The International Trade Journal
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/uitj20

Do Labor Unions Hinder or Boost International Outsourcing? Evidence from U.S. Manufacturing

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Published online: 18 Mar 2015.

To cite this article: Kuang-Chung Hsu, Shinn-Juh Lin & Yungho Weng (2015) Do Labor Unions Hinder or Boost International Outsourcing? Evidence from U.S. Manufacturing, The International Trade Journal, 29:2, 142-162, DOI: 10.1080/08853908.2014.1001537

To link to this article: http://dx.doi.org/10.1080/08853908.2014.1001537

The International Trade Journal, 29:142–162, 2015

ISSN: 0885-3908 print/1521-0545 online
DOI: 10.1080/08853908.2014.1001537

Routledge
Taylor & Francis Group

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This article provides empirical evidence that labor unions can influence firms' international outsourcing decisions in the U.S. manufacturing sector. There is a negative effect of the current level of unionism and a positive effect of the previous level of unionism on the firms' international outsourcing intensity. Our results support the proposition put forward by Lommerud et al. (2009) that labor unions hinder firms' international outsourcing behavior, if the decision to outsource is made no later than the wage-employment bargaining. However, stronger labor unions still induce international outsourcing if firms' decisions are made subsequent to wage-employment bargaining.

KEYWORDS *labor union, international outsourcing*

I. INTRODUCTION

Since being thought of as an important means of job relocation, international outsourcing has been subjected to a great deal of resistance and

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opposition from workers' unions. The previous empirical research has paid much attention to the impact of outsourcing on labor market- and labor union-related issues (such as the effects on labor demand as well as the relative wage between skilled and unskilled workers).[1] However, little has been mentioned in related empirical studies regarding the impact of labor unions on the level of outsourcing. In fact, no employers can completely ignore their labor unions when making outsourcing decisions, since in-house wage negotiations with unions still directly or indirectly affect firms' labor costs and profits. Furthermore, unions are often blamed for pushing wages up with the result that firms relocate jobs overseas. Therefore, it is important to ascertain how unions may affect firms' outsourcing decisions.

Empirical studies on the effect of union power on outsourcing are sparse.[2] Kramarz (2008) examines French data and shows that stronger union power causes firms to increase outsourcing, leading to a subsequent decline in domestic employment. Abraham and Taylor (1996), however, survey 2700 U.S. establishments and find that the existence of labor unions positively, yet insignificantly, increases the likelihood of jobs being contracted out. Similarly, Magnani and Prentice (2010) also find a neutral effect between unionization and the level (or the change) in outsourcing share in U.S. manufacturing industries.

Why are there ambiguous results among those studies discussed? One thing that these studies have in common is that all of them investigate the union-outsourcing issue by only examining the *contemporaneous* relationship between outsourcing and union power. Since long-term profit-maximizing firms typically consider current, past, and/or future union pressures while making outsourcing decisions, a possible endogeneity problem between outsourcing decisions and the union power may exist, and may have led to biased estimation results. Consequently, an empirical investigation has to consider not only the *contemporaneous*, but also the *lagged* relationship between outsourcing decisions and the union power. Before exploring the implications of such relationships in yet another empirical study, we first resort to a careful review of the related theoretical literature for a rationale of such possibilities.

The remainder of this article is organized as follows. Section 2 is a review of related theoretical discussions in the literature. Section 3 describes the

[1] Feenstra and Hanson (1996; 1999) found evidence to support the effects of international outsourcing on wage inequality. Geishecker and Görg (2005) and Hijzen et al. (2005) examined the influence of outsourcing on the relative demand for skilled labor versus unskilled labor and the wage differences between them in the U.S., Germany, and the U.K., respectively. Egger and Pfaffermayr (2004) used data for the EU-15 countries to support the hypothesis that outsourcing facilitates international factor price equalization.

[2] The discussion of how unions impact firms' efficiency and performance, however, is substantial. Previous literature has found a mixed relationship between labor unions and firms' productivity. See the survey and reviews in Chintrakarn and Chen (2011) for detailed discussion.

data. In Section 4, we provide a detailed description of the econometric models adopted in this report. The empirical results are presented and elaborated on in Section 5. The final section concludes the article.

II. THEORETICAL BACKGROUND

The effect of union power on outsourcing has been a frequently discussed topic in earlier theoretical literature, although not in empirical literature. Most research explores such a relationship by modeling a sequential game played between firms and labor unions. A subgame perfect equilibrium for such a game is usually solved by the backward induction algorithm. As the decision-sequence is a critical assumption to the ensuing solutions for the sequential games, some studies assume that the outsourcing decision is taken before the in-house wage negotiations, while others assume otherwise.

Based on the assumption that the outsourcing decision is made before wage negotiations take place, there are three recent article that particularly deserve mentioning, all of which focus on the rent extraction from wage bargaining that takes place between firms and unions. Leahy and Montagna (2012) show that the effect of union power on outsourcing is positive, while Lommerud et al. (2009) depict a negative relationship, with an indeterminate link being proved by Kramarz (2008). Leahy and Montagna (2012) indicate that, when facing two mode-of-operation regimes, a firm's total rents under outsourcing are less sensitive to union bargaining power than they are under vertical integration, and hence a higher degree of union power increases the incentive to outsource. Lommerud et al. (2009) point out that outsourcing increases the firm's total rent. A stronger labor union can capture a larger share of this rent by pushing the in-house production wage up, making international outsourcing less profitable. Therefore, the effect of union power on outsourcing is negative. Finally, Kramarz (2008) demonstrates that, if the product market is imperfectly competitive, outsourcing reduces cost, increases total output, and decreases prices as well as the amount of rent to be shared from bargaining. Furthermore, if the elasticity of demand is strictly smaller than the elasticity of substitution between imports and labor, outsourcing will decrease domestic employment and hence the domestic wage impact. Accordingly, a firm facing a stronger union will outsource a larger share of its production. However, if the elasticity of demand is strictly larger than the elasticity of substitution between imports and labor, a firm will outsource less. Therefore, the effect of union power on outsourcing is indeterminate.

By contrast, Skaksen (2004), Braun and Scheffel (2007), and Lommerud et al. (2009) discuss the situation where the outsourcing decision is assumed to be made subsequent to wage negotiation. If the unit cost of international outsourcing is not sufficiently lower than the domestic wage rate, Skaksen

(2004) shows that outsourcing can be used as a threat in the wage bargaining process, and in order to discipline the union to set a lower wage rate than usual so that the firm will not outsource. However, if the unit cost of international outsourcing is sufficiently low, outsourcing will certainly be realized. As a consequence, the union with or without the threat of the firm's outsourcing will set a higher wage rate regardless. In this case, a higher in-house production cost reduces total output and hence the outsourcing intensity. Therefore, a higher degree of union power reduces outsourcing. Moreover, both Braun and Scheffel (2007) and Lommerud et al. (2009) find evidence of an indeterminate relationship, with the economic intuition behind their results being similar to that of Kramarz (2008). Braun and Scheffel (2007) prove that a stronger union induces more outsourcing if the positive direct effect, the gain from the wage differential between in-house production and outsourcing, dominates the negative indirect effect, the loss from a higher wage rate, thereby causing both total output and the marginal benefit from outsourcing to decrease. Lommerud et al. (2009) point out that the relationship between the union and outsourcing is determined by the effect of outsourcing on in-house employment. A higher degree of union power reduces outsourcing if outsourcing increases in-house employment, while it increases outsourcing if in-house employment decreases.

Although the theoretical literature has not provided us with a definitive relationship between union power and outsourcing, which may be due to different model settings and transmission mechanism channels, two important implications can be derived from the backward induction algorithm and the subgame perfect equilibria therein. First, if outsourcing takes place prior to the wage negotiation, the union's subsequent responses will be taken into consideration in the firm's outsourcing decision. In this case, the current status of union power ought to be an explanatory variable for the firm's outsourcing decision. Second, if outsourcing takes place subsequent to the wage negotiation, firms will take the union's power as given prior to their outsourcing decision. In this case, the past status of union power serves as a more suitable explanatory variable for the union-outsourcing relationship. In short, the literature offers a theoretical rationale for exploring both the *contemporaneous* and the *lagged* relationship between the union's status and the firms' outsourcing decision.

To help make up for the deficiency of existing empirical studies based on the insights offered by the theoretical literature, this article proposes to revisit the union-outsourcing relationship by inspecting international outsourcing activity and its relationship with union power in the U.S. manufacturing industries. In order to deal with the endogeneity between unionization and international outsourcing and unobserved heterogeneity in industry-level data, a generalized method of moments (GMM) approach developed by Arellano and Bover (1995) and Blundell and Bond (1998) is adopted in this study. In contrast to the previous literature, our empirical

results show that current union power significantly reduces outsourcing, and past union power significantly increases outsourcing. In this case, the theoretical arguments in Lommerud et al. (2009) are sustained, and that the elasticity of demand is greater than the elasticity of substitution between imports and labor (Kramarz, 2008) and that the direct effect could dominate the indirect effect (Braun and Scheffel, 2007) are also verified. However, if past union power is omitted, the relationship between current union power and outsourcing remains neutral.

This study employs data from U.S. manufacturing industries in the 1970s and 1980s. There are two reasons for the choice. First, international outsourcing of U.S. manufacturing grew rapidly in both the '70s and '80s. This is the same sample period chosen by Feenstra and Hanson (1996). Second, according to the data of Current Population Survey (CPS),[3] private sector union density dropped dramatically during the '70s and '80s. In the '90s, union density still declined but at a slower pace. Although offshoring has become more widespread after the '80s, the unionization of manufacturing became less influential.

III. DATA

Following Feenstra and Hanson (1996),[4] most empirical studies measure international outsourcing as the share of imported intermediate input in total purchases of non-energy materials. Feenstra and Hanson (1999), nevertheless, proposed a more accurate way of measuring the level of international outsourcing that only accounts for the intermediate inputs purchased from the same two-digit SIC industry. In this article, we adopt the second measure of international outsourcing used by Feenstra and Hanson (1999).[5] To construct the international outsourcing measure, we follow Feenstra and Hanson (1996; 1999) by using the Census of Manufactures data which are only available in years ending with 2 and 7. Specifically, we have collected relevant information on all 447 U.S. manufacturing industries in the years 1972, 1977, 1982, 1987, and 1992.[6]

In the original data, 86 industries exhibit zero outsourcing (importing no intermediate inputs purchased from the same two-digit SIC industry). After

[3] This argument is made based on the data collected and estimated by Hirsch and Macpherson (2003).

[4] The authors would like to thank Dr. Hanson for providing both outsourcing data and data on material purchases in U.S. manufacturing.

[5] The measurements of outsourcing introduced in Feenstra and Hanson (1996) and Feenstra and Hanson (1999) are termed the broad and narrow measures of outsourcing, respectively.

[6] Originally, there were 450 industries in the four-digit 1972 SIC. Data for three industries (SIC 2794, 3672, 3673) were either not available or incomplete in the recent version of the NBER Productivity Database.

a careful examination of those industries, we find that whether a particular industry in this group chooses to have zero outsourcing does not seem to be affected by their union coverage level. Instead, their zero outsourcing is mainly due to health and safety regulations, and the lack of comparative advantage in producing final goods and services. Since those 86 industries with no international outsourcing account for roughly 20% of our original data, and their outsourcing decisions are less likely to be affected by their respective levels of union coverage, we excluded them from our sample to reduce potential bias. To match up with the data availability for the international outsourcing measure, all of the other explanatory variables are also collected only for those five years for our later regression analyses.

The data on unionization are collected from the Current Population Survey (CPS) conducted by the Bureau of Labor Statistics (BLS). Since the CPS did not start surveying questions on union coverage (UC) until January 1983, we mainly employ, in this study, data on the percentage of labor union membership (UM) as a proxy for unionization.[7] The other problem is that data from the CPS are classified by either the three-digit 1970 or 1980 CPS industry classification. By contrast, all of the other data collected and examined in this study are classified according to the 1972 four-digit SIC codes. Thus, the following two steps are taken to align data according to the same 1972 SIC codes. First, the CPS data that are classified by the 1970 CPS industry classification are converted to those based on the 1980 CPS industry classification. Then, the bridge, provided by the BLS, between the 1980 CPS industry classification and three-digit 1972 SIC codes is employed to convert all data in the CPS to a dataset based on the three-digit 1972 SIC codes. Note that the UM data for 1972 are not available. We thus use data from 1973 to 1975 to extrapolate data for 1972.

The NBER Productivity Database has data on the values of shipments, numbers of skilled and unskilled workers in employment, expenditure on investment, total factor productivity, and payments to workers for each four-digit SIC manufacturing industry. The U.S. import and export data constructed by Feenstra (1996; 1997) are collected from the website of the Center for International Data at the University of California, Davis. Information on industry concentration ratios for capturing market structure comes from the U.S. Census Bureau (1997).

To sum up, we have assembled for this study a panel dataset with 361 U.S. manufacturing industries which are involved in some level of international outsourcing in each of the five years 1972, 1977, 1982, 1987, and

[7] In addition to the shortage of union-coverage data, a drawback of CPS mentioned by Freeman and Medoff (1979) is that one member of the family responded for all, which might lead to errors due to inaccurate knowledge. Since membership, compared to coverage, is easier for other family members to recognize, employing the percentage of membership is more ideal than using coverage. The data on the percentage of union coverage are used to check the robustness of our results if the period covers only the 1980s.

TABLE 1 Variable Definitions and Summary Statistics

	Variable Definitions	1972	1977	1982	1987	1992
OS (%)	International outsourcing	2.68	3.37	4.22	5.33	6.74
		(6.14)	(6.85)	(8.45)	(7.96)	(9.20)
UM (%)	Union membership	34.62	32.18	28.08	22.92	19.49
		(12.39)	(13.57)	(12.35)	(11.45)	(10.56)
*ULC*100*	Unit labor cost	24.37	21.42	21.13	20.20	19.60
		(9.35)	(8.58)	(8.23)	(8.15)	(8.10)
SL^R (%)	Skilled/unskilled employment ratio	35.18	36.51	42.29	43.42	44.54
		(23.30)	(23.62)	(26.43)	(31.38)	(31.18)
IMP (%)	Import penetration ratio	6.63	7.75	9.78	14.56	15.03
		(10.15)	(10.63)	(12.38)	(16.62)	(37.36)
CR20(%)	Market concentration	68.05	67.71	67.59	68.67	68.54
		(20.60)	(22.22)	(22.33)	(29.88)	(22.16)
*TFP*100*	Total factor productivity	97.90	97.77	95.07	100.00	100.81
		(22.13)	(17.59)	(10.78)	(0.00)	(10.37)
IE^R (%)	Investment/value of shipment ratio	3.14	3.33	3.49	2.95	3.23
		(2.01)	(2.39)	(2.30)	(1.41)	(2.04)
Gy (%)	Growth rate of output		13.65	−0.81	17.87	6.35
			(32.42)	(38.84)	(32.63)	(23.13)

Note: Numbers in parentheses are standard deviations.

1992. Such a rich panel dataset allows us to investigate heterogeneity in the adjustment dynamics of international outsourcing between different types of industries, and enables us to recover consistent parameter estimates for the various determinants of outsourcing.

Table 1 provides summary statistics for all the variables examined in this study. Except for international outsourcing (*OS*) and labor union membership (*UM*), we have selected seven explanatory variables from most studies that address the issue of determining the international outsourcing level. As can be seen in this table, in the U.S. manufacturing industries *OS* grew rapidly in the 1970s and 1980s. The percentage of *UM* decreased dramatically, especially in the 1970s. Unit labor cost (*ULC*) also decreased over these two decades, and could be the result of the decrease in labor demand. The skilled/unskilled employment ratio (SL^R) increased rapidly in both the 1970s and 1980s. The import penetration rate (*IMP*) rose together with the surge in globalization. The market structure (CR20) remained stable during the period between 1972 and 1992.[8] The technology (*TFP*) and output growth (*Gy*) declined in 1982 due to the recession in the early 1980s. The investment/value of the shipment ratio (IE^R) only grew at a faster pace in the 1970s.

In Table 2, we list the top 10 industries with the highest percentages of labor union membership for each of the five years examined. In addition,

[8] This study also tried including CR4, CR10, and CR50 in the regressions, but only CR20 has a significant effect on international outsourcing.

TABLE 2 Top 10 Industries with the Highest Percentage of Labor Union Membership (UM)

UM Rank	1972	1977	1982	1987	1992
1	**Railroad locomotives and equipment**	**Motor vehicles and motor vehicle equipment**	**Blast furnaces, steelworks, rolling & finishing mills**	**Pulp, paper, and paperboard mills**	Blast furnaces, steelworks, rolling & finishing mills
2	**Blast furnaces, steelworks, rolling & finishing mills**	**Blast furnaces, steelworks, rolling & finishing mills**	**Railroad locomotives and equipment**	**Blast furnaces, steelworks, rolling & finishing mills**	**Pulp, paper, and paperboard mills**
3	**Motor vehicles and motor vehicle equipment**	**Railroad locomotives and equipment**	**Pulp, paper, and paperboard mills**	**Motor vehicles and motor vehicle equipment**	Motor vehicles and motor vehicle equipment
4	Pulp, paper, and paperboard mills	Glass and glass products	**Motor vehicles and motor vehicle equipment**	Engines and turbines	**Engines and turbines**
5	**Engines and turbines**	**Pulp, paper, and paperboard mills**	**Engines and turbines**	**Tires and inner tubes**	**Leather tanning and finishing**
6	**Glass and glass products**	Primary aluminum industries	**Glass and glass products**	**Glass and glass products**	**Glass and glass products**
7	Iron and steel foundries	**Engines and turbines**	Primary aluminum industries	**Railroad locomotives and equipment**	**Railroad locomotives and equipment**
8	Primary aluminum industries	**Leather tanning and finishing**	**Leather tanning and finishing**	Primary aluminum industries	**Tobacco manufactures**
9	Other primary metal industries	Iron and steel foundries	**Tires and inner tubes**	**Metal forgings and stampings**	Iron and steel foundries
10	**Metal forgings and stampings**	**Paperboard containers and boxes**	**Paperboard containers and boxes**	Iron and steel foundries	**Primary aluminum industries**

Note: Manufacturing industries are classified by CPS industrial classification. The industries in bold are the ones with lower foreign outsourcing levels than the average level for the manufacturing industry as a whole.

we compare their international outsourcing levels with the average level of international outsourcing for all manufacturing industries combined. It can be found that more than half of the industries listed in the table had lower international outsourcing levels than the average. Although we cannot reach any solid conclusion based on the crude information presented in Table 2, it is very likely that unionization does bear some relationship with the level of international outsourcing for U.S. manufacturers.

IV. METHODOLOGY

The level of outsourcing is persistent in the sense that it is affected by the outsourcing level from the previous period. Because of this, a dynamic model is called for to study how labor unions and other factors together affect the level of international outsourcing. Correspondingly, we set up the following single-equation first-order autoregressive regression model

$$\begin{aligned} OS_{it} = {} & c_t + \beta_1 OS_{it-1} + \beta_2 UM_{it} + \beta_3 UM_{it-1} + \beta_4 ULC_{it} + \beta_5 ULC_{it-1} \\ & + \beta_6 SL_{it}^{R} + \beta_7 IMP_{it} + \beta_8 CR20_{it} + \beta_9 TEP_{it} \\ & + \beta_{10} IE_{it}^{R} + \beta_{11} Gy_{it} + \eta_i + u_{it}, \end{aligned} \tag{1}$$

where i represents each of the 361 U.S. manufacturing industries; t indicates the year that belongs to either 1972, 1977, 1982, 1987, or 1992; c_t is the year-specific intercept included to account for common cyclical or trend components in the levels of international outsourcing; OS_{it} is the *international outsourcing level*; and OS_{it-1} is the previous level of international outsourcing, which has been considered to have a positive effect on OS_{it}.[9]

UM_{it} and UM_{it-1} represent the present and previous *level of unionization*, which is measured by the percentage of union membership. Based on the discussion earlier, for improving the endogeneity problem in the previous literature, which assumed a *contemporaneous* relationship between outsourcing and the union's bargaining power, we have a *lagged relationship* between these two subjects in our empirical model. The present *level of unionization* could have either a positive or a negative impact on the level of outsourcing. A positive sign indicates that a stronger labor union also results in a higher level of outsourcing. This idea is supported by Abraham

[9] Braun and Scheffel (2007) argued that because of the existence of sunk entry costs of international outsourcing, including cost required to find qualified foreign suppliers, as well as the expenditures incurred in monitoring the contract with foreign firms, previous outsourcing has had a positive impact on the present outsourcing level. A positive impact from the previous outsourcing level also means that the strategy of outsourcing is a persistent one. This positive effect has been confirmed by Girma and Görg (2004), Swenson (2004), and Díaz-Mora (2008).

and Taylor (1996) and Leahy and Montagna (2012), while a negative sign can be seen as support for the findings in Skaksen (2004) and Lommerud et al. (2009) that deunionization can trigger outsourcing or that the indirect effect dominates the direct effect, as in the framework of Braun and Scheffel (2007). In addition, the previous *level of unionization* can test the relationship between outsourcing and union power in the scenario that outsourcing takes place subsequent to wage negotiation. According to the discussion in Lommerud et al. (2009), the relationship between the labor union and outsourcing depends on how outsourcing changes domestic labor demand. This involves the debate on whether foreign and domestic workers are substitutes or complements under international outsourcing. Harrison and McMillan (2011) found that offshoring to low-wage countries substitutes for domestic employment by employing U.S. firm-level data.[10] Thus, a positive sign is expected for the previous *level of unionization*.

ULC_{it} and ULC_{it-1} are the present and previous *unit labor cost* measured as the labor cost per worker divided by output per worker,[11] which is believed to have a positive effect on the international outsourcing level.[12] However, previous studies have also argued that the decrease in labor demand caused by international outsourcing leads to a fall in labor expenditure. Therefore, a negative connection could be found because of the mutual influence between the *unit labor cost* and *international outsourcing level*. Compared to *unit labor cost* in the present time, *unit labor cost* in the previous time period is more likely to be able to capture the positive impact of *unit labor cost* on the decision to outsource. We include both the present and previous *unit labor cost* in our regression equation to assess the relationship between *unit labor cost* and outsourcing. In addition to the discussion on a positive and negative relationship between cost and outsourcing, Chen et al. (2004) have proposed that, instead of cost-saving incentives, outsourcing firms sometimes purchase a key intermediate input from more efficient suppliers that are also their rival in the final good market. If strategic outsourcing were important among U.S. manufacturing, we would expect an insignificant relationship between ULC_{it-1} and OS_{it}.

SL^R_{it} describes the *labor-skill requirement*, which is measured by the skilled/unskilled employment ratio. Normally, unskilled-labor-intensive industries in a skilled-labor-abundant country like the U.S. would tend to adopt outsourcing. On the other hand, firms engaging in production with

[10] They also found that, for firms that do significant tasks at home and abroad, foreign and domestic employment are complements. By combining both effects, offshoring is still responsible for a quantitatively small decline in manufacturing employment.

[11] Labor cost is the payroll received by both production and nonproduction workers. It does not include Social Security or other mandated payments, or employer payment for some fringe benefits. See Bartelsman and Gray (1996) for a detailed definition.

[12] The positive effect can be found in studies such as Abraham and Taylor (1996), Girma and Görg (2004), Görg and Hanley (2004), Holl (2008), and Díaz-Mora (2008).

high skill levels and adopting outsourcing as a cost reduction strategy also have incentives to outsource low-skilled jobs. Hence, the level of the high labor-skill requirement could be negatively or positively related to the level of international outsourcing.[13]

Globalization and trade liberalization that increase the competition between domestic firms and foreign firms have also been considered to be an important factor inducing international outsourcing. We employ IMP_{it} to represent the *foreign competition* measured by the import penetration ratio[14]; because import competition depresses the domestic price, market share, and profit per unit and firms tend to outsource more in-house activities that are less productive in order to raise the unit profit, *foreign competition* should have a positive impact on the level of outsourcing.[15]

The *market structure* of the US manufacturing industries can also have an impact on the level of outsourcing. $CR20_{it}$ is the market concentration of sales ratio of the top 20 firms in the industry. The effect of *market structure* on international outsourcing is undetermined.[16] TFP_{it} is the total factor productivity, which represents the *technology level*. Lommerud et al. (2009) believed that firms with better technology have a larger share of the market. They will benefit from outsourcing, which cuts their marginal cost more than that of firms with a smaller share of the market. Thus, a positive sign is expected. IE^{R}_{it} is the investment/value of the shipment ratio, which can tell us whether industries with high levels of investment also engage in international outsourcing.[17] Gy_{it} is the growth rate of output, which can capture the effects of the business cycle and life cycle in a manufacturing industry. η_i is an unobserved industry-specific time-invariant effect which allows for heterogeneity in the mean levels of the international outsourcing across industries, and u_{it} is a disturbance term, which is assumed to be independent across industries.

[13] By considering similar issues such as unionization and unit labor cost, the impact of international outsourcing on the relative employment of skilled workers is also a focus in the previous literature. Thus, the explanatory variable for the labor-skill requirement will be regarded as an endogenous variable in our model.

[14] It is computed as the ratio of imports to total consumption (total output plus imports minus exports).

[15] The idea is empirically confirmed by Sundaram (2011).

[16] One the one hand, firms in oligopoly markets have a higher probability of earning more profit than those in markets that are close to being perfectly competitive. If they reinvest their retained earnings in covering the search costs of international outsourcing, there will be a positive relationship between the concentration ratio and outsourcing. On the other hand, firms in a competitive market may also have an incentive to outsource. Outsourcing can lower firms' costs, and it also provides firms in a competitive market with an opportunity to become a dominant firm in the market. In addition, if one firm in the competitive market is outsourcing, the rest of the firms have to have the same strategy, otherwise they will be swept out of the market.

[17] If outsourcing is a result of foreign direct investment (FDI), firms that are willing to invest more will also tend to outsource. Thus, a positive impact is expected. However, a negative impact will arise where, instead of using outsourcing to lower production costs, employers adopt machines and automation to replace human labor.

Estimating the dynamic model specified in Equation (1) using ordinary least squares (OLS) will typically not produce consistent parameter estimates due to the existence of an unobserved, industry-specific time-invariant effect η_i. Instead, it is well known in the panel econometrics literature that the OLS tends to overestimate the coefficient on the lagged dependent variable $OS_{it\text{-}1}$. To remove such inconsistency, Within-Groups estimation can be employed to estimate the dynamic model. Specifically, the original observations of all dependent and independent variables for each industry are expressed as deviations from their individual means before the model is estimated. The cost of such a Within-Groups transformation is that it also introduces all realizations of the disturbances u_{it} into the error term of the transformed model in each period, which can be proved to produce an underestimate of the coefficient (see p. 7 in Bond 2002). Alternatively, the first-differenced, two-stage, least-squares (2SLS) estimator proposed by Anderson and Hsiao (1981; 1982) can be used to obtain consistent parameter estimates. However, the 2SLS estimator is generally not efficient due to the serial correlation in the disturbance terms generated by the first-differencing.

To improve estimation efficiency, the first-differenced GMM panel data estimator developed by Holtz-Eakin et al. (1988) and Arellano and Bond (1991) provides a viable alternative.[18] As demonstrated in Bond (2002), there are several other advantages in using the first-differenced GMM estimator. First, if there is a reason to believe that the dynamic model is well specified and the instruments selected are valid, the first-differenced GMM estimate of the coefficient on the lag dependent variable should fall somewhere in between the overly estimated OLS estimate and the underestimated Within-Groups estimate. This provides a safeguard to the specification of the model. Second, the first-differenced GMM estimator can be used in the absence of any strictly exogenous instruments, and can be easily extended to models with predetermined or endogenous explanatory variables. For the question examined in this article, the level of outsourcing is likely to be either contemporaneously correlated (or correlated with a lag) with other explanatory variables, such as the level of unionization, unit labor cost, etc. Therefore, we propose estimating the dynamic model specified in Equation (1) using the first-differenced GMM estimating approach.

V. ECONOMETRIC RESULTS

Before we start discussing our econometric results, the correlation coefficients in Table 3 used to check collinearity and multicollinearity can help us

[18] Rigorous surveys of this kind of first-differenced GMM panel data estimator can be found in Arellano and Honoré (2001) and Blundell et al. (2000). For an intuitive introduction to such an approach and its applications in studying micro-panel data, see Bond (2002).

TABLE 3 Correlation Coefficients Between Explanatory Variables

	OS_{it-1}	UM_{it}	UM_{it-1}	ULC_{it}	ULC_{it-1}	$SL^R{}_{it}$	IMP_{it}	$CR20_{it}$	TFP_{it}	$IE^R{}_{it}$	Gy_{it}
OS_{it-1}	1.00										
UM_{it}	−0.04	1.00									
UM_{it-1}	−0.03	0.93*	1.00								
ULC_{it}	−0.08*	−0.09*	−0.14*	1.00							
ULC_{it-1}	−0.10*	−0.11*	−0.12*	0.96*	1.00						
$SL^R{}_{it}$	−0.02	−0.16*	−0.15*	0.02	0.04	1.00					
IMP_{it}	0.17*	−0.13*	−0.10*	0.00	0.02	−0.04	1.00				
$CR20_{it}$	0.01	0.17*	0.17*	−0.29*	−0.27*	0.04	0.12*	1.00			
TFP_{it}	−0.02	0.04	−0.01	0.03	0.06*	0.02	0.04	−0.01	1.00		
$IE^R{}_{it}$	−0.05	0.08	0.08*	0.02	0.03	0.09*	−0.01	0.11*	−0.05*	1.00	
Gy_{it}	−0.02	−0.12	−0.13*	−0.06*	0.02	0.18*	−0.10*	0.02	0.11*	0.13*	1.00

Note: *significant at the 5% level.

realize the relationship between our explanatory variables. As we expected, the only variables strongly correlated with others are the *level of unionization* and *unit labor cost*, which are correlated strongly with their lag terms. Table 4 reports the estimation results of the single-equation, first-order autoregressive regression model specified in Equation (1). The first two columns report the OLS and Within-Groups estimates of the coefficient β_1 on the lagged outsourcing level OS_{it-1}, together with heteroskedasticity-consistent estimates of the asymptotic standard errors. As discussed in the previous section, if the model specified in Equation (1) provides a good representation for the outsourcing series, the OLS estimate of β_1 is likely to be biased upward, while the Within-Groups estimate of β_1 is likely to be biased downward. Certainly, from our empirical results, the OLS estimate (0.885 with a t-statistic of 52.27) is considerably higher than the Within-Groups estimate (0.277 with a t-statistic of 7.33).

Since both the OLS and the Within-Groups estimates of the coefficient β_1 are biased, and parameter estimates for the other explanatory variables reported in the second and third columns of Table 4 are similarly unreliable, we opt for the first-differenced GMM estimates. To start with, we only include major independent variables as discussed in the related literature and in Section 2 of this paper, which include OS_{it-1}, UM_{it}, UM_{it-1}, ULC_{it}, $SL^R{}_{it}$ and IMP_{it}, and present the estimation results in the fourth and fifth columns of Table 4. As demonstrated in Arellano and Bond (1991) and Bond (2002), it is important to differentiate whether explanatory variables are *endogenous, predetermined*, or *exogenous* in order to select appropriate instruments (selected mainly from the lagged explanatory variables) for the first-differenced GMM estimates.[19] To summarize, IMP_{it} can be safely treated as an exogenous variable, and ULC_{it} and $SL^R{}_{it}$ are two important factors that

[19] According to Arellano and Bond (1991), an *endogenous* variable is correlated with the current shocks in the dependent variable, and hence only lagged realizations are allowed as instruments; a *predetermined* variable is one whose future realizations can be correlated with current shocks in the

TABLE 4 Regression Results and Robustness Tests

	Dependent Variable: International Outsourcing Narrowly Defined					Robustness Checks			
	Contemporaneous & Lagged Relationship					*Contemporaneous*		Broad *OS*	*UC*
	OLS	Within-Group	Predetermined	Benchmark	Complete	Complete		Benchmark	OLS
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
OS_{it-1}	0.885	0.277	0.803	0.522	0.540	0.640	0.745	0.807	0.768
	(52.27)	(7.33)	(2.17)	(1.63)	(1.79)	(1.81)	(2.16)	(3.30)	(30.06)
UM_{it}	−0.043	−0.019	0.013	−0.425	−0.445	−0.184	−0.135	−0.318	−0.069
	(1.61)	(0.55)	(0.10)	(1.71)	(2.00)	(1.13)	(0.87)	(1.19)	(1.24)
UM_{it-1}	0.050	−0.008	0.029	0.425	0.365			0.355	0.091
	(1.95)	(0.23)	(0.33)	(2.60)	(2.49)			(1.64)	(1.77)
ULC_{it}	0.045	−0.091	−0.505	−1.087	−0.756	−0.447	−0.428	−0.319	0.099
	(0.74)	(1.18)	(1.06)	(2.50)	(2.11)	(1.49)	(1.43)	(0.47)	(0.95)
ULC_{it-1}	−0.048	−0.309	−0.371	−0.343	−0.225	−0.237		−0.198	−0.107
	(0.81)	(4.06)	(2.12)	(1.82)	(1.40)	(1.62)		(0.93)	(1.05)
$SL^R{}_{it}$	0.012	0.024	−0.177	−0.250	−0.147	−0.104	−0.112	−0.225	0.016
	(2.65)	(1.70)	(2.18)	(3.61)	(2.38)	(1.40)	(1.50)	(2.87)	(2.41)
IMP_{it}	0.032	0.018	0.009	−0.003	0.002	0.006	0.004	−0.001	0.033
	(5.59)	(2.29)	(0.36)	(0.11)	(0.12)	(0.28)	(0.21)	(0.07)	(4.37)
$CR20_{it}$	0.006	−0.005			−0.020	−0.011	−0.010		0.005
	(1.04)	(0.47)			(2.50)	(1.30)	(1.13)		(0.60)
TFP_{it}	0.027	0.031			0.018	0.028	0.030		0.097
	(2.43)	(2.35)			(0.72)	(1.13)	(1.19)		(3.11)
$IE^R{}_{it}$	−0.020	0.191			0.320	0.351	0.372		−0.012
	(0.32)	(2.02)			(1.70)	(1.85)	(1.94)		(1.37)
Gy_{it}	−0.005	−0.011			−0.023	−0.019	−0.023		−0.072
	(1.31)	(1.98)			(2.13)	(2.05)	(2.53)		(0.58)
AR(1)			0.001	0.005	0.003	0.007	0.002	0.001	
AR(2)			0.631	0.771	0.774	0.993	0.947	0.562	
Hansen			0.330	0.586	0.836	0.329	0.261	0.308	
# of instruments/#of Obs			37/1083	40/1083	51/1083	54/1083	54/1083	40/1083	

Notes: Numbers in parentheses are the absolute values of *t* statistics; "Broad *OS*" represents the broad definition of international outsourcing. "*UC*" represents union coverage.

employers need to consider before making their decisions whether to outsource, and are therefore regarded as predetermined variables. Since the effect of unionization on international outsourcing depends on the order of wage bargaining and outsourcing decisions, UM_{it} can be treated either as a predetermined or an endogenous variable. In column 4 of Table 4, UM_{it} is treated as a predetermined variable. However, in column 5 of Table 4, UM_{it} is treated as an endogenous variable.[20]

In column 4, we notice that the coefficient (β_1) of the lagged dependent variable $OS_{it\text{-}1}$ is 0.803, which is only slightly smaller than the OLS estimate (0.885). In other words, the first-differenced GMM estimate with UM_{it} being treated as a predetermined variable does not seem to result in much of an improvement over the OLS estimate, although it does indicate that the previous international outsourcing level has a significantly positive impact on the present international outsourcing level. By contrast, if UM_{it} is treated as a strictly endogenous variable, as in column 5, the coefficient (β_1) of the lagged dependent variable $OS_{it\text{-}1}$ becomes 0.522 (with a t-statistic of 1.63), which is very well placed toward the center of the range spanned by the OLS estimate (0.885) and the Within-Groups estimate (0.277). Therefore, our empirical experiments indicate that treating UM_{it} as an endogenous variable seems to be a better specification of the panel regression model for outsourcing.

By treating UM_{it} as an endogenous variable, and for completeness, we include other explanatory variables ($CR20_{it}$, TFP_{it}, $IE^{R}{}_{it}$, and Gy_{it}) of outsourcing, report the estimation results in column 6 of Table 4, and summarize the main results as follows. First of all, the pattern of the AR(1) and AR(2) coefficients in the error terms and the Hanson test indicate that our instruments in the first-differenced GMM panel equations are appropriately selected. More importantly, the coefficient of the present union membership, UM_{it}, is significantly negative, while the coefficient of the lagged union membership, $UM_{it\text{-}1}$, is significantly positive. These results seem to imply that firms restrain their tempers to please the union by reducing current outsourcing while wage negotiation is under way. However, firms that have suffered from past negotiation experiences of union pressure will eventually increase outsourcing in the future.

The negative coefficients of UM_{it}, which, as we argued in the Introduction, capture the situation where the firm's outsourcing decision is taken in advance of the wage negotiation, show that higher

dependent variable, and hence it is admissible to allow all current and lagged realizations as instruments; and an *exogenous* variable is not correlated with the error term in the model at all. Therefore, all observations (for exogenous variables) become valid instruments in all time periods.

[20] Although our sample data do not contain information on date of contract, the first-differenced GMM approach proposed by Arellano and Bond (1991) and Bond (2002) allows us to handle the situation where *UM* is a predetermined variable (wage bargaining precedes employers' decision to outsource internationally), as well as the situation where *UM* is as an endogenous variable (employers' decision to outsource internationally precedes wage bargaining.)

contemporaneous union power discourages international outsourcing (i.e., *contemporaneous* deunionization could induce international outsourcing). Our empirical results show that the theoretical ideas in Lommerud et al. (2009) and in Kramarz (2008) for the case where demand elasticity is larger than the elasticity of substitution between imports and labor can be applied to U.S. manufacturing during the 1970s and 1980s. However, the theoretical view in Leahy and Montagna (2012) that firms' rents are less sensitive to union power under outsourcing than those under vertical integration, and the positive relationship between *contemporaneous* union power and outsourcing obtained by Kramarz's (2008) empirical estimations using French data, are not supported by our empirical results.

On the other hand, the positive coefficients of UM_{it-1}, which characterizes the situation where the wage bargaining takes place in advance of the firm's outsourcing decision, indicate that a high degree of union power in the past encourages international outsourcing. Our empirical results verify the theoretical arguments, although the direct effect described in Braun and Scheffel (2007) could dominate the indirect effect, and in Lommerud et al. (2009) a strong labor union cannot make outsourcing less profitable if outsourcing decreases in-house employment. However, the theoretical argument in Skaksen (2004) is not maintained by our empirical results.

Unlike the results in previous studies, ULC_{it} negatively affects international outsourcing. A possible explanation is that considerable outsourcing decisions within the U.S. manufacturing sector were motivated by strategic reasons due to the competition they faced with their rivals.[21] The lagged ULC_{it-1}, nevertheless, is not statistically significant. The negative coefficient of SL^R_{it} indicates that unskilled-labor-intensive industries in U.S. manufacturing tend to outsource more. A significantly negative coefficient of $CR20_{it}$ and a significantly positive coefficient of IE_{it}^R indicate that firms in a competitive market as well as firms that invest more tend to outsource more. Finally, a significantly negative coefficient of Gy_{it} shows that outsourcing provides employers with another way of reducing their costs when economic conditions are less favorable, or when there is a fall in their production. The coefficients of foreign competition (IMP_{it}) and total factor productivity (TFP_{it}) are both statistically insignificant, and have no effect on firms' decisions to engage in international outsourcing.

One of our major arguments in this article concerns the endogeneity problem in previous empirical studies. However, as far as we know, these studies, such as Abraham and Taylor (1996), Kramarz (2008), and Magnani and Prentice (2010), regard *contemporaneous unionization* as one of the explanatory variables and ignore the role of *past unionization*. We hence

[21] Another possible explanation is that if a firm's R&D increases the complexity of its product in a way that leads to an increase in the labor cost, it is more expensive to outsource part of their production to host countries.

include lagged explanatory variables in our regression equation to address this problem. Estimation regressions with only the *contemporaneous* relationship between the *level of unionization* and *international outsourcing level* and the *unit labor cost* and *international outsourcing level* can show the importance of the *lagged relationship*. Columns 7 and 8 in Table 4 indicate the results from the same setting as in column 6 but without lagged explanatory variables. With a missing *lagged relationship* and a *contemporaneous relationship*, it can be seen that a negative but insignificant relationship exists between the *level of unionization* and the *international outsourcing level*. Such a relationship seems to demonstrate why the empirical results are inconsistent in previous studies when lagged variables are ignored. The signs of the remaining explanatory variables are unchanged, while estimations of the variables ULC_{it-1}, $SL^R{}_{it}$ and $CR20_{it}$ turn out to be insignificant.[22]

The robustness checks regarding the measurement issues are presented in columns 9 and 10. First, we check whether our main results regarding the relationship between the *level of unionization* and *international outsourcing level* will still hold if our dependent variable changes to the broad measure of international outsourcing (Broad *OS*). In column 9, we can see that the coefficients for UM_{it} and UM_{it-1} remain negative and positive, respectively, but the coefficient for UM_{it} is no longer statistically significantly different from zero. The coefficient for UM_{it-1} is statistically significant at the 10% level. Since the broad measure of international outsourcing includes some imported intermediate goods that could not have been produced by the U.S. workers, we cannot say that our conclusion with regard to UM_{it} and UM_{it-1} is not robust based on the signs of the coefficients for UM_{it} and UM_{it-1} in column 6 being the same as those for the coefficients in columns 9 and 10.

Second, what happens to our results if we switch the estimation of unionization from *UM* to *UC*? Although we cannot employ GMM because of the limitation on the numbers of years of *UC* data, we can compare the OLS results for *UC* with our results in column 2. As can be seen in column 10, there is not much difference between these two results. Therefore, we expect that adopting *UC* as a proxy for unionization is not much different from adopting *UM* when discussing the relationship between the *level of unionization* and *international outsourcing level* in U.S. manufacturing during the 1970s and 1980s.

VI. CONCLUSIONS

In responding to the rapid growth in outsourcing, labor unions in the outsourcing home countries use their bargaining power, strikes, and protests

[22] The coefficients of the variable OS_{it-1} become 0.640 and 0.745, which deviate from the center of the range spanned by the OLS estimate (0.885) and the Within-Groups estimate (0.277).

to try to influence firms' outsourcing decisions. In the previous literature, the discussions on this topic were mainly a matter of theoretical debate, and empirical research was seldom conducted. A common and straightforward notion is that a union with greater bargaining power will raise its wage rate to a higher level, which induces international outsourcing. However, Skaksen (2004), Braun and Scheffel (2007), and Lommerud et al. (2009) opposed such an idea and suggested that deunionization can lead to higher outsourcing in some cases.

The mixed results obtained in the previous empirical literature could be caused by a possible endogeneity problem between the outsourcing decisions and the union's power, and thus the debate can only be settled by an empirical analysis. After reviewing the theoretical literature mainly based on sequential game models, this study has not only explored the *contemporaneous* relationship but also the *lagged* relationship between outsourcing and the union's bargaining power in our regression equations. Our regression models are estimated based on data for U.S. manufacturing industries in the 1970s and 1980s. After collecting data from the Census of Manufactures, the NBER Productive Database, the Center for International Data at the University of California-Davis, and the Current Population Survey, we employed the first-differenced GMM approach developed by Arellano and Bover (1995) and Blundell and Bond (1998) to overcome the endogeneity and unobserved heterogeneity problems, and to examine the dynamic relationship between outsourcing and the labor union.

Our results show that, in the U.S. manufacturing sector, labor unions can hinder the outsourcing decision. If the outsourcing decision is made before the wage negotiations take place, the stronger the labor union an industry has, the lower the international outsourcing level it will choose. However, if the outsourcing decision is made subsequent to the wage negotiations, stronger unionization will induce the current trend to outsource. These results, from the sequential game point of view, seem to imply that firms comfort the union by cutting current outsourcing in the short run, but they then increase outsourcing in the future. Our results support the ideas that outsourcing decreases in-house employment (Lommerud et al. 2009), that the elasticity of demand is larger than the elasticity of substitution between imports and labor (Kramarz 2008), and that the direct effect could dominate the indirect effect (Braun and Scheffel 2007). These results remain under various robustness checks.

In addition, we have found that the unit labor cost, skilled/unskilled employment ratio, market power, and output growth rate have a negative influence on international outsourcing. These results imply the existence of strategic outsourcing, the determinants of industries' features and reactions to business cycles.

We conclude with two suggestions for future studies. First, although we have found that unionization in some cases has a negative impact on

firms' outsourcing intensities, our results do not imply that policy makers should promote stronger unions to ease job loss caused by outsourcing. We use the union membership ratio as a proxy for the *level of unionization* in this study. In Lommerud et al. (2009), the union's bargaining power is also the key factor that the union can use to influence firms' outsourcing decisions. Computing the union's bargaining power in every industry and employing the same dynamic estimation regression to assess the relationship between international outsourcing and the union's bargaining power are recommended avenues for future research.

Second, the American manufacturing sector was quite different in the 1970s, 1980s, and early 1990s. Labor unions experienced a variety of challenges then, and how those challenges have affected unions' responses to international outsourcing could be an interesting topic. Fenestra and Hansen (1999) found that computers increased skilled workers' wages in the 1980s. In addition to computerization, modular production and automation have become more and more important in the manufacturing industries. Our conclusions might be different if those structural changes have affected the wage and employment negotiation process between labor unions and employers. That discussion is beyond the scope of this article, and we leave it for future studies.

ACKNOWLEDGMENTS

We would like to thank Professor Donald Hester and the Department of Economics, University of Wisconsin–Madison, where part of this research was conducted by Yungho Weng as a visiting scholar in 2009, for the generous hospitality. We would also like to thank Cindy Severt, Senior Special Librarian in the Data and Information Services Center at the University of Wisconsin–Madison, for providing excellent data for this research. Financial support by Taiwan's Ministry of Science and Technology, grant numbers MOST 103-2410-H-004-017 and MOST 103-2410-H-004-034-MY2, is gratefully acknowledged. The usual disclaimer applies.

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