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Measuring Foreign Outsourcing and Labor Market Responses in US Manufacturing*

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Foreign outsourcing, otherwise known as off-shoring, has become a matter of intense public debate and great concern in both developed countries and developing countries. Yet, there is a lack of good data on foreign outsourcing since the early 1990's. This paper presents updated measures of foreign outsourcing for the recent period. Its main findings are that the share of foreign-sourced goods in total manufactured inputs almost doubled—from 12.4 percent to 22.7 percent between 1987 and 2003. I then look at the relationship between the measure of foreign outsourcing activity and wages in US manufacturing industries in recent years from 1998 to 2003. The results show that for all workers, the outsourcing level is statistically significantly and negatively associated with industry wage premiums. The estimate suggests that a magnitude of 0.9 - a 9% decrease in industry wage premiums tends to accompany a 10% increase in industry outsourcing level. Outsourcing has a bigger effect on the less-skilled workers-industry outsourcing level increases by 10% and industry wage premiums decrease by about 11% in the case of less-skilled workers.

Key Words : Outsourcing, Inter—industry Wage Premium, Threat Effects

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I. Introduction

As the manufacturing sector employment sharply decreased and wage inequality between skilled and less-skilled workers widened in recent years in developed countries, the impact of outsourcing on the advanced economies has become a focus of public debate and anxiety. Foreign outsourcing, or off-shoring, by firms in these countries has been seen as a major culprit behind job loss in both manufacturing and service industries in recent years. Yet good measures of the extent of outsourcing are difficult to find.[1)]

Past studies have calculated the importation of intermediate goods relative to total intermediate input purchases as an indicator of foreign outsourcing activity in an industry sector (see, for example, Feenstra and Hanson, 1999 and Campa and Goldberg 1997).

While changes in the share of imports in total intermediate goods will not fully capture the extent of globalization of production in an industry－some foreign outsourcing activity by US firms will show itself as a displacement of US production of final goods or exports rather than an increase in imports of intermediate goods－it does provide a measurable indicator that can be tied directly to important channels offshoring activity. Tracking the share of imported intermediate manufactured goods in total purchases of intermediate manufactured goods allows us to discern changes in a

1) Two estimates of the effects of the impact of outsourcing on employment have received attention recently. First, reports produced by the Forrester Research consulting firm in 2003 and 2004 have projected job loss in service industries over the next decade as the result of outsourcing. However, the lead author of the Forrester Research reports has described them in press interviews as based on “a very rough and gross calculation” and “educated guesses”. The second recent estimates on the effect of outsourcing on jobs have come from the addition of a new question added this year to the Bureau of Labor Statistics’ (BLS) Mass Layoffs Survey. This question asked firms carrying out layoffs of more than fifty workers whether these layoffs were the result of relocating production to foreign sites. The estimates of job loss related to outsourcing derived from the BLS’s Mass Layoffs Survey have significant limitations － most notably, the Survey only covers a small fraction of all job losses each quarter.

significant part of foreign outsourcing in the US manufacturing sector over time.[2)]

Feenstra and Hanson (1999) find that imported intermediate goods have increased from 5.3% of total intermediate purchases for U.S. manufacturing industries in 1972 to 7.3% in 1979, and 12.1% in 1990. Using a narrower measure of intermediate goods, Campa and Goldberg (1997) provide evidence for Canada, Japan, the United Kingdom and the United States in the mid-1970s, mid-1980s and mid-1990s. They find that imported inputs have increased from 4.1% of total intermediate goods in 1975 to 6.2% in 1985, and 8.2% in 1995 for U.S. manufacturing industries.

In this paper, I will present two related works: the first part of the study will present an alternative measure of imports of intermediate goods in manufacturing industries. I include a more recent period from 1987 to 2003. I then look at the relationship between the measure of foreign outsourcing activity and wages in US manufacturing industries in recent years, covering years from 1998 to 2003.

To preview the results, the first part shows that the share of imported inputs rose from 12.4 percent to 22.7 percent for all manufacturing between 1987 and 2003. The results from the second part of the study show that for all workers, the outsourcing level is statistically significantly and negatively associated with industry wage premiums in US manufacturing sector recent years. The estimate suggests that a magnitude of 0.9 - a 9% decrease in industry wage premiums tends to accompany a 10% increase in industry outsourcing level. This effect becomes larger for the less-skilled workers-industry outsourcing level increases by 10% and industry wage premiums tend to decrease by about 11%.

This paper proceeds as follows. The next section explores an alternative way of

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2) There are other possible sources of increasing imported inputs in US production in addition to outsourcing activities by US firms. First, if foreign firms set up production in US sites, they are likely to use intermediate goods shipped from their home countries or other foreign suppliers. These activities would increase the shares of imported inputs in US production without any new outsourcing activity by US firms. Second, a rise in the relative price of domestic versus foreign inputs can lead to a rise in the value share of imported inputs without actually representing a shift in the location of production abroad. In future work, we will test the size of some of these effects but we assume for now that these effects are small compared to the effect of outsourcing activity.

measuring outsourcing. The third section attempts to investigate the impact of outsourcing in labor markets, specifically with regards to wages for workers in the manufacturing sector in the United States recent years. I then end with some concluding remarks.

Ⅱ. Measuring Outsourcing in US Manufacturing Industries

Foreign outsourcing (or off-shoring) by domestic firms involves the relocation of some domestic production of goods/services to foreign countries. Foreign outsourcing by a domestic firm can involve the relocation of production that is either *internal* or *external* to the firm. Outsourcing of production internal to the firm involves replacing the firm's own domestic production with foreign production, while the outsourcing of production external to the firm involves replacing the firm's purchase of US-sourced inputs by purchases of inputs produced in foreign countries.[3)]

The various channels through which the outsourcing of production takes place and its multiple effects help to explain why measuring outsourcing activity has been challenging using available economic data. The analysis of the extent and growth of outsourcing in this study focuses on the share of imported inputs in total manufacturing inputs for industries in the US manufacturing sector. As discussed above, increased outsourcing activity is expected to increase the import of intermediate goods as outsourcing firms replace intermediate stages of their domestic production with foreign production, or shift

3) Outsourcing of production internal to the firm may involve a transfer of the firm's domestic operations to a foreign affiliate or, alternatively, the replacement of an intermediate stage internal to its domestic production process with the import of inputs from an unaffiliated foreign producer. On the other hand, outsourcing of production external to the firm involves shifting purchases of intermediate goods/services from domestic suppliers to foreign suppliers who may or may not be affiliated with the outsourcing US firm. The outsourcing of production that is internal to firms will increase imports of both intermediate and final goods/services into the US as well as displace US exports to foreign markets, while the outsourcing of production external to firms will increase the US import of intermediate goods/services.

their purchases of inputs from domestic to foreign suppliers. While changes in the share of imports in intermediate goods will not fully capture the extent of outsourcing－some outsourcing by US firms will show itself as a displacement of US production of final goods and exports rather than an increase in imports of intermediate goods－it does provide a measurable indicator that can be tied directly to outsourcing activity.[4] Tracking the share of imported intermediate goods/services in total purchases of intermediate goods/services should reliably allow to discern changes in outsourcing over time.

I use data provided in the Bureau of Economic Analysis's national input-output accounts to calculate our measures of imported intermediate goods. I measure imported intermediate goods used by US manufacturing industries using a similar methodology as the Feenstra and Hanson and the Campa and Goldberg studies mentioned above. That is, I begin by finding the import share of each commodity (the share of the commodity used in the US economy that is imported) as well as the value of each commodity used in the production process of each industry. For each industry, I then multiple the value of the commodity used in production by the import share of that commodity to find the value of imported inputs of the commodity used by that industry.[5] By summing up the imported inputs of each commodity used by that industry, we can find the industry's total imported inputs used in production. The industry data we require to carry out these calculations are included in the 'use tables' of the BEA's input-output accounts. These tables show how industries use inputs of commodities to produce goods in the economy and also report the quantities of commodities that are imported into the US.[6]

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4) Other researchers have measured imported input shares in production to create an indicator of outsourcing for years prior to the mid-1990s, most notably in several studies by Robert Feenstra and Gordon Hanson (see, for example, Robert Feenstra and Gordon Hanson, (1996) "Global Production Sharing and Rising Inequality: A Survey of Trade and Wages," NBER Working Paper 8372).

5) A basic assumption of this method of calculating the value of imported inputs is that the import share of the commodity when it is used as an intermediate good in each particular industry is the same as the import share of the commodity in the economy as a whole as calculated from the I/O accounts.

A. Imports of intermediate goods used in manufacturing industry production

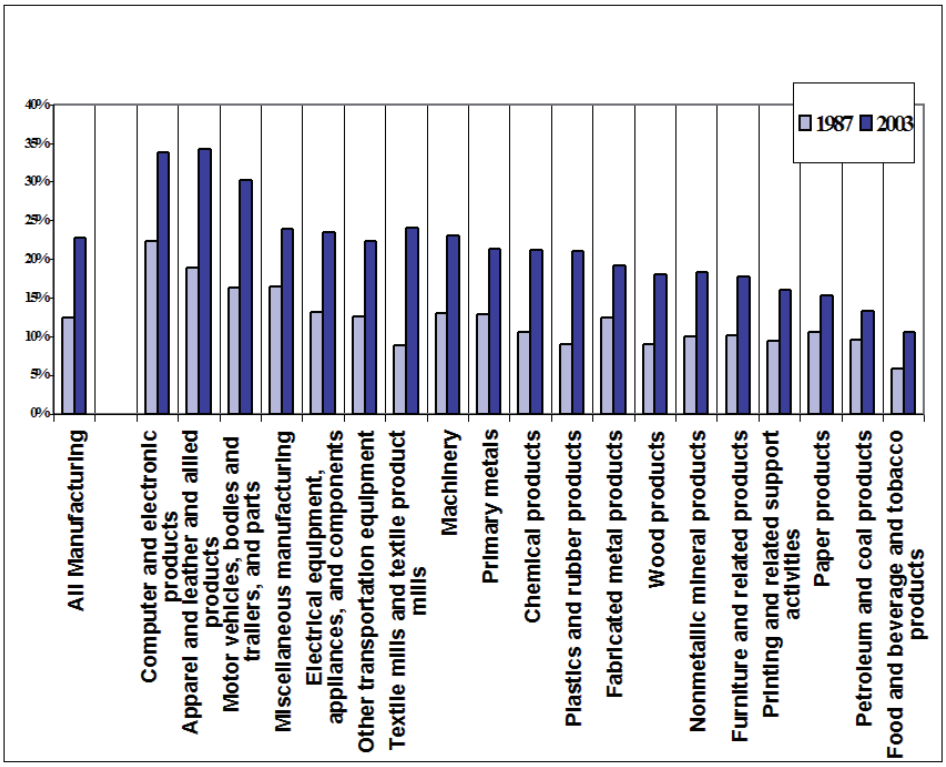
I calculate the share of imported goods in total purchases of intermediate manufactured goods for manufacturing groups and for the manufacturing sector as a whole for the years 1987, 1992, 1997, and for 1998 through 2003. We consider only intermediate goods that are manufactured commodities. For a mathematical notation of the method of finding the shares of imported intermediate goods in total inputs, see the Appendix.

Chart 1 shows the share of imported inputs in total inputs of manufactured goods used in production for nineteen manufacturing industry groups and for the manufacturing sector as a whole in 1987 and 2003. For every industry group and for the manufacturing sector as a whole, the share of imported inputs used in production has risen substantially over the time period. For all manufacturing, the share of imported inputs rose from 12.4 percent to 22.7 percent between 1987 and 2003. The industry groups with the highest measures of foreign outsourcing activity in the use of inputs were the Apparel/Leather Products group, the Computer/Electronic Products group, and the Motor Vehicles/Bodies and Trailers/Parts group. In these three industry groups, imported inputs made up about one-third of all manufactured inputs used in production in 2003.

Table 1 shows the share of imported inputs in total inputs used in production for the whole manufacturing sector and manufacturing industry groups in 1987, 1992, 1997, 2002, and 2003. Between 1987 and 2003, the industry groups with the largest

6) In 1997, the Bureau of Economic Analysis began to provide industry input－output tables using the North American Industry Classification System (NAICS); in the years previous to 1997, the input－output accounts used the Standard Industrial Classification (SIC) system. The data we present and use in our analysis breaks the manufacturing sector into the nineteen manufacturing groups defined by the NAICS; for years previous to 1997, we need to allocate the industry groups defined by the SIC system into these nineteen NAICS groups. Although the transition from the SIC system to the NAICS does not allow a perfect allocation of group data across industrial classifications, I strove to minimize the distortion of industry data as much as possible. Refer to Table 2 to see how industry data was converted from the SIC system into NAICS defined groups.

Chart 1. Imported inputs of manufactured goods used in production, as share of total inputs used in industry, 1987-2003.



increases in the share of imported inputs used in production were the Apparel/Leather Products group (15.4%), the Textiles group (15.2%), the Motor Vehicles/Bodies and Trailers/Parts group (13.9%), the Plastics and Rubber Products group (11.9%), and the Computer/Electronic Products group (11.4%). Table 1 also shows that the growth in the share of imported inputs in the manufacturing sector as a whole accelerated in the later part of the 1987 to 2003 period. Of the total increase of 10.4 percentage points in the import share of inputs used in production in the sector as a whole, the earliest period (1987-1992) accounts for 1.5 percentage points, the middle 5-year period (1992-1997) accounts for 3.8 percentage points, and the latest 6-year period (1997-2003) accounts for 5.0 percentage points. Faster growth in the share of imported inputs in the most recent 1997-2003 period is also seen in 13 of the 19 manufacturing industry groups.

Table 1. Imported inputs of manufactured goods used in production in US manufacturing industries, as a share of total inputs used by industry, various years

(unit:%)

Industry	Imported Inputs as a Share of Total Inputs					
	1987	1992	1997	2002	2003	Change in Share, 1987 - 2003
All Manufacturing	12.4	13.9	17.7	22.3	22.7	10.4
Apparel and leather and allied products	18.9	24.1	24.5	32.3	34.2	15.4
Computer and electronic products	22.3	26.5	32.7	34.6	33.7	11.4
Motor vehicles, bodies and trailers, and parts	16.3	18.0	19.1	28.7	30.2	13.9
Textile mills and textile product mills	8.8	11.3	14.3	22.5	24.0	15.2
Miscellaneous manufacturing	16.5	18.6	18.0	23.6	23.8	7.3
Electrical equipment, appliances, and components	13.2	14.8	18.3	23.1	23.5	10.3
Machinery	13.0	13.9	17.1	22.1	23.1	10.1
Other transportation equipment	12.6	15.9	18.5	23.5	22.3	9.7
Primary metals	12.8	14.3	21.2	21.3	21.3	8.5
Chemical products	10.6	12.0	15.7	20.5	21.1	10.5
Plastics and rubber products	9.0	10.6	13.3	20.2	21.0	11.9
Fabricated metal products	12.4	12.5	15.8	18.8	19.2	6.8
Nonmetallic mineral products	9.9	10.4	13.8	17.4	18.3	8.3
Wood products	8.9	8.8	14.3	17.8	17.9	9.0
Furniture and related products	10.1	10.6	13.1	17.1	17.7	7.6
Printing and related support activities	9.4	8.1	14.9	15.3	16.0	6.7
Paper products	10.6	10.3	15.2	15.1	15.3	4.7
Petroleum and coal products	9.5	8.5	9.4	12.8	13.2	3.7
Food and beverage and tobacco products	5.8	6.1	6.5	9.8	10.5	4.7

The increase in foreign outsourcing in the latest period was especially fast for the Motor Vehicles/Bodies and Trailers/Parts industry group in which the years from 1997-2003 accounted for over three-quarters of the increase in the share of foreign-sourced inputs. Of the 13.9 percentage point increase in that group's imported input share between 1987 and 2003, from 16.3 percent to 30.2 percent, the most recent 6-year period accounted for 11.1 percentage points.

B. Imports of intermediate goods produced in manufacturing industries

In addition to examining how industries use imported intermediate goods in production, I also measure the degree to which imported inputs compete with the production of intermediate goods by US manufacturing industry groups. That is, I look

at the phenomenon of foreign outsourcing from the perspective of the industry *making* intermediate goods as well as the perspective of the industry *using* intermediate goods in production. I do this because firms often use intermediate goods that are not produced in their own industry group. Consequently, foreign outsourcing that involves shifting purchases of intermediate goods from domestic to foreign suppliers can raise the share of imported inputs used in production while not directly displacing production in a firm's own industry group. Instead, the demand for production (and workers) will fall in other industries as a result of this kind of foreign outsourcing activity. In order to explore links between foreign outsourcing and labor market responses at home, I want to identify the industries where these manufactured inputs are *produced* as well as where they are used.

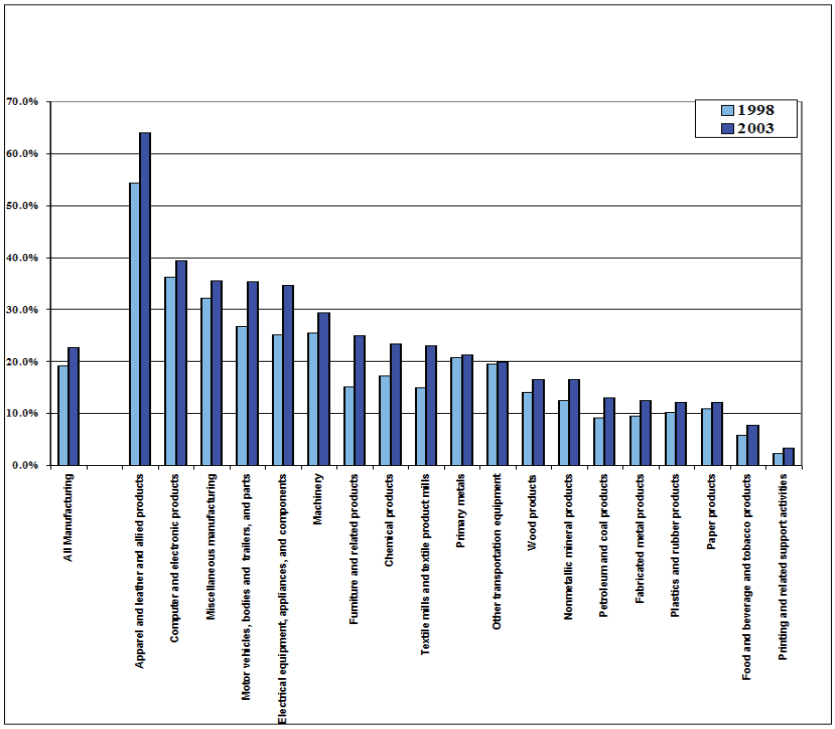
Using the "make tables" of the BEA's industry input-output accounts, I find the share of production of each manufactured commodity attributable to each of the nineteen major manufacturing industry groups. First, I refer to the calculations described above, which drew on the use tables, to find the amounts of each commodity that are used as inputs to production and the share of these inputs that are imported. I then assign these commodity values according to each industry's production or 'make' share. Summing across all commodities for the imported intermediate goods assigned to an industry, I find the total value of imports among the intermediate goods produced by the industry. I find these industry group calculations for 1998 through 2003, the years for which the required data was available in a consistent way from the BEA.[7)]

Chart 2 shows the import share of the intermediate manufactured goods produced by US manufacturing groups for the manufacturing sector as a whole and for nineteen manufacturing industry groups in 1998 and 2003. For every industry group and for the manufacturing sector as a whole, the share of imports in total inputs produced has risen over the time period. For all manufacturing, the share of imported inputs rose from 19.1 percent to 22.8 percent between 1998 and 2003.[8)]

7) For the same reason I use this measure of outsourcing activities in the second part of the study.

8) For the manufacturing sector as a whole in 2003, the import share for inputs produced by industries in Chart 2 is essentially the same as the one shown in Chart 1 for inputs used in production (22.8% and 22.7%, respectively) This makes sense because almost all manufactured

Chart 2. Imported inputs of manufactured goods used in US manufacturing production, as a share of total inputs produced by industry, 1998 and 2003



inputs used in the manufacturing sector as a whole are also produced in the manufacturing sector. The differences between imported input shares in Charts 1 and 2 (and Tables 1 and 2) show up when comparing the manufacturing industry groups. As discussed in the text, this is because industries often use inputs in their production which are produced in another industry. Also note that most of the time series variation of the import share for inputs produced by industries came from the import share rather than the intermediate commodity share. The average growth rate of the import share in all the 19 industries over the period 1998−2003 is 22% while that of the commodity composition share in all the 19 industries is −4.3%. I thank one anonymous referee for the comment on this.

Table 2. Imported inputs of manufacturing goods used in production in US manufacturing industries, as share of total inputs made by industry

(unit:%)

Industry	Imported inputs as a share of total inputs						
	1998	1999	2000	2001	2002	2003	Change in Share, 1988-2003
All Manufacturing	19.1	20.0	21.8	21.9	22.3	22.8	3.6
Apparel and leather and allied products	54.3	56.2	59.7	63.2	62.5	64.0	9.7
Computer and electronic products	36.3	37.5	40.2	39.2	41.0	39.4	3.1
Miscellaneous manufacturing	32.1	33.3	35.1	35.7	36.2	35.5	3.3
Motor vehicles, bodies and trailers, and parts	26.7	27.8	31.3	32.9	33.7	35.4	8.7
Electrical equipment, appliances, and components	25.2	27.3	29.6	31.2	33.0	34.7	9.6
Machinery	25.5	26.1	27.5	27.6	26.9	29.4	3.8
Furniture and related products	15.1	17.3	19.6	20.0	22.5	25.0	9.9
Chemical products	17.3	18.2	19.7	21.1	22.7	23.4	6.1
Textile mills and textile product mills	15.0	16.1	18.0	19.4	21.1	23.0	8.0
Primary metals	20.7	20.1	23.0	22.5	21.5	21.3	0.6
Other transportation equipment	19.6	20.9	24.2	24.1	21.1	19.9	0.3
Wood products	14.1	15.5	15.4	16.2	16.7	16.6	2.5
Nonmetallic mineral products	12.5	13.5	14.4	14.0	15.3	16.5	3.9
Petroleum and coal products	9.2	9.5	11.4	12.2	12.1	13.0	3.8
Fabricated metal products	9.5	10.1	10.9	11.1	11.8	12.5	3.0
Plastics and rubber products	10.2	10.6	11.0	11.2	11.5	12.2	2.0
Paper products	10.9	11.3	12.1	12.2	12.2	12.1	1.1
Food and beverage and tobacco products	5.9	6.2	6.4	6.6	7.0	7.7	1.8
Printing and related support activities	2.3	2.7	2.8	2.7	3.1	3.5	1.2

Ⅲ. Threat Effects of Outsourcing on Wages of Manufacturing Workers in the US.

1. Theoretical Considerations of the Threat Effects

In this section, I turn the focus of the study towards how the level of foreign outsourcing activity by US firms is associated with differences in wage premium in US manufacturing sector. More specifically, I explore the relationship between the measure of an industry's foreign outsourcing－the share of imports of intermediate goods produced in manufacturing industries－and the wage premium in that industry. In so

doing, I expect to shed new light on the study of the connection between recent globalization and changes in labor markets.

The impact of international economic integration has become a widely studied and hotly contested issue. Most debated has been the impact of "globalization" on income distribution in the industrialized economies, especially the United States (See Cline 1997, Feenstra 2000 surveys). The great majority of this work has studied the impact of international trade on the earnings gap between "skilled" and "unskilled" workers. Less research has investigated the impact of capital mobility, especially the impact of outsourcing, on income distribution.

A major question surrounding foreign outsourcing is whether employers shift production outside the country's borders in response to lower labor costs abroad, especially of developing countries. Most research on the impact of globalization on labor income uses the Heckscher-Ohlin framework. This research has found that the price changes (or embodied factor content in trade) that drive changes in income distribution, have not been large enough to account for the large changes in income distribution that have occurred (See Slaughter (1999) and Baldwin (1995) for surveys; Wood (1995, 1998), however, has found larger effects). Similarly, most researchers who have studied the distributional impact of foreign direct investment (FDI) or outsourcing have concluded that *net* foreign direct investment is simply too small in relation to the size of the U.S. economy to have much of an impact on income distribution. The overall conclusion of this research seems to be that globalization can account for only a small share–10-20%–of the increased wage gap between skilled and unskilled labor in the United States (Cline 1997).

Several researchers have suggested the need for a new perspective to investigate the impact of global economic integration. They argue that previous studies have attempted mainly to find a decreased relative demand for less skilled workers directly and have overlooked the impact of change in the elasticity of the relative labor demand. The elasticity of the labor demand can change substantially when the nature of the bargaining relationship between workers and employers are affected.[9] Wages in their

9) The elasticity of relative labor demand also changes when the product market faces more

analysis are seen as bargaining outcomes rather than simple market clearing competitive wages based on rent-sharing wage determination theory. They emphasize the enhanced capital mobility among other globalization features as the key factor underlying the secular trend in the bargaining relationship between workers and employers. The impact of globalization on the recent trend in wage inequality, therefore, should be understood in conjunction with its impact on the bargaining relationship between workers and employers. The new perspective can be referred to as "*Threat effect*" – this suggests that the threat by firms to move production abroad, or the threat to outsource, may have important consequences on wages and profits even in the absence of large price or quantity changes (see Crotty, Epstein and Kelly 1998, Rodrik 1997 / 1999).[10] Reddy (2000) refers to this effect as the *bargaining channel* (Choi 2006). The threat effect is well described in Freeman (1995):

> It isn't necessary that the West import the toys. The threat to import them or to move plants to less-developed countries to produce the toys may suffice to force low-skilled westerners to take a cut in pay to maintain employment. In this situation, the open economy can cause lower pay for low-skilled westerners even without trade; to save my job, I accept Chinese-level pay, and that prevents imports. The invisible hand would have done its job, with proper invisibility.

Several theoretical studies explain the effect FDI or outsourcing as the major form of capital flight on wage and employment both in the host and the home countries.[11] By

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intensified competition due to international economic integration. The increase in the elasticity of labor demand due to this feature of the globalization affects bargaining outcomes negatively.

10) Other authors who have mentioned threats as a potentially important feature in this field are Freeman (1995), Slaughter (2000), and Budd and Slaughter (2000).

11) To answer the question of why firms invest abroad itself is not the main purpose of this study. Since the threat effect results from the very fact that firms can go abroad more easily, it can be utilized no matter what the firms' purposes of foreign investment are. As to the question of why multinational firms go abroad, studies cite primarily two reasons: (1) access to the markets (horizontal FDI), (2) looking for factor price differences (vertical FDI). Traditionally, horizontal FDI has been a major form of FDI among US headquartered multinationals. A recent study finds that vertical FDI is more common and suggests that one should distinguish different types

using the Nash-Bargaining framework they examine outsourcing in the context of the strategic bargaining relationship between an employer and workers (union) (Reddy 2000; Rodrik 1997, 1999; Zhao 1995, 1998). In the Nash-Bargaining framework outward FDI or outsourcing is formalized as the outside option that a firm could rely on when bargaining with its employees (or union) in the home country breaks down. Most of these studies, in general, illustrate how an increase in outside options facing the firm can lower workers' wages and increase firm profits. In this model, contrary to the standard Stolper-Samuelson model, no changes in prices or investment need occur for these changes in factor prices to result (Choi 2006).

This section attempts to test the theory of "threat effect" of outsourcing, specifically with regards to wages for workers in the manufacturing sector in the United States between the years 1998 to 2003. The theory of "threat effect" suggests that, as firms are able to outsource production abroad more, the bargaining relationship between workers and employers is altered in favor of the employers. As a result, the wages of workers which are bargaining outcomes in the domestic manufacturing sector are decreased. More specifically, this section tries to see whether or not outsourcing affects wages in domestic labor markets negatively as predicted in the threat effects theory. By investigating how outsourcing affects industry wages, this section is in effect trying to understand how the bargaining relationship between workers and employers is affected when there is a change in outsourcing.

In order to examine the implications of the threat effect in the Nash bargaining framework[12]; let's consider a bargaining game between workers and firm-owner.[13]

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of FDI according to how multinationals' strategies respond to government policy (See Hanson, et al. 2001).

12) This framework is modified from the model adopted to explain the threat effects of FDI on wages in Choi (2006). The model is framed originally to explain the bargaining relationship between employer and labor union when employer has outsourcing opportunity as outside option. However, it can be still applied to show a general wage bargaining setting between employer and workers since the non－market clearing wages are found to be consistent even though the labor union membership has declined substantially in US manufacturing industries.

13) The firm－owner represents shareholders, or management who share the interest of maximizing profits. Employer, the firm－owner, and management are used interchangeably in this paper.

Wages and employment are assumed to be determined only through the bargaining process in the non competitive market and unilaterally by the firm-owner in the competitive labor market. The wage level determined in the competitive market is considered to be the reservation wage level, w^*, for workers in the organized market. Let ϕ and $1-\phi$ be the bargaining power of the workers and the employer, respectively, and π^* for the profit level that the employer could attain by outsourcing. It is π^* that is affected by the firm's accessibility of overseas production, which is positively associated with the degree of ease with which outsourcing or relocation can be carried out. Therefore the potential profit from outsourcing π^* increases as the firm has a greater access to overseas production. π^* also increases when trade barriers are lower and transportation and communication costs decrease so that the mobility of production is enhanced. The maximization problem in the Nash bargaining model can be written in the following way:

$$\max_{w,n} \phi \log\left[\left(u(w)-u\left(w^*\right)\right)n\right] + (1-\phi)\log\left(\pi-\pi^*\right) \tag{1}$$

Where n is the number of employees hired. Conventional assumptions hold for the utility function of workers, i.e. $u'(w)>0$ and $u''(w)<0$. The concavity of the production function is also assumed and the profit function is defined as $f(n)-wn$.

The first order conditions from the maximization problem are:

$$w: \frac{\phi \cdot u'(w)}{u(w)-u(w^*)} - \frac{(1-\phi)n}{\pi-\pi^*} = 0 \tag{2}$$

$$n: \frac{\phi}{n} - (1-\phi)\frac{f'(n)-w}{\pi-\pi^*} = 0 \tag{3}$$

Following Blanchflower, Oswald and Sanfey (1996), the result of first order approximation of the equation (2) gives:

$$u(w^*) \cong u(w) + (w^*-w)u'(w) \tag{4}$$

Substituting this into the equation (2), the following equation can be obtained:

$$w \cong w^* + \frac{\phi}{1-\phi}\left(\frac{\pi - \pi^*}{n}\right) \tag{5}$$

The wage is determined by the reservation wage available outside the organized market in the event of a breakdown in bargaining, the relative bargaining power of the two sides and the profit level per employee.

Equation (5) implies that:

$$\partial w / \partial \pi^* < 0 \tag{6}$$

The equilibrium bargaining wage must fall if the firm has more outside options. The empirical implication of this model is that the more outsourcing opportunity the firm has the less the wage differential above the competitive wage level the workers will receive. The following interpretation of the model is more proper for empirical implications: if an industry has a relatively large share of outsourcing in its production workers in this industry perceive that their employer is more likely to outsource than the other employers in industries that have lower share of outsourcing in production. When bargaining over wages in the industry with high outsourcing share workers in this industry are more likely to accept a wage cut.

To sum up, the hypothesis to be tested in this study is that, all else equal, workers whose affiliated industry has more outside options－as represented by their share of outsourcing in production－is more likely to concede in wage bargaining, and accordingly workers will receive a smaller industry wage premium.

2. Econometric Strategy

The goal of the empirical work is to investigate how the industry wages vary in response to changes in industry outsourcing levels. I use industry wage differentials for

wages. The estimation is carried out in two steps. The first step estimation is to construct industry wage differentials by using individual-level survey data from the Current Population Survey (CPS). The industry wage differential is a measure of average wage rate in industry j at time t. In the second step, changes in industry wage differentials are related to the changes in industry outsourcing levels.

A. First Stage

I use relative wages and the structure of wages across manufacturing industries to examine whether they are correlated with the difference in the average industry outsourcing level. To calculate measures of relative wages across manufacturing industries, the following equation is sued in the first step:

$$w_{ij} = \beta_1 + \beta_2 H_i + \phi_j D_j + \varepsilon_{ij}, \quad i = 1,...,I, \quad j = 1,...,\mathrm{J} \tag{1}$$

Where w_{ij} is the natural logarithm of hourly wage of individual i in industry j, H_i is a vector of individual characteristics and demographic variables, D_j is a vector of mutually exclusive dummy variables indicating industry of affiliation, and ε_{ij} is a random error with mean zero and variance σ^2. The equations are estimated separately for 6 years from 1998 to 2003. The coefficients of the industry dummies can be interpreted as composition-constant average wage rates for each industry-year since individual characteristics are controlled.

The equation (1) is also estimated separately for unskilled workers who have only up to high school education. These wage premiums estimated only for unskilled workers are stored and used in the second stage regressions as dependent variables.

This regression approach is proposed by Dickens and Katz (1987) and Krueger and Summers (1988) in their study of inter-industry wage differentials. In such studies, differential wages are assumed to be above the market-clearing wage level. A market can reach a non-clearing wage equilibrium because of a number of institutional reasons, including collective action through union, employers' rent sharing wage setting mechanisms,

or gift-exchange wage setting mechanisms.[14] There are also studies find some evidence that industry-specific skills or industry matching are important feature of the labor market. For instance, Carrington (1993) and Weinberg (2001) provide such evidence.

B. Second Stage

The second stage regressions are carried out at the industry-year level. I used the data of 19 manufacturing industries for the 6 years from 1998 to 2003. Table 3 shows these 19 manufacturing industries. The standard fixed effects estimators are used in the second-stage regression to deal with unobserved industry heterogeneity.[15] The fixed effects estimators include controls for both industry and year dummies. The coefficients on the industry-year dummies, $\hat{\phi}_j$ from equation (1), are regressed on the measures of outsourcing (O_{jt}), a set of year dummies and a set of industry dummies as well as the other control variables (P_{it})-employment, union density, productivity growth and capital share.

$$\hat{\phi}_{jt} = \delta_1 + \delta_2 P_{jt} + \delta_3 O_{jt} + \delta_4 YEAR_t + \delta_5 IND_j + \nu_{jt} \quad (2)$$

I weight each second step observation by the number of individual observations in that industry-year. To see the effect of outsourcing on the wages of unskilled workers separately, unskilled workers wage premiums are also used in the estimation.

3. Data

In order to get industry wage differentials in the first stage regression, Annual Merged Outgoing Rotation Group (MORG) of the Current Population Survey (CPS) data

14) Helwege (1992) argues that the inter-industry wage differentials is stable despite extremely heterogeneous growth rates across industries.

15) Of course, the individual level panel data will be desirable in order to deal with unobserved individual heterogeneity or any individual-specific industry match effect as one referee suggest. However, the industry level fixed effect estimation is widely used in similar studies and many find it useful. See Devereux (2005), for instance.

1998-2003 is used. The data in the first stage of regressions was restricted to the workers between the age of 16-76, employed in the private manufacturing sector, who work for more than one hour in a given day and earn more than a dollar and less than $250 per hour. All manufacturing workers are assigned to one of the 19 industry groups that are used in this study.

The R-square of model (1) between the years 1998 to 2003 ranges from 35% to 50%. The number of observations varies every year from 42,573 to 47,909. All the independent variables, i.e. the individual worker characteristic variables and the industry dummy variables, are statistically significant at the 5 percent level. Table 3 reports the coefficients and standard errors of industry dummies for each year from 1998 to 2003. The industry dummy coefficients are the industry wage premium that workers earn as a result of being affiliated to a particular industry. The omitting industry group or the comparison industry group here is the retail service sector.

For data on outsourcing level, I use the second outsourcing measure calculated in this study, the share of imports of intermediate goods produced in manufacturing industries because of limit of data availability. I can only collect outsourcing measures and wage premium from 1998 to 2003 because of the inconsistent industry categories resulted from using three different data sources, CPS cods, SIC and NAICS. The only period that is available without having any inconsistent industry matching is from 1998 to 2003. The union density data are additionally used in the second step and they are created by using the CPS data.[16)]

To see the simple graphical illustration of the relationship between changes in industry outsourcing levels and industry wages, I have calculated the growth rates of the two variables for the period. Figure 1 and 2 illustrate the relationship etween changes in

16) The union density data are created by using the method in Freeman and Medoff (1979):

$$U_j = \frac{\sum_i A_{ij} W_{ij}}{\sum_i W_{ij}} \bullet 100$$

where U_j is the percentage of workers in industry j who are unionized, A_{ij} = 1 if worker i is employed and in a union, and is zero otherwise, W_{ij} is the CPS sampling weight. The MORG of CPS data are used for the computation.

Table 3. List of Industries with CPS, SIC & NAICS Codes Matched

S.no	Industry Name	Codes	
		SIC 1987	NAICS
1	Food & Beverage & Tobacco Products	201-208, 21	3111-3118 3121-3122
2	Textile Mills & Textile Product Mills	221-229	3131-3133 3141, 3151
3	Apparel & Leather & Allied Products	231-239, 311, 313-317, 319	3152, 3159 3161,3162, 3169
4	Wood Products	241-245	1131,3211-3212
5	Paper Products	261-263, 265 267	3221-3222
6	Printing & Related Support Activities	271-279	3231 5111, 5122
7	Petroleum & Coal Products	291, 295, 299	3241
8	Chemical Products	281-287, 289	3251-3256, 3259
9	Plastics & Rubber Products	301-306, 308	3261, 3262, 3391
10	Non-Metallic Mineral Products	321-329	3271-3274, 3279
11	Primary Metals	331-333, 335-339	3311-3315
12	Fabricated Metal Products	341-349	3321-3329, 3345 3363
13	Machinery	351-356, 358-359	3331-3332 3334-3336
14	Computer & Electronic Products	357	3333, 3341
15	Electrical Equipment, Appliances, & Components	361-367, 369	3342-3344, 3346 3351-3353, 3359
16	Motor Vehicles, Bodies, Trailers & Parts	371, 374	3361-3363, 3365
17	Other Transportation Equipment	372, 373, 375, 376, 379	3364, 3366, 3369
18	Furniture & Related Products	251-259	3371, 3372, 3379
19	Miscellaneous Manufacturing	391-399	3399

Note: The CPS data uses Standard Industry Classification (SIC) system unti1 the year 2002, after which the census uses the North American Industrial Classification (NAICS) system instead of the SIC industrial classification system. This change in industrial classification systems not only led to changes in the industry codes, but also in the names and number of the various sub-industry categories. In order to make sure that the industry categories for all the years were consistent the 3-didgit SIC codes were matched to the equivalent 4-digit NAICS codes (See Table 1) using a census bureau SIC to NAICS conversion table. The NAICS codes in the conversion tables were 6-digit codes, thus restricting these codes to 4-digits posed the problem of repetition of some sub-industries. For example in the NAICS list of the conversion table, the code 314121 refers to the sub-industry "Curtain & Drapes", which appears under the industry category of "Apparel & Other Textile Products," while the code 314111 refers to the sub-industry "Carpet & Rug Mills", which appears under "Textile Mill Products", the problem here is evident if one wants to restrict the NAICS code to just the 4-digit 3141 i.e. which industry-category should this sub-industry fall under? For this paper the above problem was resolved by looking at the number of times the 4-digit NAICS industry code appears in each industry category, and then placing the 4-digit sub-industry code under the industry category where it appears most number of times. For example the 4-digit code 3141 appears most under the "Textile Mill Products" category of the NAICS list of the conversion table, thus this code was then placed under the "Textile Mills & Textile Product Mills" industry category of this paper. Furthermore after matching the NAICS codes to the SIC codes these codes had to be further matched with theCPS Industry Code. This conversion was done using the CPS to SIC and NAICS conversion table.

Figure 1. Wages and Growth of Outsourcing in US Manufacturing

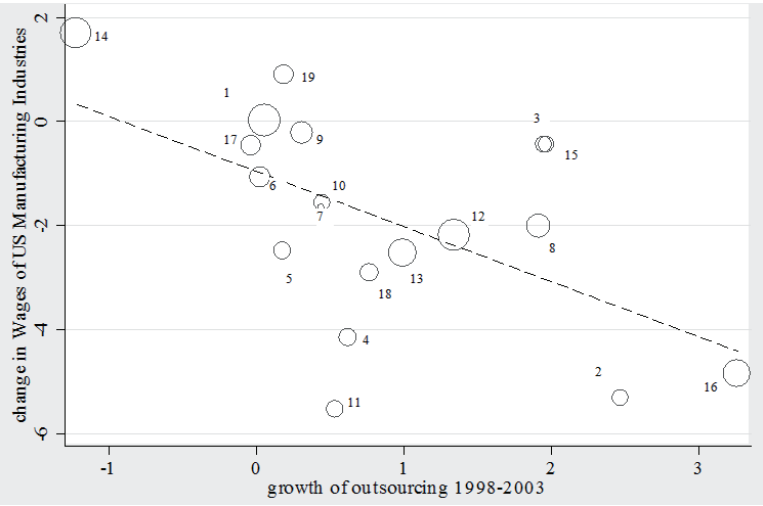
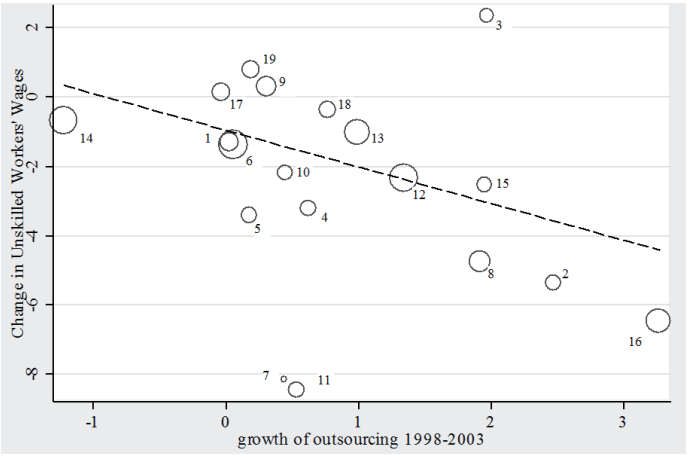


Figure 2. Unskilled Workers' Wages and Growth of Outsourcing in US Manufacturing



industry outsourcing levels and industry wages for all bworkers and less-skilled workers respectively. In the figures, industries are labeled by the number assigned to the industry in table 4. The figures also contain the regression line fitted to the points that are weighted by average employment in the industry for the

Table 4. Industry Wage Differentials

	1998		1999		2000		2001		2002		2003	
Ind	IWD	SE	IWD	SE	IWD	SE	IWD	SE	IWD	SE	IWD	SE
1	0.184	0.010	0.186	0.010	0.185	0.010	0.170	0.010	0.177	0.010	0.077	0.011
2	0.230	0.017	0.204	0.018	0.196	0.019	0.201	0.020	0.177	0.020	0.125	0.025
3	0.096	0.013	0.082	0.014	0.097	0.014	0.077	0.015	0.092	0.016	0.010	0.021
4	0.188	0.014	0.192	0.014	0.183	0.015	0.162	0.016	0.146	0.015	0.058	0.019
5	0.314	0.015	0.295	0.015	0.278	0.016	0.261	0.016	0.289	0.015	0.141	0.021
6	0.209	0.010	0.195	0.010	0.194	0.010	0.185	0.010	0.198	0.010	0.130	0.016
7	0.427	0.028	0.366	0.027	0.379	0.030	0.345	0.030	0.411	0.029	0.287	0.040
8	0.347	0.011	0.320	0.011	0.303	0.011	0.309	0.011	0.327	0.011	0.259	0.013
9	0.224	0.013	0.224	0.013	0.234	0.014	0.240	0.014	0.222	0.014	0.136	0.017
10	0.237	0.017	0.233	0.016	0.204	0.016	0.207	0.017	0.222	0.017	0.113	0.025
11	0.292	0.015	0.226	0.014	0.225	0.015	0.244	0.015	0.236	0.015	0.162	0.021
12	0.231	0.011	0.205	0.011	0.220	0.012	0.209	0.011	0.209	0.011	0.125	0.013
13	0.265	0.010	0.261	0.010	0.254	0.010	0.252	0.010	0.239	0.011	0.153	0.014
14	0.308	0.013	0.306	0.013	0.317	0.014	0.327	0.014	0.324	0.015	0.269	0.019
15	0.273	0.009	0.263	0.009	0.247	0.010	0.266	0.010	0.268	0.010	0.232	0.012
16	0.356	0.011	0.346	0.011	0.321	0.012	0.312	0.012	0.307	0.012	0.196	0.014
17	0.321	0.012	0.318	0.012	0.304	0.013	0.308	0.013	0.317	0.013	0.300	0.016
18	0.183	0.016	0.171	0.015	0.172	0.016	0.161	0.016	0.154	0.016	0.083	0.018
19	0.222	0.011	0.216	0.011	0.224	0.011	0.231	0.011	0.231	0.011	0.124	0.013

Ind = industry code. IWD = Industry Wage Differentials. IWDs are coefficients on the industry dummies from the estimation of the equation (1) at every year. SE = Standard Errors.

period. In both figures, I see a negative relationship between changes in wages and outsourcing for all workers and less-skilled workers as well. In figure 2, the negative relationship is more distinct. The regression results discussed in the next section confirm these graphical results.

4. Results

The estimates from the regressions in equation (2) are in table 5. There are two columns in table 5; column 1 reports the estimates with industry wage premiums for all workers; column 2 reports results with industry wage premiums only for less-skilled workers. The results for both specifications are similar. For all workers, the estimate for outsourcing variable is negative as predicted in the threat effect theory and is statistically significant. The estimate suggests that a magnitude of 0.9 - a 9% decrease in industry wage premiums tends to accompany a 10% increase in industry outsourcing level.

Table 5. Effects of Outsourcing on Industry Wage Premiums

Independent Variables	All Workers	Less-skilled Workers (<= 12 years schooling)
Outsourcing	-0.855**	-1.083**
	(0.363)	(0.401)
Ln(employment)	-5.759	-8.592**
	(3.709)	(3.677)
Productivity growth	-4.383	-14.379*
	(6.200)	(7.443)
Capital Share	-0.020	0.058
	(0.097)	(0.106)
Unionization	0.083	0.193*
	(0.104)	(0.108)
Sample size	114	114

Notes: - Number of Observation is 114 and group number is 19.
- Estimated by two-way-fixed effect model (i.e with both group and period effect).
- Coefficients with * and ** are statistically significant at the 10% and 5% level respectively. Standard errors are in parentheses.

Note that estimates for productivity growth and unionization become statistically significant for the less-skilled workers specification. The positive and statistically significant coefficient of the unionization variable suggests that it is less-skilled workers who benefit from the high union density as found in many similar studies. Another interesting point is that the coefficient of the productivity growth variable is negative and statistically significant for less-skilled workers, which suggest that less-skilled workers wages tend to decrease when the productivity growth increases for the period.

The estimation method used in this study assumes that an industry's outsourcing levels are randomly distributed and that changes in outsourcing levels were independent of industry characteristics such as wage and employment growth. This exogeneity is a strict assumption. If the change in outsourcing over time is correlated with other industry variables, the estimated coefficient will be biased. To assess the validity of this assumption I regressed changes in outsourcing between 2000-2003 on the previous growth of industry wage premium and employment between 1998-2000. The results are presented in table 6. Negative coefficients of employment growth in both all workers and less-skilled workers specifications suggest that industries with lower growth rates of employment in the previous period had reductions in outsourcing. However, they are

Table 6. Regressions of Average Outsourcing Growth on Wage and Employment Growth

All Manufacturing	Dependent Variable	
	Average Outsourcing Growth, 2001-03	
Average Wage Growth 1998-00	0.043 (0.113)	-
Average Less-skilled Wage Growth 1998-00	-	0.036 (0.059)
Average Employment Growth 1998-00	-3.573 (3.778)	-3.501 (3.744)
Constant	0.084 (0.333)	0.066 (0.274)
R-Squared	0.058	0.071
Observation	19	19

not statistically significant at any conventional levels. The estimates of the wage growth are not statistically significant. The assumption used in this study is validated by these results.[17)]

Ⅳ. Conclusion

This paper attempts to find and update measures of outsourcing and test the threat effect hypothesis by looking at US manufacturing sector. The threat effects theory suggests that enhanced capital mobility can have an impact on wages and profits even in the absence of large price or quantity changes. The threat effects have an impact on wages and profits by changing bargaining relationship between workers and employers.

This study demonstrates that foreign outsourcing, as measured by the importance of manufacturing inputs, has gone up significantly throughout U.S. manufacturing since 1998, and has accelerated in many manufacturing industries in the last five years. By using the measure of outsourcing calculated in this study, I found that outsourcing levels are negatively associated with worker's industry wage premium and the magnitude of

17) However, the period that the study covers is not long enough to support the robustness of the results of the exogeneity test.

the effect is bigger among less-skilled workers.

Previous studies that attempted to find a link between wage inequality and outsourcing focused on underlying changes in the relative demand between skilled and less skilled workers. It is not surprising that they did not detect important changes in the welfare of less-skilled workers since they narrowed their search to such channels. As this study suggests, it is through the bargaining channel that labor market responds to enhanced capital mobility.

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Appendix

Calculating Imported Inputs to Measure Outsourcing Activity

Imported inputs used in production by industries

Use of imported intermediate manufactured goods used by industry i in production:

$$\text{Imported Inputs}^{U}_{i} = \sum_{c=1}^{n} (\text{Input}^{U}_{ic} \times [IM_c / (\text{Shipments}_c + IM_c - EX_c)]),$$

where

Input^{u}_{ic} = use of commodity c by industry i in production;

IM_c = imports of commodity c;

Shipments_c = domestic shipments of commodity c;

EX_c = exports of commodity c.

The share of imported goods in total intermediate manufacturing goods used in production for industry i is:

$$\text{Imported Inputs}^{U}_{i} / (\sum_{c=1}^{n} \text{Input}^{U}_{ic}).$$

Imported inputs produced by industries

Production of imported intermediate manufactured goods by industry i:

$$\text{Imported Inputs}^{M}_{i} = \sum_{c=1}^{n} \text{Input}^{M}_{ic} (\times [IM_c / (\text{Shipments}_c + IM_c - EX_c)]),$$

where

Input^{m}_{ic} = production of commodity c by industry i;

IM_c = imports of commodity c;

$Shipments_c$ = domestic shipments of commodity c;

EX_c = exports of commodity c.

The share of imported goods produced in total intermediate manufacturing goods produced by industry i is:

$$\text{Imported Inputs}^{M}_{i} \;/\; \left(\sum_{c=1}^{n} \text{Input}^{M}_{ic}\right).$$

논문초록

해외 아웃소싱과 노동시장의 반응: 미국 제조업을 중심으로

최 민 식

해외 아웃소싱은 선진국에서나 개도국에서나 할 것 없이 최근의 세계화와 더불어 주요한 논쟁거리이며, 또한 이와 관련한 부정적인 효과에 대한 우려의 목소리 또한 크다. 하지만 해외 아웃소싱에 대한 정확한 정의나 측정하는 방법이 크게 발달하지 못했기 때문에 그 변화를 엄밀하게 살펴볼 수 없었다. 특히 1990년대 초반 이후에는 그나마 측정치가 별로 없는 상황이다. 본 논문에서는 최근의 해외 아웃소싱에 대한 측정치를 계산함과 동시에 해외 아웃소싱이 노동시장, 특히 임금의 변화에 미치는 영향을 미국 제조업을 중심으로 살펴보았다. 1987년에서 2003년까지 미국 제조업의 총제조부품(manufactured inputs)중 해외 아웃소싱의 비중은 12.4%에서 22.7%로 10.3% 포인트 증가했다. 해외 아웃소싱이 미국 제조업 노동시장에 미치는 영향을 살펴본 본 연구의 후반부에서는 해외 아웃소싱 수준이 제조업 근로자들의 산업프리미엄에 통계적으로 유의미한 음의 효과를 준다는 것이 밝혀졌다. 추정계수의 크기는 0.9로서 10%의 해외 아웃소싱이 있는 산업의 경우 10%의 산업별 임금프리미엄이 하락하게 된다는 것을 의미한다. 이 크기는 미숙련 노동자들에게는 11%로 나타났다.

주제어 : 아웃소싱, 산업별 임금격차, 위협효과