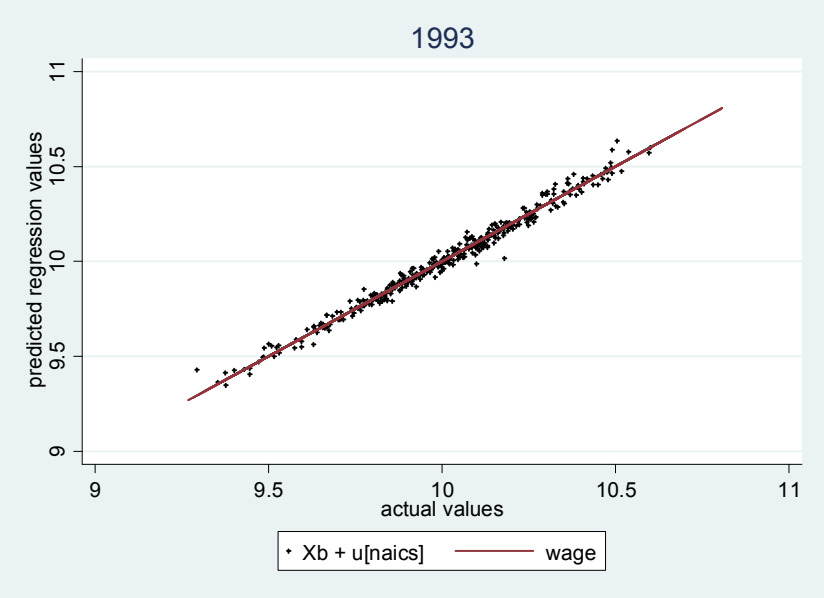


Figure D-5: Predicted Regression Values – Actual Values for Year 1994

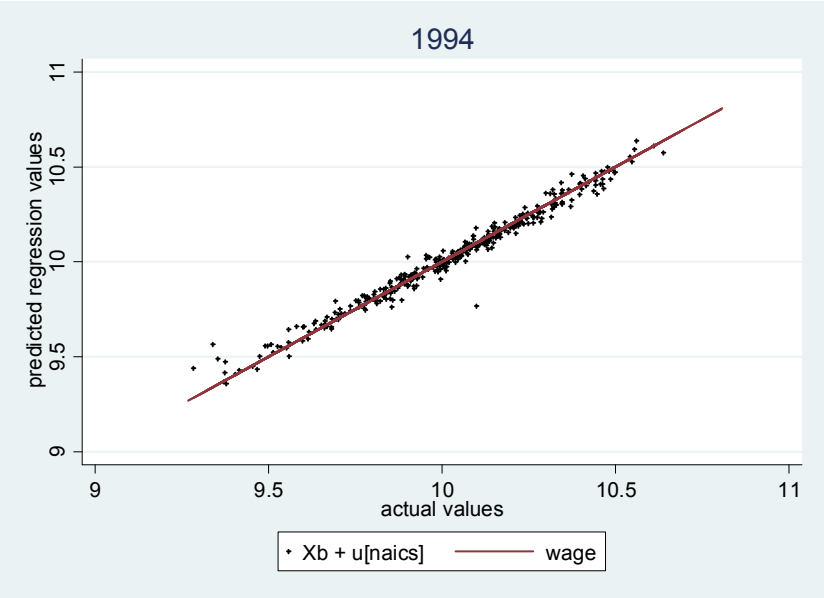


Figure D-6: Predicted Regression Values – Actual Values for Year 1995

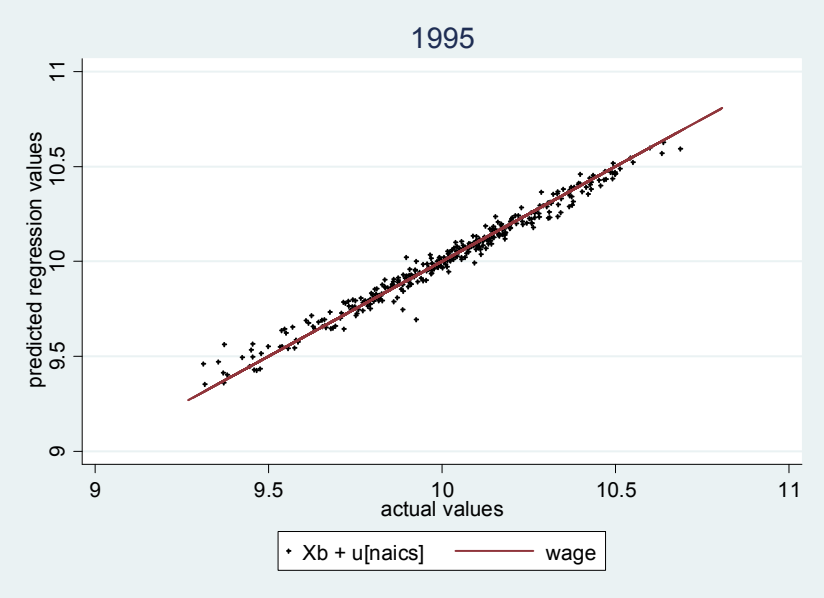


Figure D-7: Predicted Regression Values – Actual Values for Year 1996

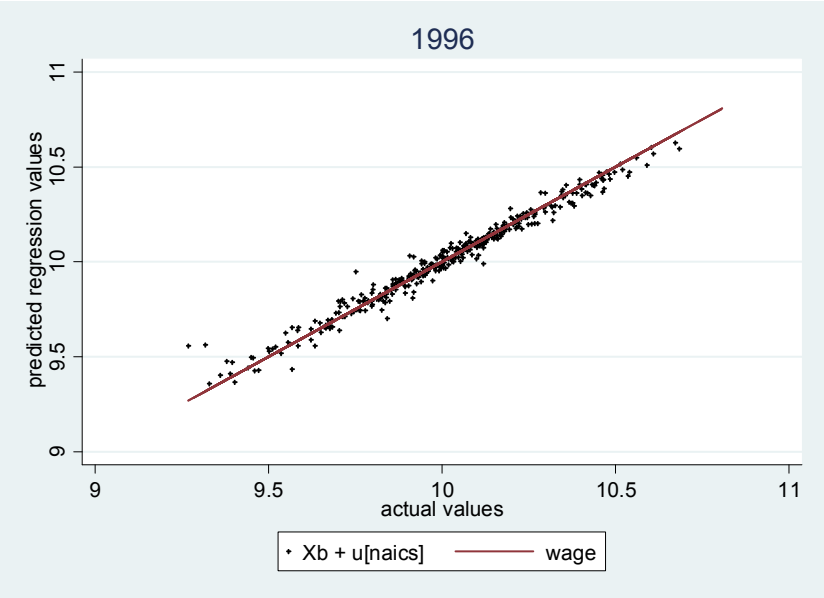


Figure D-8: Predicted Regression Values – Actual Values for Year 1997

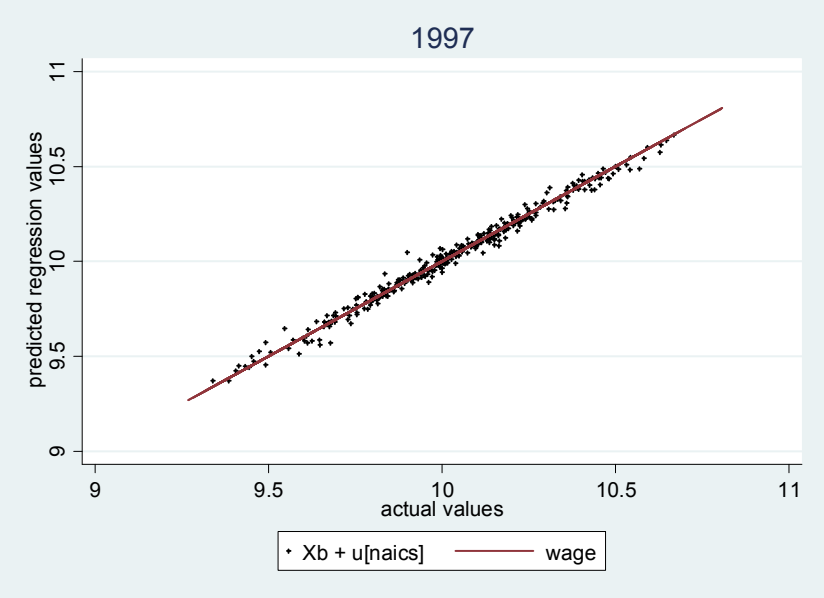


Figure D-9: Predicted Regression Values – Actual Values for Year 1998

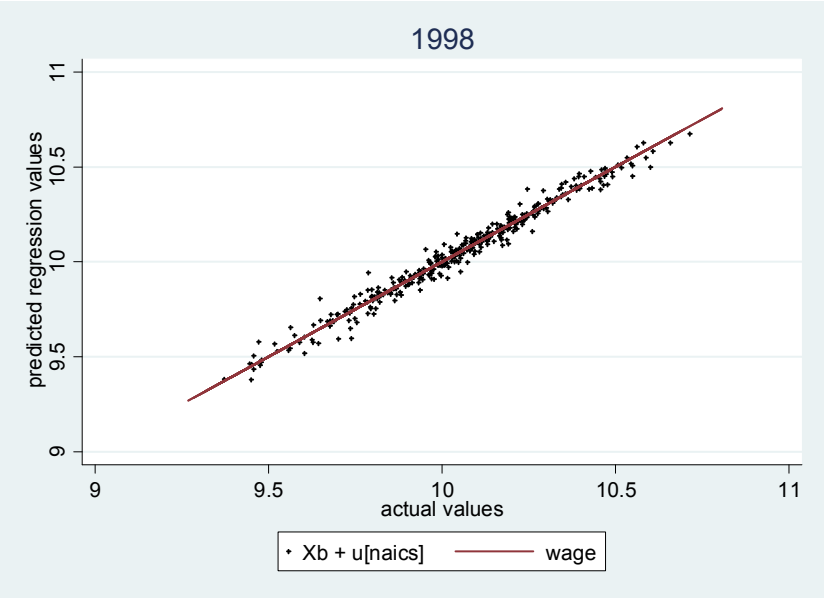


Figure D-10: Predicted Regression Values – Actual Values for Year 1999

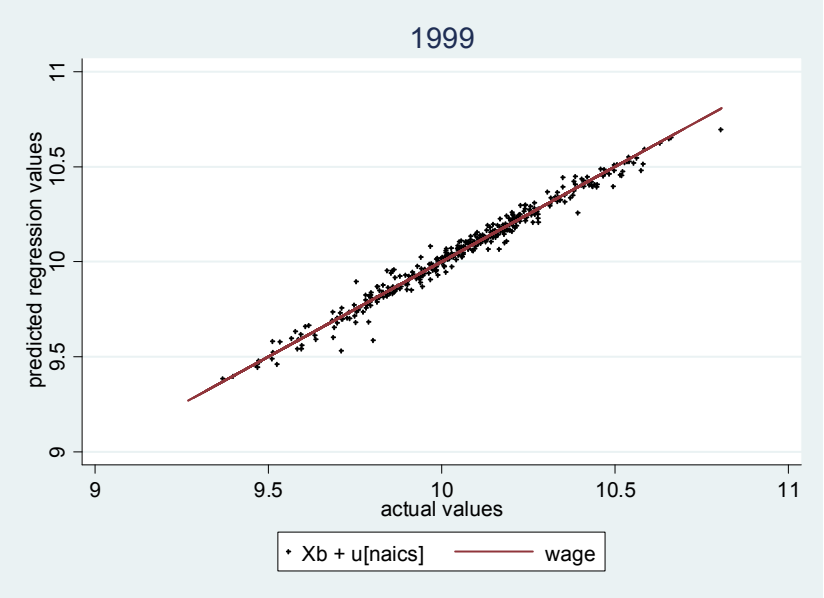


Figure D-11: Predicted Regression Values – Actual Values for Year 2000

Figure D-12: Predicted Regression Values – Actual Values for Year 2001

Figure D-13: Predicted Regression Values – Actual Values for Year 2002

(a) The predictions are made by including fixed effects ("predict $\hat{y}$, xbu"). The squared correlation coefficient between the predicted and actual values is 0.95.

(b) Both the predicted and actual values are summarized for the period 1990-2002 in Table D-1.

Table D-1: Summary for Predicted and Actual Values

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Wage	4589	10.03344	.2605857	9.268339	10.80856
Predicted Wage	4589	10.03344	.257002	9.334245	10.69548

APPENDIX E: Summary Results for First Stage Regressions of IV Estimations

1) Summary results for the first-stage regression associated with Table 5 (column (1)) are presented in Table E-1. The endogenous profit per employee variable is instrumented with the export value variable.

Table E-1: Summary Results for First-stage Regression (Profit per Employee)

Variable	F test of excluded instruments	Underidentification	Weak identification
Profit per employee	F(1, 4222) = 20.83 P-val = 0.0000	AP Chi-sq(1)= 20.90 P-val = 0.0000	AP F(1, 4222)= 20.83

Underidentification test

Ho: matrix of reduced form coefficients has rank=K1-1 (underidentified)

Ha: matrix has rank=K1 (identified)

Kleibergen-Paap rk LM statistic Chi-sq(1)= 15.53 P-val= 0.0001

Weak identification test

Ho: equation is weakly identified

Cragg-Donald Wald F statistic= 18.14

Kleibergen-Paap Wald rk F statistic= 20.83

Stock-Yogo weak ID test critical values for K1=1 and L1=1:

10% maximal IV size= 16.38

15% maximal IV size= 8.96

20% maximal IV size= 6.66

25% maximal IV size= 5.53

2) Summary results for the first-stage regression associated with Table 6 (column (1)) are exhibited in Table E-2. The endogenous value added per employee variable is instrumented with the export value variable.

Table E-2: Summary Results for First-stage Regression (Value Added per Employee)

Variable	F test of excluded instruments	Underidentification	Weak identification
Value added per employee	F (1, 4222) = 10.053 P-val = 0.0015	AP Chi-sq(1)= 10.08 P-val = 0.0015	AP F (1, 4222)= 10.05

Underidentification test

Ho: matrix of reduced form coefficients has rank=K1-1 (underidentified)

Ha: matrix has rank=K1 (identified)

Kleibergen-Paap rk LM statistic Chi-sq(1)=8.91 P-val=0.0028

Weak identification test

Ho: equation is weakly identified

Cragg-Donald Wald F statistic= 37.01

Kleibergen-Paap Wald rk F statistic= 10.05

Stock-Yogo weak ID test critical values for K1=1 and L1=1:

10% maximal IV size= 16.38

15% maximal IV size= 8.96

20% maximal IV size= 6.66

25% maximal IV size= 5.53