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ABSTRACT

In this paper, we link industry-level data on offshoring activities of U.S. multinational firms, import penetration, and export shares with individual level worker data from the Current Population Surveys. We examine whether increasing globalization through offshoring or trade has led to reallocation of labor, both within and out of manufacturing, and measure its impact on the wages of domestic workers. We also control for the "routineness" of individual occupations. Our results suggest that (1) offshoring to high wage countries is positively correlated with U.S. manufacturing employment (2) offshoring to low wage countries is associated with U.S. employment declines (3) wages for workers who remain in manufacturing are generally positively affected by offshoring; in particular, we find that wages are positively associated with an increase in U.S. multinational employment in high income locations (4) much of the negative effects of globalization operate through downward pressure on wages of workers who leave manufacturing to take jobs in agriculture or services and (5) the downward pressure on aggregate U.S. wages operating through import competition has been quite important for some occupations. This effect has been overlooked because it operates across, not within, industries.

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“How can we quantify the actual effect of rising trade on wages? The answer, given the current state of the data, is that we can’t.”

Paul Krugman, Brookings Panel on Economic Activity (2008)

“Why not just estimate the returns to schooling and the industry wage levels from Current Population surveys (CPS)? This type of analysis—which is the standard in the wage-structure literature—would probably give a much more robust answer….”

George Borjas, in *The Impact of International Trade on Wages*, edited by Feenstra (2000)

I. Introduction

Between 1982 and 2002, the United States economy experienced a boom in offshoring and a doubling of imports of manufactured goods from low-wage countries. Over this same period, roughly 6 million jobs were lost in manufacturing and income inequality increased sharply. These parallel developments have led many to conclude that “good” manufacturing jobs have been shipped overseas at the expense of the domestic labor force, putting downward pressure on wages of American workers. Concern over these developments motivated the U.S. Congress to pass the American Jobs Creation Act of 2004. Similar legislation aimed at keeping jobs in the United States has been proposed by Barack Obama. Yet the degree to which changes in the U.S. labor market are related to international trade and offshoring is debatable.

Labor economists wishing to explain the rise in wage inequality in the U.S. generally target skill-biased technological change (Autor, Levy and Murnane, 2003, Autor, Katz and Kearney, 2006 and Goos and Manning, 2007) or labor market institutions, such as the erosion of union power (Nickell and Layard 2003, DiNardo, Fortin and Lemieux, 1996). However, Autor, Katz and Kearney (2006) acknowledge that international trade and offshoring are likely to become an increasingly important driver of wage inequality, both because of rapid growth in developing countries (where wages are low) and because of dramatic reductions in the cost of computer and communications technology.

Alternatively, trade economists have focused on general equilibrium models to explain rising inequality: the Stolper-Samuelson theorem posits that opening up to trade will lead to a fall in unskilled wages or an increase in skilled wages for countries with a comparative advantage in producing skill-intensive goods. Some representative studies focusing on general equilibrium effects include Baldwin and Cain (1997), Baldwin and Hilton (1984), Krugman (2000), and Leamer (1994, 1998, 2000). These studies, which use data ending in the early 1990s, generally find that trade only explains a small portion of the steep rise in wage inequality[1].

Some recent work has shifted the focus to possible linkages between offshoring and U.S. wages. Feenstra and Hanson (1999) adopt a general equilibrium approach used to identify linkages between trade flows and wages to examine linkages between offshore activity and inequality. Using data for the U.S. manufacturing sector between 1979 and 1990, they find that the real wages of production workers were probably unaffected by offshoring activities, while the real wages of non-production workers increased by 1 to 2 percentage points. Feenstra and Hanson use a two-step procedure to first identify the impact of outsourcing and high technology investments on productivity and prices, and then trace through the induced productivity and price changes to production and non-production wages. Another study that finds small or insignificant

[1] See also the many original papers and comprehensive reviews of the literature on this topic in *The Impact of International Trade on Wages* (2000), edited by Robert Feenstra.

effects of offshoring on U.S. wages is Liu and Trefler (2008), who measure the impact of services offshoring to China and India on labor outcomes of service sector employees.

Other studies, instead of focusing on wages, have examined whether domestic employment decisions of U.S. multinationals are affected by their offshoring activities.[2] Brainard and Riker (1997) showed that employment across high and low wage affiliate locations of U.S. multinationals is complementary for manufacturing activities. Borga (2005) and, Desai, Foley, and Hines (2005), and Slaughter (2003) also find that expansion of U.S. multinationals abroad *stimulates* job growth at home. Slaughter (2003) reports the largest positive effects of offshoring: for every new job abroad, U.S. employment increases two-fold.[3] Reviewing these studies, Mankiw and Swagel (2006) conclude that “foreign activity does not crowd out domestic activity; the reverse is true.”

Another set of studies on this topic (Brainard and Riker (2001), Hanson, Mataloni and Slaughter (2003), Muendler and Becker (2006), Harrison and McMillan (2007), and Harrison, McMillan, and Null (2007)) reaches the opposite conclusion: jobs abroad *do replace* jobs at home, but the effect is small. Regardless of the reasons for discrepancies in results (see Harrison and McMillan (2009) for a discussion), all of the studies that analyze outcomes within firms registered with the Bureau of Economic Analysis share an important limitation. Since there are no details available on worker characteristics in these data, this research is often restricted to exploring employment shifts between a U.S. parent and its foreign affiliate.

What is most surprising about the growing literature on trade, offshoring, and wages is the lack of studies that use individual-level data to explore the linkages between manufacturing wages,

[2] We will use the term trade to mean trade in final goods and trade in intermediate inputs – the latter is sometimes referred to as offshore outsourcing. We use offshoring to refer to the physical relocation of parts of the business to countries outside the U.S.

[3] Slaughter’s estimates are presented in a high profile report released by the government on the consequences of offshoring for the U.S. economy.

offshoring, and international trade[4]. Liu and Trefler (2008) is an important exception, but they focus primarily on the question of offshoring in the services sector to China and India. While their pathbreaking study finds no impact of services offshoring on wages, it is more likely that there would be important consequences for U.S. wages from increasing international trade as well as offshoring of manufacturing activity. Import competition as a share of sales in manufacturing has doubled in the last twenty years and offshoring in this sector has also increased significantly. In Feenstra's (2000) book exploring the impact of trade on wages, only one study uses individual-level data to explore the linkages. That study, by Lovely and Richardson (2000), relies on the PSID data and cannot identify significant effects of trade on U.S. wages, in part due to the fact that they follow a small sample of individuals over time.

In recent work, both Feenstra (2009) and Krugman (2008) suggest that the effects of trade and offshoring on U.S. wages may be more important than these previous studies would suggest. Krugman challenges conventional wisdom by arguing that published research on trade and wages is largely outdated. He theorizes that the dramatic increase in manufactured imports from developing countries since the early 1990s could be responsible for the increase in wage inequality in the United States and other advanced countries. Feenstra (2008), in his Ohlin lectures, writes that "my own views have always favored a trade-based explanation [for the shift in labor demand toward more-skilled workers], and that the views of Krugman and others may be changing".

The theoretical literature on the linkages between multinational activity, labor demand, and wages does not yield clear predictions on the relationship between offshore activities and home labor market outcomes. For example, Helpman's (1984) model which seeks to explain multinational activity yields markedly different predictions for the linkages between wages and offshore activities than Grossman and Rossi-Hansberg (2008). In the Helpman (1984) model, the

[4] We thank Larry Katz for suggesting the idea of merging the CPS data with the BEA data.

motivation for foreign investment is based on factor price differences that exist outside of the endowment allocation when there is factor price equalization. Consequently, in that alternative equilibrium, factor price differences follow from different relative endowments, and foreign investors will be drawn to countries where they could pay (for example) lower wages for a homogeneous type of good. Such a framework implies that under some initial relative endowments offshoring for vertically-oriented multinationals can be associated with intra-firm imports of low-wage goods, largely invisible exports from headquarters of intangibles such as management skills, falling domestic demand for unskilled labor, and falling domestic wages.

More recent work by Grossman and Rossi-Hansberg (2006) draws on insights from Autor, Levy and Murnane (2003) to develop a framework in which falling costs of offshoring can lead to wage gains for both skilled and unskilled workers at home. Grossman and Rossi-Hansberg (2006) use Autor, Levy and Murnane's differentiation between routine and non-routine tasks to build a theoretical model of trade in tasks. Advances in technology (such as improvements in communication) make offshoring of routine tasks less costly, leading firms to increase production abroad. What is surprising is that offshoring of routine tasks for vertically motivated multinationals (there is no horizontal motive for foreign investment here) leads to ambiguous predictions for domestic wages. The intuition behind this result is that falling costs of offshoring act like a positive productivity shock. Although the primary motivation for offshoring is to save on labor costs, low-skill workers at home may still gain if terms of trade effects and labor supply effects (offshoring acts like an increase in the labor supply, which puts downward pressure on domestic wages) are not too large.

In this paper, we examine *both* the impact of trade and offshoring on U.S. labor market outcomes by combining information on wages and worker characteristics from the March Current

Population Surveys (CPS) with data on trade and offshoring across industries and over time. Our data on offshoring activities by U.S. multinational firms comes from the Bureau of Economic Analysis and provides the only comprehensive coverage of the offshore activities of U.S. firms. Our data on international trade includes both export shares and import penetration. Following Autor, Levy, and Murnane (2006), we also test whether the impact of offshoring or trade on U.S. wages is more pronounced for occupations which can be characterized as routine. We include a rich set of control variables; in particular, we control for total factor productivity growth and changing investment goods prices.

The standard approach to identifying effects of import competition on wages is to use differences in import penetration across industries. This approach has been used to measure industry wage differentials as well as to measure the effects of sector-specific import competition on wages and employment. Our results suggest that longitudinal wage changes due to either changes in import competition or offshoring within the same industry are not very significant. We find that the impact of offshoring on wages between 1982 and 2002 is also quantitatively small among those who *remain* in a specific manufacturing sector. For example, a 10 percent increase in offshoring to low-wage countries has virtually no impact on wages across all educational categories. Likewise, a 10 percent increase in offshoring to high-wage countries is associated with just a small *increase* in wages of less educated workers of between 1 and 0.6 percent. In contrast, we find that workers who leave manufacturing lose on average 3 to 9 percent in real wages.

We find small effects of offshoring on employment and only positive effects of offshoring on wages. Consistent with Harrison and McMillan (2006) and Harrison, Null, and McMillan (2007), we find that these small effects on employment depend on the location of offshore activities. A 10 percentage point increase in offshoring to low-wage countries reduces employment in manufacturing by .2% while offshoring to high-wage countries increases employment in manufacturing by .8 %.

While we find significant employment reallocation in response to import competition and smaller employment responses to offshoring, we find almost no effects of globalization on wages over time within the same industry. If most of the downward pressure from globalization on wages occurs in general equilibrium, whereby wages equilibrate across manufacturing sectors very quickly as workers relocate, then analyses which rely on changes in wages within an industry may miss important effects of international trade on wages.

We address this problem by calculating an *occupation-specific* measure of offshoring, import competition, and export activity.[5] If workers find it easy to relocate within manufacturing sectors or leave manufacturing altogether, but are more likely to remain in the same occupation when they switch jobs, then occupation-specific measures of international competition are more appropriate for capturing the effects of trade and offshoring on wages. Our results suggest that this is indeed the case, and that international trade has had large, significant effects on occupation-specific wages. These large wage effects are consistent with our results showing significant reallocation of employment across industries in response to import competition. The downward pressure on wages due to import competition has been overlooked because it operates between and not within industries. Our results suggest that a one percentage point increase in occupation-specific import competition is associated with a .25 percentage point decline in real wages. While some occupations have experienced no increase in import competition (such as teachers), import competition in some occupations (such as shoe manufacturing) have increased by as much as 40 percentage points.

[5] We are greatly indebted to Gordon Hanson for suggesting this idea.

The paper is organized as follows. Section II describes the data and documents trends in trade, offshoring, wages and employment. Section III discusses the theoretical motivation for our framework, and Section IV presents our first set of results which use industry-specific shifts in exposure to trade and offshoring to identify their impact on wages and employment. Section V extends the analysis to identify the economy-wide effects of global forces and also shows that wages fall significantly when workers leave manufacturing. Section VI concludes.

II. Trends in Offshoring, Trade, Wages and Employment

This section is devoted to outlining broad trends in the data for employment, wages, and the relationship between wages and measures of globalization. The last panel of Figure 1 shows the contraction of manufacturing employment between 1979 and 2002. Total employment (using the CPS employment numbers) fell from 22 to 17 million during the sample period, with rapid declines at the beginning of the 1980s and in the most recent years. The remaining panels of Figure 1 decompose these changes by showing the trends according to educational attainment, again using the MORG CPS employment numbers. For both the least educated workers (those with less than a high school education, or LTHS) and those who completed high school, there were significant declines in manufacturing employment over the entire period. While employment for individuals with some college education increased in the earlier years, it began to decline in 2000. Total employment for workers with at least a college degree increased over the sample period, declining only the last three years of the sample period. The very different employment trends across educational attainment suggest that analyzing wages without taking into account the enormous changes in the composition of the manufacturing workforce would be quite misleading.

Within manufacturing, the labor force has become increasingly well educated as workers with high school degrees or less leave the sector and are replaced by an increasing number of college graduates.

Figure 2 shows the average manufacturing real hourly wage by education level over the sample period, using the MORG CPS sample described in the Data Appendix. The trends are the same whether we use current period employment weights or fixed employment weights based on the 1979 composition of manufacturing. Real hourly wages fell for the least educated workers and increased for workers with at least some years of college. The biggest wage gains were for manufacturing workers with an advanced degree. The decline in wages for high school dropouts and the steep wage increases at the upper end of the income distribution are consistent with the stylized facts on increased wage inequality in the United States [see Autor, Kearney and Katz (2007) for a review of these trends]. [6]

Offshoring and International Trade

Figure 3 shows domestic and foreign affiliate employment for U.S. multinational firms, which account for a large share of the total U.S. manufacturing employment reported in Figure 1. The dashed lines in Figure 3 show that low income affiliate employment by U.S. based multinationals nearly doubled over the entire period while affiliate employment in high income countries remained roughly constant. Overall, offshore affiliate employment as a share of total

[6] While the trends in Figure 2 are informative, they do not control for other factors that affect income, such as sex, age, and experience. Though not shown here, we redid the trends in wages by educational attainment, but instead using wage residuals. These wage residuals were computed using Lemieux's (AER ? year) approach for each educational category separately. We also added industry dummies to control for inter-industry wage differentials. The wage residuals show similar trends, with falling wage premia for less educated workers and rising wage premia for more educated workers.

employment globally for U.S. multinationals increased from 28 percent in 1982 to 36 percent in 2002. This increase was almost entirely driven by a doubling of affiliate employment shares in developing countries, from 8 to 17 percent. Affiliate employment in developed countries, as a share of total worldwide employment, remained roughly constant over the entire period at around 20 percent. The increase in developing country activity has been accompanied by a reduction in the U.S. workforce for these parents from almost 12 million workers in 1982 to 7 million workers in 2002.

Figure 4 presents a visual summary of increasing international trade for U.S. manufacturing during the sample period. The solid line in Figure 4 plots the ratio of imports to imports plus shipments over time and the dashed line plots the ratio of imports from developing countries to imports plus shipments. Unlike offshoring, the trends in import penetration were already evident throughout the 1980s. Both imports from developed and developing countries increased steadily between 1982 and 2002, with the most dramatic increase occurring for developing countries. Figure 5 is borrowed from Grossman and Rossi-Hansberg (2006) and shows that imported intermediate inputs are becoming increasingly important to the U.S. manufacturing sector. In summary, as Grossman and Rossi-Hansberg (2008) put it: there has been a boom in the offshoring of manufacturing tasks. As Krugman (2008) observed,

> "There has been a great transformation in the nature of world trade over the past three decades. Prior to the late 70s developing countries exported primary products rather than manufactured goods; one relic of that era is that we still sometimes refer to wealthy nations as "industrial countries," when the fact is that industry currently accounts for almost twice as high a share of GDP in China as it does in the United States. Since then, however,

developing countries have increasingly become major exporters of manufactured goods, and latterly selected services as well."

We now compare changes in offshoring and international trade to initial job characteristics by industry. In Figure 6 we plot the increase in offshoring by industry as a function of the share of routine jobs in that industry in 1983. Our measure of routine is based on, Levy and Murnane (2005) who describe routine jobs as "tasks that can be expressed using procedural or 'rules-based' logic, that is codified in a fully specified sequence of logical programming commands ("If-Then-Do" statements) that designate unambiguously what actions the machine will perform and in what sequence at each contingency to achieve the desired result." Of course, Autor et al. (2003) use routineness to designate which jobs can be easily performed by computers. However, the jobs that are classified as routine also include the jobs in manufacturing that we typically think of as being offshorable. These jobs include: attaching hands to faces of watches, sewing fasteners and decorative trimming to articles and, though not mentioned explicitly in their paper, include services tasks that we think of as offshorable such as answering telephones.

Figure 6 shows substantial variation in the change in offshoring to low income countries by industry, with changes ranging from -20% to an increase in 45%. Figure 6 shows a clear positive relationship between the increase in offshoring and the share of jobs in that industry classified as routine in 1983. The largest increases in offshoring occurred in Leather Products and Footwear – 45% in both cases – and the share of routine workers in these industries in 1983 were 68% and 71% respectively. By contrast, offshoring actually declined in highly capital-intensive industries such as Industrial Chemicals and Engines and Turbines and increased minimally in industries such as Construction and Steel. In these industries, the share of routine workers in 1983 ranged from 50 to 55%.

Figure 7 looks remarkably similar to Figure 6 but plots increases in import penetration against the initial share of routine workers in the industry in 1983. The increase in import penetration also varies widely by sector but now Office and Accounting machines tops the list in terms of increased imports, followed closely by Footwear, Apparel and Clocks. All of these sectors have a share of routine workers of around 70% with the exception of Office and Accounting Machines which has a low (50%) share of routine workers.[7] Sectors with a greater concentration of routine workers in 1983 were exposed to significantly larger increases in import penetration. Sectors with fewer routine jobs that experienced little to no increase in import competition include: cement, iron and steel and industrial machinery.

Trends in Services

We complete our review of the stylized facts in the CPS data by presenting trends in employment and wages for the services sector. Figure 8 shows a decline in employment in services for workers with less than a high school degree, while employment in all other educational categories has increased over the sample period. Figure 9 shows a significant decline in real wages for workers with less than a high school degree, while real wages for other educational categories have increased. Comparing Figures 2 and 9, average real wages have been consistently lower in services than in manufacturing across all educational categories. This is an important stylized fact, which helps us to understand that one avenue through which offshoring or

[7] Krugman [2008] refers to this anomaly noting that it is probably the case that although the sector as a whole appears to use fewer routine workers, it is probably the case that if we could disaggregate the trade data to a finer level, we would find that the import penetration has occurred in the sub-sectors of Office and Accounting Machines that do use a higher share of routine workers. In any case, this anomaly does not obscure the basic trend.

competition from trade could put downward pressure on wages is by increasing the movement of workers out of manufacturing and into services. Katz and Summers (1989) and Krueger and Summers (1988) discuss the types of institutions (such as strong unions) which have contributed in the past to historically higher wages in manufacturing.

III. Theoretical Motivation

We discuss first the literature on trade and wages, and then turn to a discussion of offshoring and wages. Representative studies focusing on general equilibrium effects include Baldwin and Cain (1997), Baldwin and Hilton (1984), Krugman (2000), and Leamer (1994, 1998, 2000). Many of these studies begin with a simple illustration of the relationship between trade and factor prices by using a specific formulation of the Stolper-Samuelson results with a two-good, two-factor, and two-country framework. For example, Leamer (1994) begins with a typical zero profit condition that can be written in vector form as Aw=p, where p is a vector of prices, w is the vector of factor costs and A is the vector of input intensities. If there are only two factors (skilled and unskilled labor) and two goods (textiles (T) and machinery (M)), then Leamer reproduces the standard general equilibrium result with an HO (Heckscher-Ohlin) framework that wages and income inequality will depend on both technology (as represented by the A matrix) and product prices (p_T,p_M). If we assume that textiles are unskilled labor-intensive and machinery is skilled labor-intensive, then the wages of unskilled workers will vary positively with p_T and negatively with p_M; this result is reversed for skilled workers.

This framework suggests that in general equilibrium wages will be determined by relative product prices and relative technology. The strong assumption in this framework is that factors costlessly relocate across sectors, so that there are no industry-specific wage differentials. We will begin our estimation with the extreme assumption that factors cannot relocate across sectors, so that wages are set by only the prices and technology within each sector. We will then relax that assumption and allow workers to move across sectors but not across occupations.

The theoretical literature on offshoring provides a useful framework for understanding how offshoring activities could either put upward or downward pressure on domestic wages. In Grossman and Rossi-Hansberg (2008), improvements in communications technology allow firms to increase the tasks which can be sent offshore (offshored). As more low skill tasks are offshored, input costs fall and offshoring represents a positive technology shock, which could lead to an increase in wages.

In the Grossman and Rossi-Hansberg model (referred to as "GR" below), foreign investment is motivated solely by factor price differences, with different distinct tasks performed in different locations. However, tasks may only be offshored if they are sufficiently "routine"—not too costly to supervise from abroad. For simplicity, in their model only tasks performed by unskilled workers have the possibility of being offshored. Workers move costlessly between sectors: workers are characterized by the different tasks they perform, not by the industry (or good) they are affiliated with. In a GR world, there would be no *industry-level* wage effects associated with import penetration or outsourcing activity because workers immediately move across sectors to equalize wages throughout the economy for performing the same task. The lack of inter-industry wage differentials associated with differing exposure to trade or offshore activities is an assumption that we will test in our empirical work below.

Grossman and Rossi-Hansberg (2008) posit two types of workers, skilled workers with wages h and unskilled workers with wages w. There are two types of goods, export-competing and import-competing. Their key insight is that unskilled wages will vary with the degree of offshoring activity based on the following equation:

$$(1) \qquad \% \Delta w = -\%\Delta\Omega(I) - \mu_1\%\Delta p - \mu_2(dI/1\text{-}I)$$

where I is defined as the percentage of routine (i.e. low skill) tasks performed offshore, as a percentage of all tasks performed both at home and abroad. The percentage change in the unskilled wage can be decomposed into three distinct components. The first term is the positive productivity effect due to offshoring of activities previously performed at home. Grossman and Rossi-Hansberg posit that as the cost of offshoring falls due to technology improvements, productivity gains will lead to increased wages at home. One can think of offshoring as using an additional input that makes U.S. workers more productive.

The second term, the terms of trade effect, is the relative price of the offshoring country's export good in terms of its import good, or its terms of trade. The third term, the labor supply effect, captures the negative impact of offshoring. There is a negative effect on wages due to the fact that an increase in offshoring acts like an increase in the labor supply, putting downward pressure on domestic wages. While the popular press has focused on this last term, this framework makes clear that the net effect of offshoring (controlling for the relative price effect) could in fact be positive for unskilled workers if the productivity gains from offshoring exceed the negative impact of labor supply effects.

For skilled workers, GR show that the effect of offshoring on skilled wages s is unambiguously positive:

(2) $\% \Delta s = \mu_3 \% \Delta p + \mu_4 (dI/1-I)$

Improvements in terms of trade p will unambiguously benefit skilled workers in a country with a comparative advantage in producing skill-intensive goods. Increases in offshoring will benefit skilled workers because they gain through the first term (the terms of trade effect) but are not adversely affected by the increase in the labor supply of unskilled workers (the second effect). While Grossman and Rossi-Hansberg only allow the routine tasks performed by unskilled labor to be offshored, in practice all types of labor could be offshored. As Autor et al. (2003) point out, highly skilled workers could in principle perform routine tasks, while unskilled workers could perform non-routine tasks. We choose to remain agnostic in the empirical work which follows and test for the impact of offshoring on both routine versus non-routine and skilled versus non-skilled workers.

If we combine the standard HO insights on wage determination with the more recent literature on offshoring and wages, a complex picture emerges. Wage changes of workers at different skill (or routine) levels are associated with relative product price changes, technology changes, and the fraction of domestic employment which is offshored. However, this literature is entirely general equilibrium in nature, which suggests that inter-industry wage differentials should not exist or, if they do, are not associated with changes in globalization.

To move from the theory to our empirics in Section IV, we require measures of relative prices, technology, and offshore activities. Since relative price series for imports and exports are incomplete, we substitute for prices by using the share of exports in production and import penetration at the four digit SIC 1987 level. For technology, we use the NBER's calculations of total factor productivity provided by Wayne Gray. Offshore activity in each industry is measured by the total employment in foreign affiliates among multi-national U.S. firms, separated into high and low income locations. Harrison and McMillan (2009) report that the BEA sample of multi-national firms accounted for 80 percent of total output in manufacturing in 1980, suggesting that the coverage is fairly extensive. We have also experimented with using the fraction of tasks offshored, to be more consistent with equation (3), similar results[8].

We begin our empirical analysis by examining the linkages between industry-specific measures of trade (export shares and import penetration), offshoring, and individual wages over time. Controlling for industry fixed effects (which capture time-invariant inter-industry wage differentials), we find almost no relationship between changes in industry-specific wage differentials and international trade. The lack of industry-level wage changes which are associated with changes in trade is consistent with the assumptions made in the trade literature about the ease with which workers are able to move across industries. However, we do find a significant relationship between our measures of offshoring and domestic wages. These results are discussed in Section IV. We then broaden the analysis to test for the impact of trade and offshoring on occupation-specific wages. We find a significant relationship between occupation-specific changes in wages and changes in international trade, suggesting that researchers have been looking for wage effects linked to globalization in the wrong place. Nevertheless, this analysis is not strictly a test of the general equilibrium theories discussed above, which assume that wages of workers with the same education and experience should converge across both industries and occupations.

[8] Results available upon request from the authors.

IV. Estimates of the Impact of Trade and Offshoring on Employment and Wages within a Sector

We begin exploring the link between globalization and labor market outcomes over the period 1982 to 2002 by estimating the following equation:

$$(3a)\; w_{ijt} = \beta_0 Z_{ijt} + \beta_1 Routine_{ijt} + \beta_2 G_{jt-1} + \beta_3 TFP_{jt-1} + \beta_4 PINV_{jt-1} + \beta_5 REALSHIP_{jt-1} + \beta_6 d_t + \beta_7 I_j + \varepsilon_{ijt}$$

where *w* is the log of hourly earnings received by individual i, working in industry j in year t. Z is a vector of individual characteristics, R is our measure of how "routine" a job is and G is a vector of different industry-level measures of exposure to offshoring and international trade. PINV is the cost of investment goods and captures in part the role of falling computer prices and the potential impact of labor-saving technology on labor market outcomes. PINV, which varies by industry and year, is taken from the NBER's productivity database. TFP is measured as total factor productivity and is computed by the NBER for all years through 1996, and was updated through 2002 using data provided to the authors by Wayne Gray. To avoid possible biases due to output or demand shocks which could be correlated with affiliate employment, we also control for the real value of shipments in sector j at time t-1. However, we also estimated all the specifications reported in this paper without including a control for sector level output and the results are not affected by inclusion of this variable. We also allow for time effects *d* and industry effects *I* . While most approaches to analyzing wages also include occupation fixed effects, our measure of routineness is collinear with occupation fixed effects and consequently they are excluded here.

We will explore the linkages between employment and industry-level measures of globalization using a comparable equation for employment at the sector level:

$$(3b)\ L_{jt} = \alpha_0 Z_{jt} + \alpha_1 Routine_{jt} + \alpha_2 G_{jt-1} + \alpha_3 TFP_{jt-1} + \alpha_4 PINV_{jt-1} + \alpha_5 REALSHIP_{jt-1}$$
$$+ \alpha_6 d_t + \alpha_7 I_j + \varepsilon_{ijt}$$

Variables included in the Z vector to control for worker characteristics have been aggregated to the jth sector level using 1979 weights. To estimate equations (3a) and (3b), we have merged data on import penetration and export shares from Bernard, Jensen, and Schott (2006), which we recalculated and updated through 2002, with offshoring activity from the Bureau of Economic Analysis (BEA) and the individual level data from the Current Population Surveys (CPS). The CPS data includes information on the individual's industry affiliation, allowing us to merge these data with the BEA offshoring and BLS terms of trade information. We augment equations (3a) and (3b) to include the following information on worker characteristics: years of work experience, age, sex, union affiliation, race, and education level.

To measure *Routine*, we have obtained the data from Autor, Levy and Murnane (2003) which allows us to classify each occupation according to five different measures of routineness. Autor et al (2003) show that over the last 40 years there has been a reduction in the tasks performed within the U.S. that are routine and an increase in the tasks that are non-routine. They argue that this shift could have occurred at every educational level, not just for unskilled workers. Nevertheless, the means presented in presented in Appendix Tables 1 and 2 suggest that more routine tasks are more likely to be performed by workers with lower educational levels. The means for 1982 and 2002 also show that the percentage of employment which can be characterized as routine has fallen over time. We will test for the possibility that the downward pressures on employment and wages in manufacturing are more likely for routine tasks in our empirical work by splitting the CPS samples into more or less routine occupations. This sample split allows us to essentially introduce an interaction between *Routine* and the other right-hand side variables in equations (3a) and (3b).

We present our first set of estimates for equation (3b) in Table 1. The dependent variable is the log of total employment in sector j at time t ; all results include CPS-provided weights to correct for possible sampling bias and the standard errors in parentheses reflect correction for arbitrary heteroskedasticity. We also allow for clustering of errors at the industry level. All results include controls for year, industry and education dummies.

Our G vector in equations (3a) and (3b) includes four measures of globalization: offshoring to low income affiliate locations, offshoring to high income affiliate locations, export shares and import penetration. To allow for the possibility that offshoring to low-wage locations might have different effects than offshoring to high wage locations, we include as separate regressors the log of employment in sector j by U.S. based multinationals in low and high wage countries. Our measure of affiliate employment in high and low income affiliate locations is defined as the sum of all manufacturing affiliate employment for sector j in low or high wage locations, lagged one period. Our measure of import penetration is the share of imports in domestic consumption, where domestic consumption is defined as domestic production less exports plus imports. Export shares are defined as the share of exports in domestic production for sector j. Since the classification for export and import shares is at a higher level of disaggregation than the information on offshoring activities provided by the BEA, we aggregated this information using constant period production weights.

In Table 1, we first present all education categories pooled in column 1 and present separate education categories in columns (2) through (6). The education categories include (1) high school drop-out (2) finished high school (3) some college (4) finished college and (5) graduate experience. Pooling all educational categories, the results in column one suggest that the effect of offshoring depends on whether affiliate employment is located in high or low wage countries. A 1 percent increase in employment in low wage countries reduces domestic employment by .02 percent while a 1 percent increase in employment in high wage countries increases domestic employment by .08 percent. Breaking the results down by educational category, we see that the negative effects of offshoring to low wage countries are largest for workers with less than a high school degree. The point estimate, at -0.04, is only statistically significant for this educational level and suggests that a 1 percent increase in affiliate employment in low income locations is associated with a .04 percent reduction in employment of workers with less than a high school education. On the other hand, the positive effects of offshoring to high wage countries are evident across all educational categories. In particular, the point estimates are significant for workers with a high school degree or less and for college-educated workers, suggesting that offshore employment in high income locations is complementary with employment at home across all educational categories.

While the coefficients on offshoring are small and suggest both substitution (in low wage countries) and complementarity (in high wage locations), the coefficients are large and negative for both import penetration and export activity. For the pooled sample, a 1 percentage point increase in import penetration reduces U.S. manufacturing employment by .6 percent. Across all sectors, import penetration doubled on average (see Appendix Table 1) from 8 to 16 percentage points. Over the sample period, the 8 percentage point increase in import penetration alone can explain nearly 5 percent of the reduction in manufacturing employment. In addition, the coefficients are the largest and most negative (and significant) for U.S. workers with a high school education or less. The point estimate for workers with a high school education is -.85, indicating that the average 8 percentage point increase in import penetration was associated with a reduction in employment of high school graduates by nearly 7 percent.

While it is not surprising that import competition is associated with declining employment of workers with less than a college degree, the negative and significant coefficient on sectoral export shares is less intuitive. The negative coefficients may indicate that export growth was labor-saving for workers with less than a college degree. Average export shares increased from 9 to 14 percent of sectoral output (Appendix Table 1) between 1982 and 2002, which would be associated with a significant decline in employment of less educated workers. Likewise, the negative and significant coefficient on total factor productivity suggests that productivity growth has been labor-saving for all educational categories except workers with an advanced degree. For other workers, productivity growth in manufacturing has been achieved in conjunction with falling employment.

In Table 2, we examine whether the routine nature of a particular task affects the results reported in Table 1. We follow Autor et al (2003) in aggregating their five different measures of how routine a task is to create one index. While two indicators indicate the degree of manual routine and cognitive routine tasks, three other categories measure how non-routine a task is. Their measures of non-routine tasks include non-routine manual, non-routine interactive, and non-routine analytical. For the two measures of routine tasks, the least routine occupations are classified as 1 and the most routine are classified as 10. Following Autor et al (2003), we aggregate these measures to get one summary measure of routine that varies by worker education level (e), industry (j) and year (t) as:

$$Routine_{ejt} = \frac{Routine\,Cognitive_{ejt} + Routine\,Manual_{ejt}}{Routine\,Cognitive_{ejt} + Routine\,Manual_{ejt} + DCP_{ejt} + EFH_{ejt} + Math_{ejt}}$$

The task inputs are described in more detail in the Data Appendix and include routine cognitive and manual, nonroutine analytic, nonroutine interactive, and non-routine manual.

In Table 2 we report separate estimates for different degrees of routineness. We have divided the sample into three groups based on the *Routine* indicator, to identify whether the coefficients in equation (3b) vary systematically with *Routine*. The results confirm the importance of separating tasks into routine and non-routine. Both the negative effects of offshoring in low income affiliate locations and the positive effects in high income locations are concentrated in occupations which are classified as the most routine (column (3)). As in Table 1, the largest effects are associated with a positive, complementary relationship between employment in high income regions and employment at home: for the most routine tercile, a 1 percentage point increase in employment in high income affiliate is associated with a .12 percentage point increase in aggregate U.S. employment of the most routine workers. The negative effects of offshoring to low income affiliates are also concentrated in the most routine tercile, but the magnitudes are very small: a 10 percentage point increase in employment in low income affiliates is associated with a .2 percent fall in real wages.

The results in Tables 1 and 2 suggest that there are large shifts in employment resulting from changes in offshoring, the real price of investment, productivity growth, import competition and export activity. The results indicate that productivity growth, export growth, and import competition have all been associated with significant declines in domestic manufacturing employment. The results on offshoring suggest that the effects have been smaller in magnitude and mixed in sign: offshoring to high income countries is associated with employment gains at home, while offshoring to low income countries is associated with small employment losses. These results are important in so far as they suggest a fluid labor market where changes in other factor prices and global competition lead to employment reallocation.

In Table 3, we shift our attention to the linkages between individual level wages and our globalization outcomes. In these regressions, we control for individual characteristics including education, experience, age, sex, race, and union membership. We also include year and industry dummies. The identification strategy here is to use within-sector j shifts in exposure to offshoring, import penetration, and export activity to measure the effects on wages of workers in sector j. This approach will be contrasted with our strategy to measure the economy-wide impact across all workers in a particular occupation in Section V. In Table 3, the outcomes for wages are generally consistent with the results for employment presented in Tables 1 and 2. There is no statistically significant relationship between low income affiliate employment and industry-level wages; indeed, the point estimates are close to zero. However, there is a positive and significant relationship between high income affiliate employment and domestic wages; the point estimate suggests that a 1 percent increase in affiliate employment is associated with a .01 percent increase in wages. The wage effects are greatest for the least educated and most educated workers; for these groups, a 1 percentage point increase in employment is associated with a .03 to .04 percent increase in wages.

Both real investment goods prices and export activity exhibit very different associations across educational categories. The positive association between investment goods prices and wages for the least educated workers is consistent with the notion that investment goods (such as computers) act as substitutes for the least educated workers. For workers with less than a high school degree, the point estimates suggest that a 1% fall in the price of investment goods reduces wages by .07 percent. For the most educated workers, the sign on investment goods prices switches to negative and significant, indicating that investment goods and educated workers are complements and higher investment goods prices are associated with declining wages.

Increasing export shares are associated with lower wages for workers with less than a high school education, while increasing export shares are associated with higher wages for college educated workers. These results show that the doubling of export shares have been associated with a significant increase in wage inequality. In particular, an increase in export shares of 10 percentage points (on average export shares nearly doubled, from 9 to 16 percent) is associated with a decline in real wages of 1.6 percent for workers with less than a high school education and an increase of 1.2 percent for those with a college degree.

In Table 4, we examine whether the effects of industry-level measures on log wages vary with the routine nature of occupations. The decomposition shows that the wage gains to U.S. workers in sectors with increasing affiliate activity in high income regions are restricted to workers outside of the most routine occupations. Decomposing the wage effects into routine categories also highlights the important role played by the price of investment goods. A lower price of investment goods positively affects wages for workers in the less routine occupations, suggesting that investment goods are complementary to jobs for those kinds of positions. The effects of lagged total factor productivity growth on wages show a similar pattern, with negative and significant effects of productivity growth on wages apparent only in the routine terciles. The effects of increasing routineness have a negative, large and significant impact on wages across all terciles.

So far, our analysis takes into account *within industry* trends in wages and employment. This misses two potentially important effects of offshoring. First, we have not adequately captured the wage losses or gains accruing to individuals who shift from manufacturing to other sectors of the economy. The associated distributional implications are likely to be important given the magnitude of the reallocation and a historically important wage premium paid to manufacturing (relative to service) workers in the United States. In addition to distributional consequences, there may also be efficiency consequences associated with the reallocation of labor from high to low-wages industries – see for example Katz and Summers (1989) and Krueger and Summers (1988). Second, we have not captured the cumulative impact of import competition on workers who are easily able to relocate across sectors but cannot easily shift across occupational categories. We focus on these effects in Section V.

V. Estimates of the Impact of Trade and Offshoring on Employment and Wages for the Whole Economy: Occupation-specific Effects

One puzzle is how we can identify significant reallocations in employment in response to different globalization measures but small wages effects. This is particularly true for offshoring to low income affiliate locations and the effect of import penetration on wages. One explanation consistent with the evidence is that a number of workers are leaving manufacturing, and consequently the potentially negative impact on their wages cannot be captured by the wage regressions in Tables 3 and 4. One way to test for this possibility is to exploit the fact that some workers surveyed by the CPS are surveyed more than once.

To form a sample of these workers, we merged the CPS MORG individual-level data on workers from all industries with BEA offshore employment and trade data, by industry and year. The sample of workers who could be observed in two periods was 259,361 workers that were longitudinally matched by unique identifiers (hhid, hhnum and lineno) and validation criteria (sex, race and age), out of the 4,223,687 original CPS MORG observations. Workers observed from 1994 to 1995 were additionally sorted by state, as well as unique identifiers and validation criteria, as the CPS only assigned unique household identifiers (hhid) within state for part of the period. One extract was created for the 1994 workers, one for the 1995 workers, one for (non-1994) workers in their first period observed, and one for (non-1995) workers in their second period observed. The 1994 and 1995 extracts were then merged on the above criteria, as were the non-1994 and non-1995 extracts. The two merged datasets were appended together and any merges not matching on unique identifiers and sex, race, and age were dropped. This left 271,112 matched CPS workers, 259,361 of which had non-missing wages in both periods observed.

In Table 5, we measure changes in individual wages for this subsample, which includes observations sampled over two periods. The dependent variable is the log difference in the real hourly wage for each worker who appears in the CPS more than one period. The results in Table 5 make it clear that the biggest wage effects are not felt by workers who remain in manufacturing and experience increasing pressure on wages through greater offshore activities by U.S. multinationals or through greater trade competition. The biggest negative wage effects, in fact, occur when workers leave manufacturing to go to either agriculture or services. In column (1), which aggregates all educational categories, the results suggest that workers who leave manufacturing to go to services experience on average a three percent real wage loss, while workers who leave manufacturing for agriculture experience a six percent real wage loss.

If we disaggregate the effects into different levels of educational attainment, we see that the biggest wage declines are experienced by workers with less than a high school degree or those with a college degree. There were no effects on those with an advanced degree, suggesting that this category was able to avoid a decline in real wages when shifting to services. The effects of the other variables are not precisely estimated. It continues to be the case that increasing employment in low income affiliate locations is associated with domestic wage declines, while increasing employment in high income affiliate locations is associated with domestic wage increases. However, the only significant effects are associated with workers who leave manufacturing altogether.

To take into account the relationship between wages and globalization measures at the occupation level, we create a measure of effective exposure of an occupation to offshoring or trade. This variable was created from a merged dataset of BEA offshore employment data, trade data, and CPS MORG individual-level data, by industry and year. We calculate for each occupation its exposure to trade using the distribution of workers employed in this occupation *across* industries in 1979. For each occupation *i* and industry *j*, we have: $\alpha_{ij} = \frac{L_{ij}}{L_i}$ where L_{ij} is the total number of workers in occupation *i* and industry *j*, and L_i is the total number of workers across all industries in occupation *i*. We then calculate occupation-specific import penetration in year *t* for occupation *i* as

$$\sum_{j=1}^{J} \alpha_{ij} \cdot IMP_{jt}$$

where IMP_{jt} is the measure of import penetration for goods in industry *j* in year *t*. Occupation-specific measures of export shares, low and high income offshoring were created the same way.

In Table 6 we report the coefficients on trade and offshoring measures when we re-estimate the wage regressions reported in Tables 3 and 4 using our occupation-specific measures. We report three different sets of results. The first column includes only industry fixed effects to control for constant differences across industries. The middle column includes two-digit occupation fixed effects, while the last column includes both industry and occupation-specific fixed effects.

What is most striking about the results in Table 6 is that the effects of both offshoring and trade are larger in sign and generally significant at the five percent level, in contrast to the industry-level results reported in Tables 3 and 4. In the first row, the coefficients on low-income affiliate employment suggest that a 1 percent increase in employment abroad is associated with a .19 percent reduction in wages at home across all occupations. These regressions control for year effects, education, gender, age, race, experience, union membership, and industry affiliation. When we introduce both occupation and industry fixed effects, the coefficient drops to .06, but remains statistically significant.

For high income affiliate employment, however, the coefficient is positive and significant. In the first column, the coefficient of .16 suggests that a one percent increase in affiliate employment in the previous period is associated with a .16 percent increase in domestic wages. The coefficient drops to .06 when occupation controls are added. The third and fourth rows report the association between last period's occupation-specific import penetration or export share and current period wages. In the first column, the coefficient is significant and positive for export shares and significant and negative for import shares. A coefficient on exports of 2.40 in the first column suggests that an increase in export shares of 10 percentage points would lead to an occupation-specific increase in real wages of 24 percent. An example of an occupation which experienced a more than 10 percentage point increase in export orientation is electrical and electronic equipment assemblers, whose export share increased from 11.3 percent in 1983 to 24.1 percent in 2002. A coefficient of -1.36 suggests a 13.6 percent reduction in real wages would be associated with a 10 percentage point increase in occupation-specific import penetration. Examples of occupations that had at least a ten percentage point increase in occupation specific import penetration include tool and die makers, numerical control machine operators, textile cutting machine and sewing machine operators, shoe repairers, and shoe machine operators (see Table 8). When we include both industry and occupation fixed effects (see the last two columns of Table 6), the coefficient on import penetration falls to .27 but remains statistically significant for the whole sample.

We find it useful to relate the results in Table 6 to the literature on inter-industry wage differentials. Figure 10 illustrates the decline in inter-occupation wage differentials over the last twenty years. The figure shows a plot of occupation-specific wage differentials (the coefficients on the occupation dummies for the results reported in Table 6) in 1984 and 1985 relative to 2001 and 2002. What Katz and Summers (1989) and Krueger and Summers (1988) documented for inter-industry wage differentials, we also show to be true for *inter-occupation* wage differentials: a remarkable persistence over two decades. However, Figure 10 also shows a significant narrowing of the spread. While the log wage differential extended from -0.8 to 0.4 in the early 1980s, by the early 2000s that spread had been cut in half and most of the point estimates are between –0.2 and 0.2. The results in Table 6 provide suggestive evidence that that trade and offshoring could account for the narrowing of the wage differential documented in Figure 10.

In Table 7 we separate the coefficient estimates by the broad educational categories used in the previous tables. The coefficient estimates are consistently negative and significant for less educated workers in sectors with affiliate employment in low income countries, but the coefficients are not statistically significant at conventional levels for more educated workers. As in the previous table, there is a positive and significant association between higher affiliate employment in high income affiliate locations and wages at home. This association is significant across all educational categories, but is largest for workers with more education. The negative effects of offshoring in low income locations appear to be minimal for more educated workers, who benefit the most from offshoring to high income affiliate locations.

As in Table 6, we also find that occupation-specific export shares are positively associated with wages and that occupation-specific import penetration is negatively associated with wages. The negative association with import competition is greatest for employees with some college, but is not generally significantly associated with wage declines for more educated workers. The point estimate of -.31 for workers with some college implies a ten percentage point increase in import penetration would be associated with a 3.1 percent real wage decline.

It is useful to consider how important these effects are in the context of the overall U.S. economy. Many occupations were not exposed to competition from international trade at all; for individuals in these occupations, the effect of increasing export and import activity is likely to have been very small. We list all the occupations in Appendix Table 4 with zero exposure to trade on either the export or import side at the beginning and end of the sample period. These occupations include teachers, therapists, sales workers, judges, dancers, and many others. However, a number of occupations experienced enormous increases in exposure to international trade during the sample period. These occupations are listed in Table 8. Table 8A shows the occupations with the largest increase in import penetration, while Table 8B shows those occupations where export activity increased the most.

In Table 8A, the most affected workers were shoe machine operators, for whom occupation-specific import penetration increased from 37.2 percent in 1983 to 77.4 percent in 2002. For these workers, the coefficient on import penetration in the first column of Table 7, which is -.27, implies that their real wages fell by nearly 11 percent as a result of competition from trade. The contrasting experiences of workers in textiles and apparel related sectors compared to many service sector employees such as teachers helps to explain why some parts of the U.S. economy have been deeply affected by globalization while others have not. On average, occupation-specific import and export shares only increased from an average of 2 to 4 percent during the 1983 through 2002 period, in large part because of the importance of services and the lack of global competition in service occupations (see again Appendix Table 4). Consequently, the average effect of an increase from .02 to .04 for occupation-specific import competition is quite small, equal to .02 x .27, which is a fall in real wages of half a percent. However, what Table 8A makes clear is that some groups of occupations experienced significant wage declines as a consequence of rising (occupation-specific) import competition.

Table 8B shows those occupations where export shares increased the most. While there were some significant increases in export activity across a number of occupations, the magnitudes are considerably smaller than in Table 8A. At the occupation level, these smaller changes mirror what was occurring in the United States at the macro level: large increases in import competition but only modest increases in export shares. Import competition is significantly associated with declining occupation-specific wages, while export activity is associated with increasing wages (but the coefficients are generally insignificant). The fact that occupation-specific imports increased more than exports, coupled with the larger magnitudes and greater statistical significance of the coefficients on import competition, suggests that the net effect of increasing export and import activity on domestic wages has been negative.

Both Krugman (2008) and Feenstra (2009) suggest that the effects of international trade and offshoring activities may have increased in the 1990s relative to earlier decades. The different specifications reported in Table 9 explore whether in fact the effects of international competition on domestic wages were greater in the 1990s relative to the 1980s. The first six rows present different time periods within the 1984 through 2002 period. The lasts four rows explore whether the effects of international competition were different for female workers, unionized workers, and older workers, defined as either those over forty years of age or over fifty years of age.

The results in Table 9 indicate that the impact of offshoring activity on domestic wages only became significant in the 1990s. The negative association between employment in low income affiliates and domestic wages does not appear until this period, as does the positive association between employment in high income affiliates and domestic wages. If we restrict the sample to 1984 through 1996, the coefficients on offshoring fall to -0.03 (for low income affiliates) and 0.03 (for high income affiliates) and are no longer statistically significant at conventional levels. For the 1997 through 2002 period, the coefficient rises to -.11 for low income low locations and 0.11 for high income locations. These estimates imply that a 10 percent increase in low (high) income affiliate locations was associated with a 1.1 percent decline (increase) in domestic wages.

In contrast, the point estimates for occupation-specific import penetration are stable over the sample period. The coefficients range from -.25 to -.41 and are generally significant. The point estimates are positive and significant for export share only in the second half of the sample period, indicating that wages were not significantly (positively) associated with export activity until the 1990s.

We then turn to an analysis of different demographic groups. Anecdotes in the popular press and elsewhere suggest that women, union workers, and older workers may have been disproportionately affected by international competition. If we restrict the sample to either women or union workers, there is no evidence that their wages were more negatively affected than the rest of the sample. In fact, the wages of unionized workers and women appear to have been relatively unaffected by either export activity or import competition. However, the wages of older workers do appear to have been disproportionately affected by offshoring activities, as the point estimates are larger for these groups of workers.

VI. Conclusion

This paper merges data for 1982 through 2002 on wage earners throughout the U.S. economy with data on import competition, export activity, and offshoring employment of U.S. multinational firms. We explore the implications of increasing globalization for U.S. employment and wages, controlling for both industry-level and individual-level determinants of labor market outcomes such as education, experience, age, productivity, and investment prices. We also identify the routineness of different occupations, and explore whether the degree of routineness of an occupation affects the relationship between labor market outcomes and measures of globalization.

We show that the impact of offshoring on labor market outcomes depends on the location of offshore activity. Expansion in offshore employment in low income locations is associated with employment declines and wage reductions. However, offshore activity in high income locations is positively correlated with U.S. wages and employment. These associations are significantly stronger in the 1990s relative to the previous decade. We also find significant effects of import competition on employment reallocation. These results indicate that much of the negative effects of globalization operate through downward pressure on wages of workers who leave manufacturing to take jobs in agriculture or services

One important innovation of the paper is to move beyond an analysis of wages and trade within the manufacturing sector to analyze the impact of trade and offshoring on occupations throughout the U.S. economy. To do this, we introduce an occupation-specific measure of import penetration, export shares, and offshoring activity. When we redefine the analysis at the level of the occupation, we find large and significant effects of import competition and offshoring activities on U.S. wages. Thus, while there is significant movement into and out of different sectors of the U.S. economy, mobility across occupations is much more limited. Another advantage of expanding the analysis to the level of the occupation is that we are able to explore the importance of "routineness" for wage determination, and to broaden the analysis of how trade affects domestic labor markets beyond manufacturing to the rest of the labor force.

We find it useful to relate the contribution of our research to two sets of widely influential studies: first, the articles by Katz and Summers (1989) and Krueger and Summers (1988) on inter-industry wage differentials; and second, the new theoretical framework on offshoring and wages developed by Grossman and Rossi-Hansberg (forthcoming). Katz and Summers (1989) and Krueger, and Summers (1988) presented evidence showing remarkable stability in inter-industry wage differentials both over time and across countries. Katz and Summers (1989) hypothesized that these observed inter-industry wage differentials could reflect different exposure to international trade. In this paper, we extend the concept of inter-industry wage differentials to describe inter-occupation wage differentials. We then demonstrate that occupation-specific wages have been significantly affected by both offshoring and international trade. In particular, a one percentage point increase in import penetration is associated with a .25 percentage point fall in occupation-specific wages.

This research also provides empirical support for Grossman and Rossi-Hansberg (forthcoming), who show that an increasing share of offshore employment as a percentage of domestic employment has an ambiguous impact (in theory) on domestic wages. We document that offshoring to high wage locations is positively associated with US wages, while offshoring to low-wage countries is not. Grossman and Rossi-Hansberg account for this possibility, by showing that the net impact of offshoring on domestic wages of routine workers is ambiguous and depends on the relative strength of shifts in terms of trade, the contribution of technology to reducing labor costs, and labor supply effects. In the case of offshoring to low income locations, our results suggest that the factors responsible for putting downward pressure on domestic wages appear to dominate, particularly during the 1990s.

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Data Appendix:

A. Current Population Survey

We use the CPS Merged Outgoing Rotation Groups for years 1979 to 2002. Note that our analysis relies on the MORG copy prepared by the Center for Policy and Economic Research (CEPR). The CEPR MORG files are created from the National Bureau of Economic Research version of these data, and we rely on the processing performed by CEPR to produce consistent variables for wages, education, and other demographic characteristics of the MORG sample. Our sample includes wage/salary workers ages 16 to 64 in current employment. Earnings weights, equal to the product of CPS sampling weights and hours worked in the prior week, are used in all calculations. Hourly wages are the logarithm of reported hourly earnings for those paid by the hour and the logarithm of usual weekly earnings divided by usual weekly hours. Overtime, tips, and commissions are included in wages, and top-coded wages are imputed by assuming a log-normal distribution for weekly earnings as described by Schmitt (2003). The calculated nominal hourly wage is converted to a real wage using the Consumer Price Index for 2006, and then trimmed to values between $1 and $100 per hour.

Source: Schmitt, John. 2003. "Creating a consistent hourly wage series from the Current Population Survey's Outgoing Rotation Group, 1979-2002". Available for download at http://www.ceprdata.org/cps/cps_documentation.php.

B. Bureau of Economic Analysis

Our data on offshoring is based on the most comprehensive available data and is based on firm-level surveys on U.S. direct investment abroad, collected each year by the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. The BEA collects confidential data on the activities of US-based multinationals, defined as the combination of a single U.S. entity that has made the direct investment, called the parent, and at least one foreign business enterprise, called the foreign affiliate. We use the data collected on majority-owned, non-bank foreign affiliates and non-bank U.S. parents for the years from 1982 to 2002. The foreign affiliate survey forms that U.S. multinationals are required to complete on an annual basis include detailed information on the number of employees hired abroad. In previous work we have cross-checked these data with national survey data from other countries and found the employment numbers to be remarkably similar. Using these data, we construct a panel of number of employees hired abroad by country by year.

C. Trade Data

Our data on import penetration were made available at the 4-digit ISIC level by Bernard, Jensen, and Schott (2006). We also include a measure of import penetration from low-wage countries, also computed by these authors.

D. Data on Occupational Characteristics (David Autor)

Definitions of the Nature of Tasks, taken from Autor, Murnane and Levy (2003)

Task Name	Task Description
DCP: Direction, Control, and Planning of Activities	Measures nonroutine cognitive tasks, intended to capture interactive, communication, and managerial skills. This variable captures the extent to which the occupation involves direction, control, and planning of activities. It takes on high values for occupations requiring interpersonal and managerial tasks.
GED-MATH	Measures quantitative or analytical reasoning skills.
STS: Set limits, Tolerances or Standards	Measures routine cognitive tasks. Measures adaptability to work requiring the setting of limits, tolerances or standards.
FINGDEX: Finger Dexterity	Measures routine manual activity. FINGDEX is an abbreviation for finger dexterity.
EYEHAND	Measures non-routine manual task requirements. EYEHAND is an abbreviation for eye, hand, foot coordination.
Notes: Our measure of routineness is defined as the sum of the cognitive and manual routine measures divided by all the measures. Routine = (sts + fingdex)/(sts + fingdex + math + dcp + eyehand)	

Table 1: OLS Estimates of Employment Determinants Overall and by Education Level, 1983-2002
Dependent Variable: Log U.S. Manufacturing Sector Employment

Variable	All Education	Less than High School	High School Degree	Some College	College Degree	Advanced Degree
Lagged log of low income affiliate employment, including China	-0.02**	-0.04**	-0.02	0.001	-0.01	-0.03
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Lagged log of high income affiliate employment	0.08**	0.14***	0.06*	0.04	0.09**	0.02
	(0.03)	(0.05)	(0.03)	(0.05)	(0.04)	(0.06)
Lagged log of price of investment using 1979 weights	-0.07	-0.21	0.18	0.08	-0.27	-0.22
	(0.17)	(0.24)	(0.24)	(0.2)	(0.19)	(0.19)
Lagged total factor productivity level using 1979 weights	-0.16**	-0.10	-0.13	-0.19**	-0.24**	-0.17*
	(0.07)	(0.12)	(0.08)	(0.08)	(0.1)	(0.09)
Lagged export share using 1979 weights	-0.28	0.21	-0.85*	-0.56*	0.06	0.28
	(0.27)	(0.51)	(0.49)	(0.32)	(0.53)	(0.57)
Lagged import penetration using 1979 weights	-0.60*	-0.77	-0.83*	-0.34	-0.50	-0.59
	(0.32)	(0.7)	(0.42)	(0.34)	(0.52)	(0.68)
Lagged log of real price of shipments using 1979 weights	0.15**	0.14	0.10	0.13*	0.19**	0.16**
	(0.06)	(0.11)	(0.08)	(0.07)	(0.08)	(0.07)
Number of observations	6,427	1,305	1,309	1,306	1,298	1,209
R-squared	0.86	0.93	0.97	0.96	0.95	0.89

Source : Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note : Robust standard errors reported in parentheses below coefficient estimates. All employment specifications include industry, year, and education fixed effects. Low-income affiliate employment is defined according to the World Bank income categories.

Table 2: OLS Estimates of Employment Determinants Overall, Within Tertiles of Routine Tasks Performed Each Year, 1983-2002

Dependent Variable: Log U.S. Manufacturing Sector Employment

Variable	Routine Tertile		
	Least	Middle	Most
Lagged log of low income affiliate employment, including China	-0.02	-0.01	-0.02*
	(0.02)	(0.02)	(0.01)
Lagged log of high income affiliate employment	0.06	0.08	0.12***
	(0.04)	(0.05)	(0.04)
Lagged log of price of investment using 1979 weights	-0.25	0.17	0.08
	(0.16)	(0.21)	(0.23)
Lagged total factor productivity level using 1979 weights	-0.23***	-0.13	-0.15
	(0.08)	(0.08)	(0.12)
Lagged export share using 1979 weights	-0.15	-0.37	-0.23
	(0.42)	(0.26)	(0.47)
Lagged import penetration using 1979 weights	-0.29	-0.06	-0.62
	(0.46)	(0.38)	(0.54)
Lagged log of real price of shipments using 1979 weights	0.18**	0.09	0.18*
	(0.07)	(0.08)	(0.1)
Routine	2.43***	-0.18	-1.45***
	(0.31)	(0.66)	(0.53)
Number of observations	2,162	2,127	2,138
R-squared	0.92	0.92	0.92

Source : Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note: Robust standard errors reported in parentheses below coefficient estimates. All employment specifications include industry, year and education fixed effects. Low-income affiliate employment is defined according to the World Bank income categories.

Table 3: OLS Estimates of Wage Determinants Overall and by Education Level, 1983-2002

Dependent Variable: Log Wage

Variable	All Education	Less than High School	High School Degree	Some College	College Degree	Advanced Degree
Lagged log of low income affiliate employment, including China	0.001	-0.002	0.003	0.004	0.0004	-0.01
	(0.002)	(0.004)	(0.003)	(0.004)	(0.005)	(0.007)
Lagged log of high income affiliate employment	0.01**	0.04***	0.01**	0.002	0.01	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Lagged log of price of investment using 1979 weights	-0.05**	0.07***	0.00	-0.06**	-0.05*	-0.12***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
Lagged total factor productivity level using 1979 weights	-0.02	0.02	-0.02*	-0.03***	-0.003	-0.002
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Lagged export share using 1979 weights	0.05	-0.16*	-0.01	0.12	0.12**	-0.04
	(0.06)	(0.09)	(0.08)	(0.08)	(0.05)	(0.12)
Lagged import penetration using 1979 weights	0.07	0.23**	0.10	-0.11	-0.02	-0.06
	(0.08)	(0.09)	(0.08)	(0.11)	(0.09)	(0.17)
Lagged log of real price of shipments using 1979 weights	0.01	-0.01	0.004	0.02**	-0.001	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of observations	586,712	99,160	251,280	131,796	78,920	25,556
R-squared	0.45	0.35	0.31	0.27	0.20	0.15

Source : Wage data taken from Current Population Surveys Merged Outgoing Rotation Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note: Robust standard errors reported in parentheses below coefficient estimates. Wage specifications include controls for a worker's age, sex, race, experience, whether in a union, and industry, year and education fixed effects. Low-income affiliate employment is defined according to the World Bank income categories.

Table 4: OLS Estimates of Wage Determinants Overall, Within Tertiles of Routine Tasks Performed Each Year, 1983-2002

Dependent Variable: Log Wage

Variable	Routine Tertile: Least	Middle	Most
Lagged log of low income affiliate employment, including China	0.001	0.002	0.001
	(0.003)	(0.002)	(0.003)
Lagged log of high income affiliate employment	0.02**	0.02***	0.01
	(0.01)	(0.01)	(0.01)
Lagged log of price of investment using 1979 weights	-0.06***	-0.07***	0.004
	(0.02)	(0.02)	(0.03)
Lagged total factor productivity level using 1979 weights	-0.008	-0.03***	-0.01
	(0.01)	(0.01)	(0.01)
Lagged export share using 1979 weights	0.04	0.02	0.0001
	(0.06)	(0.07)	(0.08)
Lagged import penetration using 1979 weights	-0.05	0.15*	0.09
	(0.08)	(0.08)	(0.09)
Lagged log of real price of shipments using 1979 weights	0.009	0.02***	0.009
	(0.01)	(0.01)	(0.01)
Routine	-0.48***	-0.38***	-0.48***
	(0.03)	(0.05)	(0.14)
Number of observations	191,997	197,630	196,565
R-squared	0.38	0.35	0.39

Source: Wage data taken from Current Population Surveys Merged Outgoing Rotation Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note: Robust standard errors reported in parentheses below coefficient estimates. Wage specifications include controls for a worker's age, sex, race, experience, whether in a union, and industry, year and education fixed effects. Low-income affiliate employment is defined according to the World Bank income categories.

Table 5: OLS Estimates of Wage Growth For Workers Observed Two Periods, 1983-2002
Dependent Variable: Log Difference in Real Hourly Wage

Variable	All Education	Less than High School	High School Degree	Some College	College Degree	Advanced Degree
Left manufacturing, entered services	-0.03***	-0.03***	-0.02***	-0.04***	-0.05***	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)
Left manufacturing, entered agriculture	-0.06**	-0.09**	-0.05	0.02	-0.26**	-0.31
	(0.03)	(0.04)	(0.05)	(0.07)	(0.13)	(0.35)
Log difference in low income affiliate employment	-0.002	-0.008	-0.01	0.01	0.03	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)
Log difference in high income affiliate employment	0.02	0.06*	0.02	0.004	-0.03	0.01
	(0.02)	(0.03)	(0.02)	(0.03)	(0.06)	(0.12)
Log difference in price of investment	-0.06	0.10	-0.11*	-0.02	-0.03	-0.25
	(0.04)	(0.12)	(0.06)	(0.09)	(0.12)	(0.23)
Difference in total factor productivity	0.02	-0.02	0.001	0.002	0.02	0.22*
	(0.03)	(0.09)	(0.04)	(0.05)	(0.07)	(0.13)
Difference in export share	0.09	0.26	0.11	0.04	-0.17	0.97*
	(0.08)	(0.27)	(0.11)	(0.15)	(0.26)	(0.56)
Difference in import penetration	-0.21	-0.32	-0.23	-0.06	0.09	-2.15*
	(0.15)	(0.3)	(0.21)	(0.33)	(0.52)	(1.27)
Lagged log of real price of shipments using 1979 weights	-0.003	-0.01	-0.002	-0.008	0.009	-0.01
	(0.005)	(0.013)	(0.007)	(0.009)	(0.01)	(0.03)
Number of observations	37,450	7,032	16,946	8,038	4,202	1,219
R-squared	0.01	0.03	0.01	0.02	0.03	0.06

Source : Wage data taken from Current Population Surveys Merged Outgoing Rotation Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note : Robust standard errors reported in parentheses below coefficient estimates. This specification includes controls for a worker's gender, age, education, experience, whether in a union, and industry and year fixed effects. Low-income affiliate employment is defined according to the World Bank income categories.

Table 6: OLS Estimates of Wage Determinants Overall,
By Occupational Exposure to Trade and Offshoring, 1984-2002

Dependent Variable: Log Wage

Variable	Industry Fixed Effects	Two-Digit Occupation Fixed Effects	Industry and Two-Digit Occupation Fixed Effects
Lagged occupation-specific log of low income affiliate employment	-0.19***	-0.06*	-0.06***
	(0.04)	(0.03)	(0.02)
Lagged occupation-specific log of high income affiliate employment	0.16***	0.06**	0.06***
	(0.04)	(0.03)	(0.02)
Lagged occupation-specific export share	2.40***	0.63*	0.14
	(0.39)	(0.33)	(0.16)
Lagged occupation-specific import penetration	-1.36***	-0.40*	-0.27***
	(0.19)	(0.23)	(0.09)
Number of observations	3,079,998	2,505,731	2,505,724
R-squared	0.43	0.45	0.48

Source: Wage data taken from Current Population Surveys Merged Outgoing Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US

Note : Robust standard errors are reported in parentheses below coefficient estimates and are clustered at the industry level where industry fixed effects are used and at the two-digit occupation level where occupation fixed effects are used. Robust standard errors are clustered at the industry level in regressions with both two-digit occupation and industry fixed effects. Wage specifications include controls for a worker's gender, age, race,

Table 7: OLS Estimates of Wage Determinants Overall, By Occupational Exposure to Trade and Offshoring, 1984-2002
Dependent Variable: Log Wage

	Industry and Two-Digit Occupation Fixed Effects					
Variable	All Education	Less than High School	High School Degree	Some College	College Degree	Advanced Degree
Lagged occupation-specific log of low income affiliate employment	-0.06***	-0.05***	-0.04**	-0.04**	-0.05*	-0.06*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Lagged occupation-specific log of high income affiliate employment	0.06***	0.04**	0.03**	0.05**	0.05**	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Lagged occupation-specific export share	0.14	-0.40*	0.10	0.24	0.17	0.48*
	(0.16)	(0.23)	(0.19)	(0.18)	(0.18)	(0.28)
Lagged occupation-specific import penetration	-0.27***	0.13	-0.18*	-0.31**	-0.32	-1.02
	(0.09)	(0.08)	(0.11)	(0.16)	(0.33)	(0.79)
Number of observations	2,505,724	316,480	885,497	685,042	413,145	205,560
R-squared	0.48	0.42	0.39	0.40	0.32	0.25

Source: Wage data taken from Current Population Surveys Merged Outgoing Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note : Robust standard errors are clustered at the industry level and reported in parentheses below coefficient estimates. Wage specifications include controls for a worker's gender, age, race, experience, whether in a union, and year, industry and education fixed effects. Low-income affiliate employment is defined according to the World Bank income categories.

Table 8A: Import Penetration in 1983 and 2002, for 40 Occupations with Highest Import Penetration in 2002

	Import Penetration	
Occupation	**1983**	**2002**
Industrial engineers	0.070	0.157
Washing, cleaning, and pickling machine operators	0.064	0.159
Adjusters and calibrators	0.080	0.159
Agricultural engineers	0.093	0.160
Punching and stamping press machine operators	0.097	0.162
Shaping and joining machine operators	0.095	0.164
Wood lathe, routing, and planing machine operators	0.086	0.167
Grinding, abrading, buffing, and polishing machine operators	0.090	0.168
Production samplers and weighers	0.067	0.172
Miscellaneous metal, plastic, stone, and glass working machine operators	0.095	0.172
Precision grinders, filers, and tool sharpeners	0.097	0.172
Production inspectors, checkers, and examiners	0.081	0.177
Cabinet makers and bench carpenters	0.076	0.177
Patternmakers and model makers, wood	0.095	0.177
Miscellaneous woodworking machine operators	0.083	0.177
Folding machine operators	0.063	0.179
Lathe and turning machine operators	0.097	0.181
Metal plating machine operators	0.080	0.183
Cementing and gluing machine operators	0.084	0.184
Milling and planing machine operators	0.091	0.184
Mechanical engineering technicians	0.087	0.184
Drilling and boring machine operators	0.095	0.187
Hand molding, casting, and forming occupations	0.103	0.188
Tool and die makers	0.097	0.189
Patternmakers, lay-out workers, and cutters	0.092	0.190
Miscellaneous textile machine operators	0.071	0.192
Miscellaneous precision woodworkers	0.061	0.195
Lathe and turning machine set-up operators	0.109	0.197
Precision assemblers, metal	0.084	0.201
Assemblers	0.100	0.203
Tool and die maker apprentices	0.104	0.204
Knitting, looping, taping, and weaving machine operators	0.046	0.205
Production testers	0.072	0.206
Numerical control machine operators	0.103	0.207
Solderers and brazers	0.094	0.218
Electrical and electronic equipment assemblers	0.090	0.219
Textile cutting machine operators	0.085	0.226
Textile sewing machine operators	0.136	0.304
Shoe repairers	0.182	0.379
Shoe machine operators	0.372	0.774

Table 8B: Export Share in 1983 and 2002, for 40 Most Export-Intensive Occupations in 2002

	Export Share	
Occupation	**1983**	**2002**
Data processing equipment repairers	0.072	0.137
Technical writers	0.080	0.139
Textile cutting machine operators	0.029	0.141
Punching and stamping press machine operators	0.081	0.141
Hand molding, casting, and forming occupations	0.065	0.147
Mechanical Engineers	0.090	0.147
Miscellaneous metal and plastic processing machine operators	0.104	0.149
Production inspectors, checkers, and examiners	0.074	0.150
Agricultural Engineers	0.116	0.151
Grinding, abrading, buffing, and polishing machine operators	0.085	0.154
Molding and casting machine operators	0.073	0.154
Miscellaneous precision metal workers	0.129	0.157
Machinists	0.100	0.164
Industrial Engineers	0.096	0.166
Adjusters and calibrators	0.081	0.166
Aircraft mechanics, except engine	0.137	0.166
Precision grinders, filers, and tool sharpeners	0.102	0.168
Misc. metal, plastic, stone, and glass working machine operators	0.087	0.170
Assemblers	0.091	0.171
Miscellaneous textile machine operators	0.033	0.171
Winding and twisting machine operators	0.037	0.174
Metal plating machine operators	0.084	0.176
Patternmakers and model makers, metal	0.107	0.177
Lathe and turning machine set-up operators	0.089	0.178
Drilling and boring machine operators	0.112	0.184
Tool programmers, numerical control	0.116	0.185
Lathe and turning machine operators	0.112	0.188
Miscellaneous precision workers	0.118	0.191
Tool and die makers	0.097	0.191
Mechanical engineering technicians	0.126	0.193
Production testers	0.108	0.200
Aerospace Engineers	0.180	0.219
Milling and planing machine operators	0.132	0.219
Precision assemblers, metal	0.152	0.223
Knitting, looping, taping, and weaving machine operators	0.027	0.224
Solderers and brazers	0.105	0.225
Numerical control machine operators	0.116	0.230
Tool and die maker apprentices	0.113	0.232
Electrical and electronic equipment assemblers	0.113	0.241
Shoe machine operators	0.023	0.261

Table 9: OLS Estimates of Wage Determinants Overall,
By Occupational Exposure of a Group to Trade and Offshoring
Dependent Variable: Log Wage

	Industry and Two-Digit Occupation Fixed Effects						
Specification	Lagged occupation-specific log of low income affiliate employment	Lagged occupation-specific log of high income affiliate employment	Lagged occupation-specific export share	Lagged occupation-specific import penetration	Lagged occupation-specific share of imports from low income countries	Number of observations	R-squared
1984-1991	-0.009	0.01	0.17	-0.33***		1,136,786	0.50
	(0.02)	(0.02)	(0.22)	(0.1)			
1992-2002	-0.07***	0.06***	0.42**	-0.25**		1,368,938	0.47
	(0.02)	(0.02)	(0.16)	(0.11)			
1984-1991	-0.01	0.01	0.19	-0.41	0.12	1,136,786	0.50
	(0.02)	(0.02)	(0.21)	(0.25)	(0.28)		
1992-2002	-0.07***	0.07***	0.47***	-0.35	0.09	1,368,938	0.47
	(0.02)	(0.02)	(0.17)	(0.24)	(0.19)		
1984-1996	-0.03*	0.03**	0.09	-0.28***		1,781,273	0.49
	(0.02)	(0.02)	(0.18)	(0.09)			
1997-2002	-0.11***	0.11***	0.45**	-0.31**		724,451	0.46
	(0.03)	(0.03)	(0.19)	(0.12)			
Female	-0.05***	0.06***	-0.11	-0.11		1,266,338	0.48
	(0.02)	(0.02)	(0.19)	(0.12)			
Union	-0.04*	0.03	-0.04	-0.06		477,292	0.34
	(0.02)	(0.02)	(0.16)	(0.14)			
Over 40	-0.08***	0.08***	-0.01	-0.15**		1,034,555	0.45
	(0.02)	(0.02)	(0.14)	(0.08)			
Over 50	-0.09***	0.09***	-0.068	-0.18**		451,364	0.46
	(0.02)	(0.02)	(0.13)	(0.09)			

Source: Wage data taken from Current Population Surveys Merged Outgoing Rotation Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note: Robust standard errors are clustered at the industry level and reported in parentheses below coefficient estimates. Wage specifications include controls for a worker's gender, age, race, experience, whether in a union, and year, industry and education fixed effects. Low-income affiliate employment is defined according to the World Bank income categories.

Appendix Table 1: Average Values, By Manufacturing and All Industries. 1982 and 2002.

	1982		2002	
	Manufacturing Only	All Industries	Manufacturing Only	All Industries
Log Wage	2.69	2.55	2.85	2.74
Demographics				
Age	38.10	36.18	41.17	39.21
Female	0.33	0.46	0.31	0.49
Union (1983)	0.30	0.23	0.15	0.15
Experience	19.81	17.39	22.12	19.77
Nonwhite	0.17	0.16	0.23	0.23
Education	2.25	2.52	2.65	2.87
Routineness of Task				
Routine Cognitive and Manual Tasks /All Tasks	0.62	0.53	0.58	0.49
Tasks				
Finger Dexterity (Routine)	4.12	3.87	3.95	3.71
Sets limits, Tolerances, Standards (Routine)	5.76	4.00	5.32	3.66
Math reasoning skills	3.36	3.60	3.64	3.89
Direction, Control, Planning Activities	2.04	2.35	2.58	3.01
Eye, Hand, Foot Coordination	1.03	1.09	0.98	1.05
Trade				
Import Penetration	0.08	--	0.16	--
Export Share	0.09	--	0.14	--
Log of Price of Investment	4.54	--	4.63	--
Total Factor Productivity	0.94	--	1.07	--
Log of Real Price of Shipments	8.95	--	9.37	--
Offshoring				
Log of Low Income Affiliate Employment	9.68	--	10.30	--
Log of High Income Affiliate Employment	10.84	--	11.08	--
Occupation-Specific Measures (1983 and 2002)				
Import Penetration	0.05	0.02	0.09	0.03
Export Share	0.04	0.02	0.08	0.03
Log of Low Income Affiliate Employment	3.57	1.31	3.86	1.20
Log of High Income Affiliate Employment	4.00	1.46	4.06	1.26
Share of Imports from Low Income Countries	0.02	0.01	0.08	0.02

Source : Wage data taken from Current Population Surveys Merged Outgoing Rotation Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note : No data available on unions in 1982. Low-income affiliate employment is defined according to the World Bank income categories. The routineness of a task is defined for each occupation following Autor et al. (2001). The classification of an industry as vertically or horizontally integrated is described in the appendix. Calculation of routine and total factor productivity are also defined in detail in the technical appendix.

Appendix Table 2: Summary Statistics, 1982 and 2002.

			1982					**2002**		
Panel A. Employment-weighted means.	# Obs	Mean	Min	Max	St. dev.	# Obs	Mean	Min	Max	St. dev.
Log wage										
Full sample	36,729	2.71	0.48	5.02	0.48	23,362	2.87	0.44	4.83	0.53
Less than high school	8,966	2.48	0.53	4.22	0.42	2,675	2.41	0.49	4.40	0.37
High school degree	15,919	2.65	0.48	4.84	0.42	9,448	2.73	0.51	4.63	0.43
Some college	6,739	2.81	0.66	5.02	0.44	6,041	2.90	0.44	4.63	0.45
College degree	3,918	3.11	0.48	4.26	0.47	3,947	3.26	0.49	4.83	0.50
Advanced degree	1,112	3.33	0.66	4.57	0.48	1,251	3.47	1.58	4.63	0.50
Routine										
Full sample	34,788	0.62	0.14	0.96	0.22	23,799	0.57	0.15	0.95	0.23
Less than high school	8,245	0.71	0.15	0.96	0.18	2,695	0.72	0.16	0.95	0.16
High school degree	14,963	0.66	0.14	0.96	0.19	9,564	0.65	0.15	0.95	0.20
Some college	6,511	0.58	0.15	0.96	0.22	6,179	0.57	0.16	0.90	0.22
College degree	3,886	0.42	0.15	0.93	0.19	4,068	0.39	0.16	0.93	0.19
Advanced degree	1,108	0.38	0.15	0.93	0.17	1,293	0.35	0.16	0.93	0.15

						All Education Groups				
			1982					**2002**		
Panel B.	# Obs	Mean	Min	Max	St. dev.	# Obs	Mean	Min	Max	St. dev.
Log of low income affiliate employment	36,763	9.71	6.40	11.93	1.47	23,581	10.34	6.58	12.80	1.49
Log of high income affiliate employment	36,763	10.88	7.09	12.99	1.05	23,581	11.12	7.73	13.10	0.95
Import penetration at 1979 weights	36,690	0.08	0.003	0.45	0.06	19,907	0.18	0	0.83	0.11
Export share at 1979 weights	36,690	0.09	0.001	0.32	0.07	23,788	0.16	0	0.58	0.12
Log of price of investment at 1979 weights	36,690	4.54	4.45	4.81	0.07	22,971	4.65	3.96	4.86	0.23
Total factor productivity at 1979 weights	36,690	0.94	0.56	1.34	0.09	23,788	1.08	0	5.31	0.79
Log of real price of shipments at 1979 weights	36,690	9.09	6.31	10.92	0.90	22,428	9.61	5.70	13.04	1.48

Source : Wage data taken from Current Population Surveys Merged Outgoing Rotation Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note : There are 36,763 workers with non-missing observations in 1982 and 23,799 in 2002. Low-income affiliate employment is defined according to the World Bank income categories. The routineness of a task is defined for each occupation following Autor et al. (2001). The classification of an industry as vertically or horizontally integrated is described in the appendix. Calculation of routine and total factor productivity are also defined in detail in the technical appendix.

Appendix Table 3: OLS Estimates of Wage Growth For Workers Observed Two Periods Who Stayed in Manufacturing, 1983-2002

Dependent Variable: Log Difference in Real Hourly Wage

Variable	All Education	Less than High School	High School Degree	Some College	College Degree	Advanced Degree
Log difference in low income affiliate employment	-0.002	-0.001	-0.007	0.005	0.02	-0.03
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)
Log difference in high income affiliate employment	0.02	0.04	0.02	-0.01	0.05	-0.04
	(0.02)	(0.03)	(0.02)	(0.04)	(0.07)	(0.14)
Log difference in price of investment	-0.07	0.19	-0.14**	0.01	-0.01	-0.18
	(0.04)	(0.13)	(0.06)	(0.1)	(0.13)	(0.25)
Difference in total factor productivity	-0.01	-0.13	0.003	-0.04	-0.04	0.22
	(0.03)	(0.09)	(0.05)	(0.06)	(0.08)	(0.15)
Difference in export share	0.03	0.38	0.04	-0.08	-0.01	0.06
	(0.08)	(0.28)	(0.11)	(0.15)	(0.28)	(0.65)
Difference in import penetration	-0.06	-0.31	-0.14	-0.10	1.11*	-2.62*
	(0.15)	(0.31)	(0.21)	(0.33)	(0.58)	(1.39)
Lagged log of real price of shipments using 1979 weights	-0.01	-0.01	-0.005	-0.02**	0.01	-0.03
	(0.005)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)
Number of observations	31261	5959	14455	6485	3357	995
R-squared	0.01	0.03	0.01	0.02	0.03	0.09

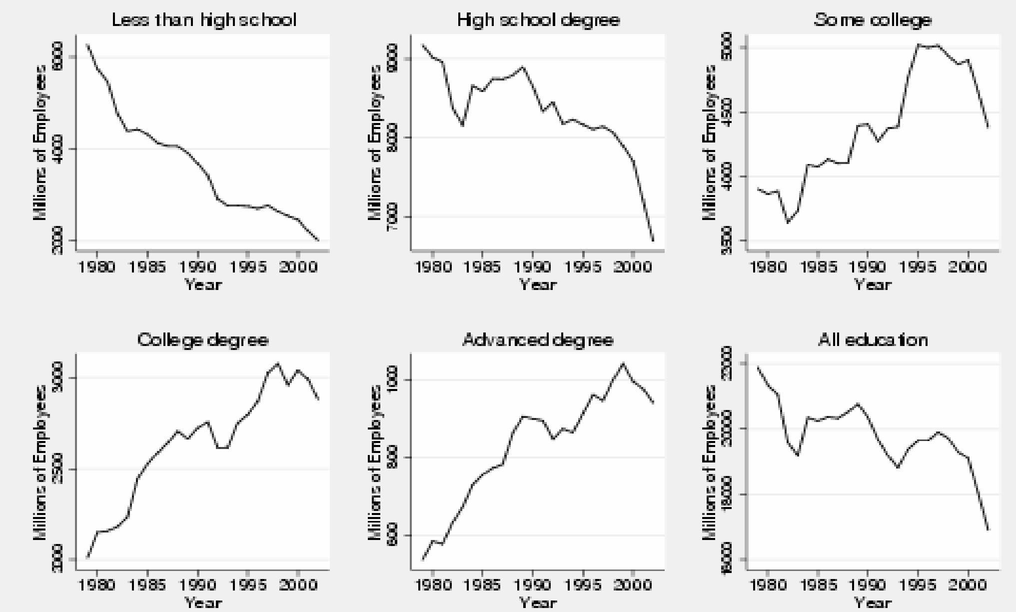
Source : Wage data taken from Current Population Surveys Merged Outgoing Rotation Groups for the years 1982-2002. Affiliate (or offshore) employment data is taken from the Bureau of Economic Analysis annual survey of US firms with multinational affiliates.

Note : Robust standard errors reported in parentheses below coefficient estimates. This specification includes controls for a worker's gender, age, education, experience, whether in a union, and industry and year fixed effects. Low-income affiliate employment is defined according to the World Bank income categories. Calculation of total factor productivity is defined in detail in the technical appendix.

Appendix Table 4: Occupations with Zero Import Penetration and Export Share in 1983 and 2002

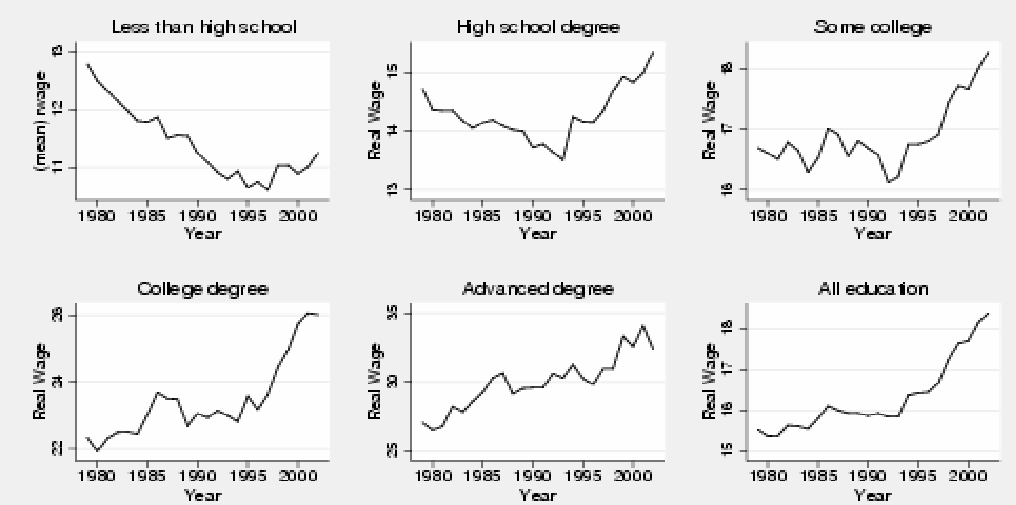
Occupation	Occupation	Occupation
Legislators	Theology teachers	Police and detectives, public service
Chief executives and general administrators, public administration	Trade and industrial teachers	Sheriffs, bailiffs, and other law enforcement officers
Administrators and officials, public administration	Home economics teachers	Correctional institution officers
Administrators, protective services	Teachers, postsecondary	Food counter, fountain and related occupations
Administrators, education and related fields	Postsecondary teachers, subject not specified	Kitchen workers, food preparation
Managers, medicine and health	Teachers, prekindergarten and kindergarten	Dental assistants
Managers, food serving and lodging establishments	Teachers, elementary school	Supervisors, personal service occupations
Managers, properties and real estate	Teachers, secondary school	Barbers
Underwriters	Teachers, special education	Hairdressers and cosmetologists
Actuaries	Sociologists	Baggage porters and bellhops
Atmospheric and space scientists	Social scientists	Welfare service aides
Dentists	Urban planners	Family child care providers
Optometrists	Recreation workers	Early childhood teacher's assistants
Podiatrists	Religious workers	Horticultural specialty farmers
Health diagnosing practitioners	Judges	Managers, farms, except horticultural
Respiratory therapists	Musicians and composers	Managers, horticultural specialty farms
Occupational therapists	Dancers	Supervisors, farm workers
Physical therapists	Announcers	Marine life cultivation workers
Speech therapists	Athletes	Nursery workers
Therapists	Dental hygienists	Graders and sorters, agricultural products
Physicians' assistants	Health record technologists and technicians	Inspectors, agricultural products
Earth, environmental, and marine science teachers	Radiologic technicians	Captains and other officers, fishing vessels
Biological science teachers	Air traffic controllers	Automobile mechanic apprentices
Chemistry teachers	Broadcast equipment operators	Telephone line installers and repairers
Physics teachers	Insurance sales occupations	Locksmiths and safe repairers
Natural science teachers	Securities and financial services sales occupations	Supervisors, brickmasons, stonemasons, and tile setters
Psychology teachers	Sales workers, motor vehicles and boats	Supervisors, painters, paperhangers, and plasterers
Economics teachers	Sales workers, apparel	Brickmason and stonemason apprentices
History teachers	Sales workers, shoes	Carpenter apprentices
Political science teachers	Sales workers, furniture and home furnishings	Electrician apprentices
Sociology teachers	Sales workers, radio, TV, hi-fi, and appliances	Paving, surfacing, and tamping equipment operators
Social science teachers	Sales workers, hardware and building supplies	Drillers, earth
Engineering teachers	Auctioneers	Supervisors, extractive occupations
Mathematical science teachers	Hotel clerks	Drillers, oil well
Computer science teachers	Postal clerks, except mail carriers	Mining machine operators
Medical science teachers	Mail carriers, postal service	Motion picture projectionists
Health specialties teachers	Meter readers	Motor transportation occupations
Business, commerce, and marketing teachers	Insurance adjusters, examiners, and investigators	Railroad conductors and yardmasters
Agriculture and forestry teachers	Eligibility clerks, social welfare	Rail vehicle operators
Art, drama, and music teachers	Bank tellers	Marine engineers
Physical education teachers	Teachers' aides	Bridge, lock, and lighthouse tenders
Education teachers	Cooks, private household	Longshore equipment operators
English teachers	Housekeepers and butlers	Supervisors handlers, equipment cleaners, and laborers
Foreign language teachers	Child care workers, private household	Helpers, Construction, and Extractive Occupations
Law teachers	Private household cleaners and servants	Helpers, surveyor
Social work teachers	Supervisors, police and detectives	

Figure 1. U. S. Manufacturing Employment, by Education Level: 1979-2002



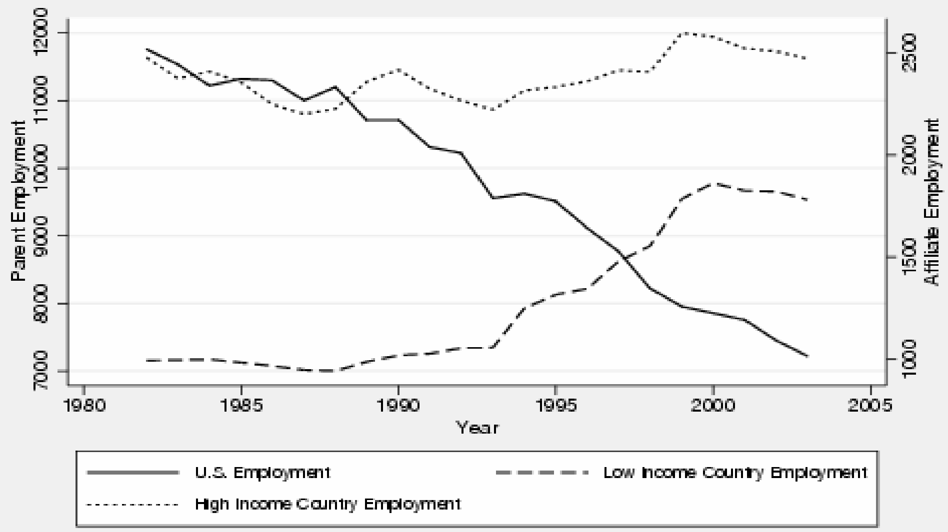
Note: Author's calculations based on the Current Population Survey's Outgoing Rotation Group, 1979–2002.

Figure 2. U. S. Manufacturing Real Wages, by Education Level: 1979-2002



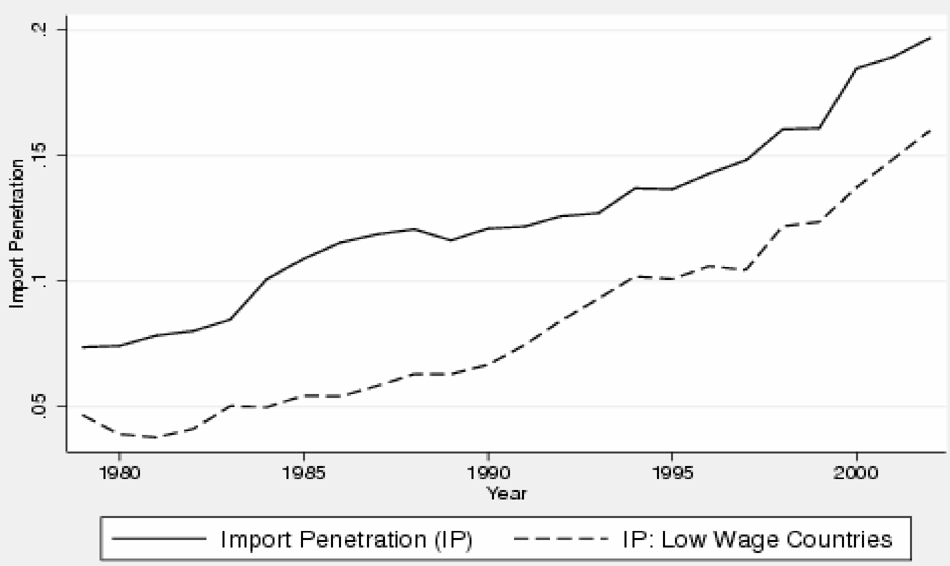
Note: Author's calculations based on the Current Population Survey's Outgoing Rotation Group, 1979–2002. Earnings weights, equal to the product of CPS sampling weights and hours worked in the prior week, are used in all calculations. Hourly wages are the logarithm of reported hourly earnings for those paid by the hour and the logarithm of usual weekly earnings divided by usual weekly hours. Overtime, tips, and commissions are included in wages, and top-coded wages are imputed by assuming a log-normal distribution for weekly earnings as described by Schmitt (2003). The calculated nominal hourly wage is converted to a real wage using the Consumer Price Index for 2006, and then trimmed to values between $1 and $100 per hour.

Figure 3. Domestic and Foreign Employment of U.S. Based Multinationals
Source: BEA



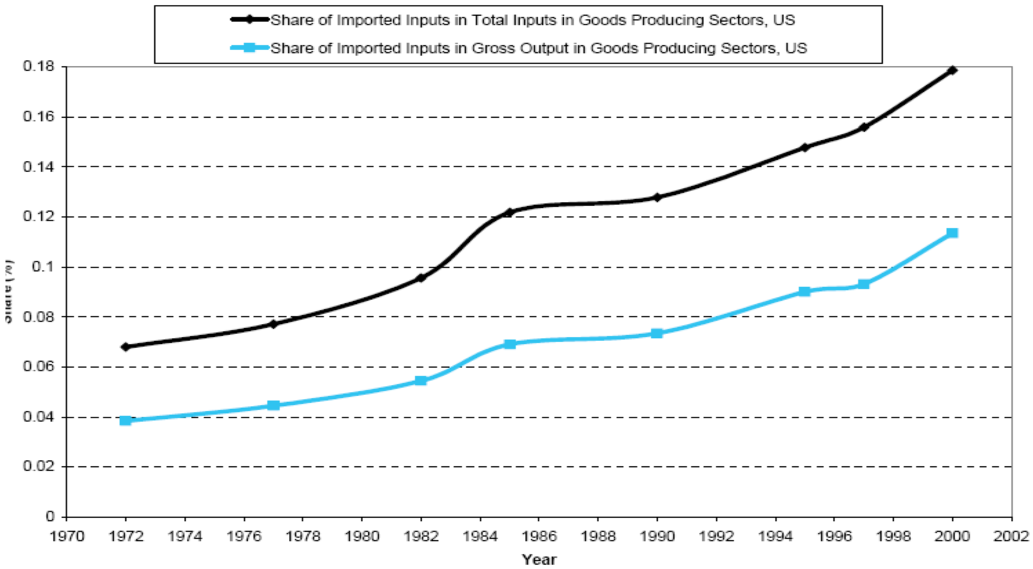
Note: Author's calculations based on the most comprehensive available data and is based on firm–level surveys on US direct investment abroad, collected each year by the Bureau of Economic Analysis (BEA) of the US Department of Commerce. Using these data, we compute number of employees hired abroad by country by year and then aggregate these numbers by Low (High) Income countries according to World Bank classifications.

Figure 4. Import Penetration: Total and From Low Wage Countries



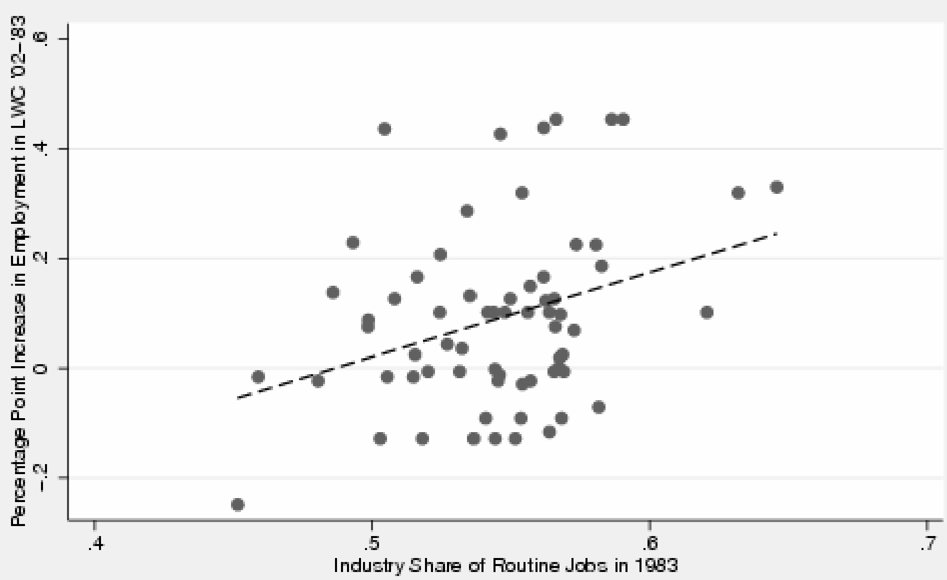
Note: Import penetration and import penetration from low–wage countries come from Bernard et al (2006). We aggregated the industry level data to an annual number using employment weights calculated from the Current Population Survey's Outgoing Rotation Groups 1979–2002.

Figure 5. Imported Inputs – Table 1 in GR
Data Source: OECD Input/Output Matrices



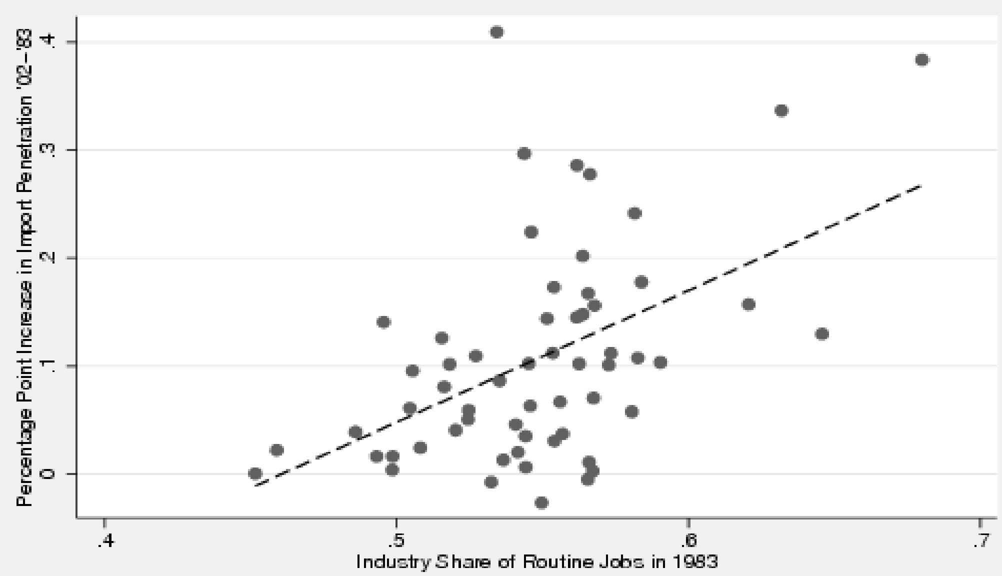
Source: Grossman and Rossi-Hansberg, "The Rise of Offshoring: It's Not Wine for Cloth Anymore"

Figure 6. Change in Low Wage Employment as Function of Initial Job Characteristics



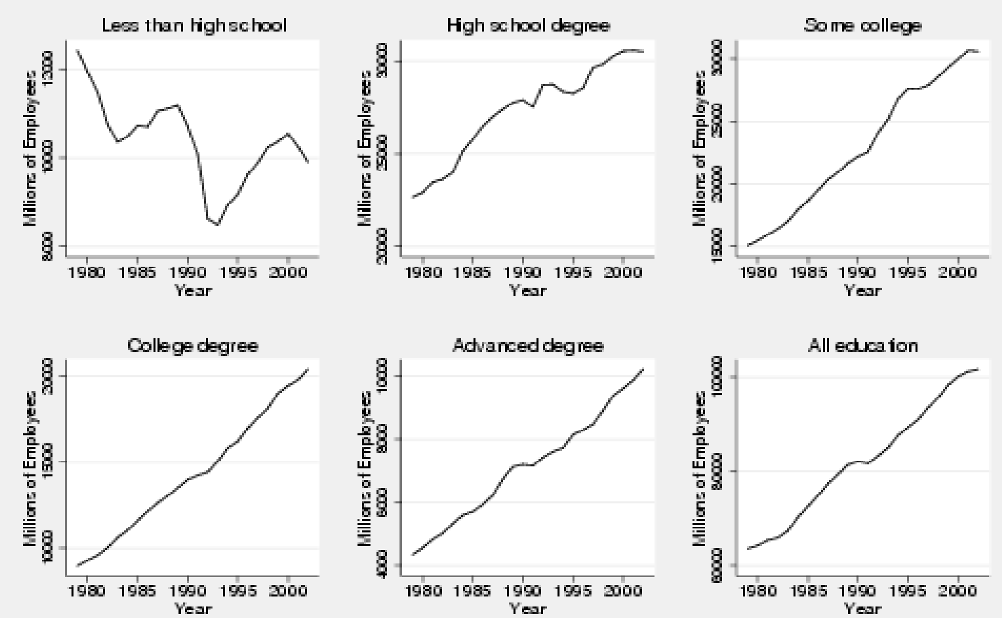
Note: Change in low wage employment is defined as the change between 1983 and 2002 in the share of employees hired by U.S. based multinationals in developing countries. Industry share of routine jobs is computed from information about individual job characteristics reported in the Current Population Survey and is defined according to Autor et al as the ratio of routine manual and cognitive tasks to all tasks.

Figure 7. Change in Import Penetration as Function of Initial Job Characteristics



Note: Change in import penetration is defined as the percentage point change between 1983 and 2002 in import penetration. Industry share of routine jobs is computed from information about individual job characteristics reported in the Current Population Survey and is defined according to Autor et al as the ratio of routine manual and cognitive tasks to all tasks.

Figure 8. U. S. Services Employment, by Education Level: 1979-2002



Note: Author's calculations based on the Current Population Survey's Outgoing Rotation Group, 1979−2002.

Figure 9. U. S. Services Real Wages, by Education Level: 1979-2002

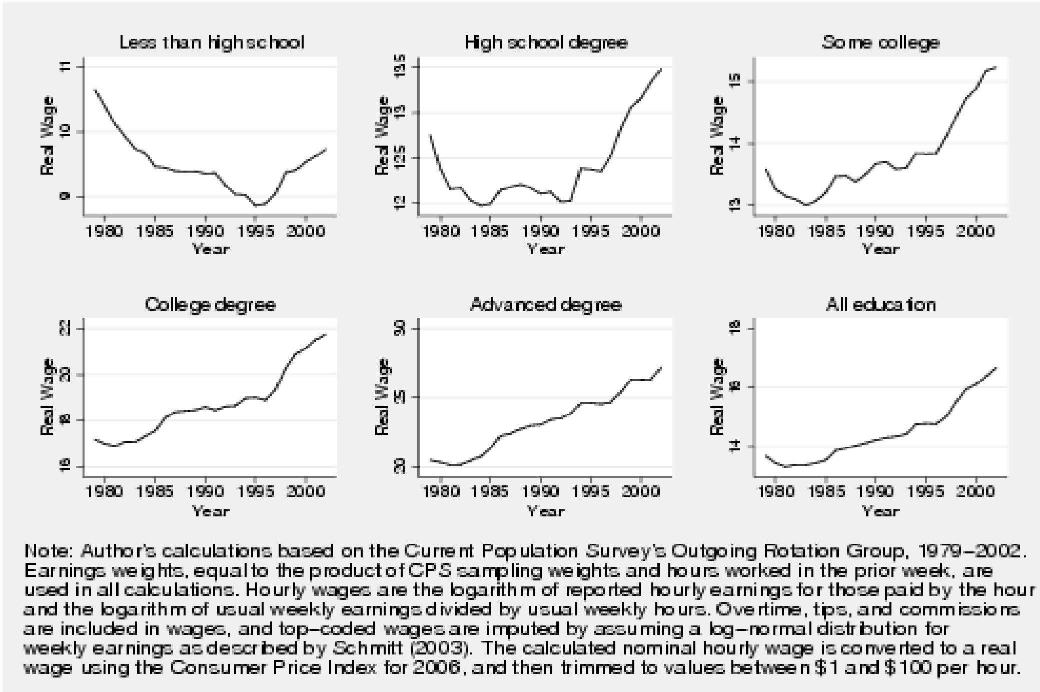


Figure 10. Inter-Occupation Wage Differentials : 83/83 to 01/02