NBER WORKING PAPER SERIES

IMMIGRATION, OFFSHORING AND AMERICAN JOBS

Gianmarco I.P. Ottaviano
Giovanni Peri
Greg C. Wright

Working Paper 16439
http://www.nber.org/papers/w16439

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2010

This paper was written as part of the project "Mobility of People and Mobility of Firms" coordinated by the Centro Studi Luca d'Agliano (LdA) and funded by the Fondazione CRT. We thank Giorgio Barba-Navaretti, Rosario Crinò, Gordon Hanson, Rob Feenstra, Alan Manning, John McLaren and participants in several seminars and conferences for useful comments and suggestions. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Immigration, Offshoring and American Jobs
Gianmarco I.P. Ottaviano, Giovanni Peri, and Greg C. Wright
NBER Working Paper No. 16439
October 2010
JEL No. F22,F23,J24,J61

ABSTRACT

How many "American jobs" have U.S.-born workers lost due to immigration and offshoring? Or, alternatively, is it possible that immigration and offshoring, by promoting cost-savings and enhanced efficiency in firms, have spurred the creation of jobs for U.S. natives? We consider a multi-sector version of the Grossman and Rossi-Hansberg (2008) model with a continuum of tasks in each sector and we augment it to include immigrants with heterogeneous productivity in tasks. We use this model to jointly analyze the impact of a reduction in the costs of offshoring and of the costs of immigrating to the U.S. The model predicts that while cheaper offshoring reduces the share of natives among less skilled workers, cheaper immigration does not, but rather reduces the share of offshored jobs instead. Moreover, since both phenomena have a positive "cost-savings" effect they may leave unaffected, or even increase, total native employment of less skilled workers. Our model also predicts that offshoring will push natives toward jobs that are more intensive in communication-interactive skills and away from those that are manual and routine intensive. We test the predictions of the model on data for 58 U.S. manufacturing industries over the period 2000-2007 and find evidence in favor of a positive productivity effect such that immigration has a positive net effect on native employment while offshoring has no effect on it. We also find some evidence that offshoring has pushed natives toward more communication-intensive tasks while it has pushed immigrants away from them.

Gianmarco I.P. Ottaviano
University of Bologna
Dip Scienze Economiche
Strada Maggiore 45, 40125 Bologna
ITALY
ottavian@economia.unibo.it

Greg C. Wright
Department of Economics
University of California, Davis
One Shields Avenue
Davis, CA 95616
gcwright@ucdavis.edu

Giovanni Peri
Department of Economics
University of California, Davis
One Shields Avenue
Davis, CA 95616
and NBER
gperi@ucdavis.edu

1 Introduction

The relocation of jobs abroad by multinationals and increased labor market competition due to immigrant workers are often credited with the demise of many manufacturing jobs once held by American citizens. While it is certainly true that manufacturing production and employment, as a percentage of the total economy, have declined over recent decades in the U.S., measuring the impact of globalization on jobs has been difficult. The reason is that, on the one hand, offshoring some production processes or hiring immigrants to perform them directly reduces the demand for native workers, while on the other hand the cost-savings of such restructuring of production increases the productivity and size of firms and improves their competitiveness. As a consequence, this process may indirectly increase the demand for native workers, if not exactly in the same tasks that were offshored and given to immigrant workers, then certainly in tasks that are complementary to them. Several recent papers have emphasized the potential cost-savings effect of offshoring (Grossman and Rossi-Hansberg 2008, Harrison and McMillan 2008, Wright 2010) arguing that this effect could offset or even reverse the "direct displacement effect" on employment and thereby generate a non-negative effect on the employment of less educated native workers. Other papers (Peri and Sparber 2009, Peri 2009) have suggested that immigrants may generate similar productivity-enhancing effects by increasing the demand for less educated native workers, especially in production tasks that are complementary to those performed by immigrants.

This paper develops a model and presents empirical evidence with respect to 58 U.S. manufacturing industries over the period 2000-2007, making progress on two important questions. First, how did the decrease in offshoring and immigration costs, accompanied by the higher share in jobs contested by offshore and immigrant workers, affect the employment of native workers within the manufacturing sector? Second, what kinds of production tasks suffered most from the competition created by offshore and immigrant workers and what kinds of tasks benefited? Our model features a manufacturing sector in which native, immigrant and offshore workers compete to perform a range of productive tasks in each manufacturing industry. Building on Grossman and Rossi-Hansberg (2008) the model predicts that lower costs of offshoring and immigration in an industry will increase, respectively, the share of offshore and immigrant workers in production in that industry. However, since those workers perform their tasks at a lower cost for the firm, an increase in the share of "globalized" jobs also leads to an expansion of the industry (productivity effect), an increase in total employment in it and possibly even an increase in the overall employment of native workers (though not their share within the industry). The model, by arraying productive tasks from manual- and routine-intensive to cognitive- and non-routine-intensive and postulating that the productivity of immigrants and the cost of offshoring are, respectively, decreasing and increasing along this spectrum, provides predictions on the range of tasks that will be performed by immigrants, those that will be offshored, and those that will be performed by natives. Moreover, the model makes predictions regarding the impact on the "average task" (in the spectrum) performed by natives (and immigrants) and on their level of employment when offshoring and immigration costs decline.

The model focuses on employment effects. It assumes a manufacturing economy with many industries and one factor (unskilled workers) that is mobile across industries and another (skilled workers, or knowledge, or capital) that is fixed for each industry. In this way, all the testable effects of offshoring and immigration that differ across industries are translated into differential employment effects (for natives) due to the fact that since wages are equalized across industries the common effect on wages cannot be estimated. In particular, the model makes three main predictions with respect to employment and the average tasks performed by natives and immigrants. First, in equilibrium each industry offshores the "intermediate tasks" (in the manual-routine to cognitive-non-routine spectrum), hires immigrants for the more manual-routine tasks, and hires natives for the more cognitive-non-routine ones. As a result, a decrease in offshoring costs increases the range of offshored tasks, reducing the share of tasks performed by natives and immigrants, pushing natives towards more cognitive-intensive tasks and immigrants towards more manual-intensive tasks. Second, a decrease in immigration costs increases the share of tasks performed by immigrants, reduces those that are offshored by absorbing some of the most manual-intensive tasks previously done offshore, but has only a small or no effect on the share of employment (and the average task) of native workers. Immigrants, in other words, compete more with offshore workers than with native workers due to their more "extreme" specialization in manual jobs relative to natives, who are concentrated in the communication-cognitive part of the spectrum. Thus, lower immigration costs lead to substitution of immigrants for offshore workers. Third, and most importantly, lower costs of offshoring and immigration produce cost-savings and, therefore, productivity-enhancing effects for the industry. This increases total labor demand, offsetting either partially or totally the negative effect on the labor share of natives so that total native employment of less educated workers may be unaffected or may even expand as a consequence of either of these forms of cost-savings.

We test the predictions of the model using employment data from two different sources. The American Community Survey (ACS) data (2000-2007) allow us to measure the employment of natives and foreign-born in manufacturing for each of 58 industries in the U.S. Next, the Bureau of Economic Analysis (BEA) dataset on the operations of U.S. multinationals allows us to measure employment in U.S. multinational affiliates abroad for the same 58 industries over the same period. We then look at the impact of increased ease of offshoring and ease of immigration on each type of employment in an industry (immigrants, natives and offshore workers). Motivated by Feenstra and Hanson (1999) we define the "ease of offshoring" as the share of intermediate inputs that is imported, and we construct the measure by combining the initial offshoring by a country in an industry with the subsequent total growth in offshoring in the country. This measure thus varies across industries and over time. Following Card (2001) we measure "ease of immigration" as the constructed share of immigrants in an industry, based on the composition of immigrant workers in the industry by nationality in 2000 and the subsequent growth of each national group. The underlying assumption is that these two indicators vary, respectively, with the costs of offshoring (which varies across industries due to differences in industry specialization across countries) and with the cost of immigration (which varies by country of origin and affects industries unevenly according to the initial distribution of immigrants). We find that an increase in the ease of offshoring reduces the share of both native and immigrant workers in total industry employment while an increase in the ease of immigration reduces the share of offshore workers with no impact on the share of native workers. However, looking at employment levels (rather than shares) an increase in the ease of offshoring does not have an effect on the employment of natives in a industry whereas an increase in the ease of immigration has a positive impact on it. This is consistent with the existence of a positive productivity effect due to immigration and offshoring within manufacturing industries. Finally, by matching occupation data from the ACS with the content of "manual", "communication" and "cognitive" skills (and routine and non-routine activities) from the O*NET database we can assess the response of the average task performed by native and immigrants workers (on a manual and routine-cognitive and non-routine scale). Our final finding is that an increase in offshoring pushes the average task performed by natives toward higher cognitive and non-routine content and the average task of immigrants toward more manual and routine content. In contrast, an increase in the share of immigrants has no effect on the average task performed by natives. The empirical results together imply that immigrant workers do not compete much with natives since they specialize in manual tasks, so that an increase in immigrants is more likely to reduce the range of offshored tasks in a industry without affecting the employment level and type of tasks performed by natives. Offshore workers, on the other hand, compete more directly with natives and so an increase in offshoring pushes natives toward more cognitive-intensive tasks. However, the positive productivity effect of offshoring then eliminates any negative effect on native employment. We check the robustness of these results using different definitions of tasks, adding controls and testing the assumption that cross- industry wages do not vary systematically. An interesting qualification to our results is that both the effects on employment and on the average task are stronger when we restrict offshoring to be primarily vertical (rather than horizontal), which is the form best characterized by our model since we assume that firms offshore production in order to cut costs rather than to serve the foreign market.

The rest of the paper is organized as follows. The next section describes the novel contributions of this paper in the context of the existing literature. Section 3 presents the model and derives the main results and predictions. Section 4 presents the data, describing sources and trends. Section 5 produces the empirical evidence on the model's predictions. Section 6 concludes the paper.

2 Literature Review

Several recent papers have analyzed the effect of offshoring on the demand for domestic labor and are relevant to the present analysis. On the theoretical front, Grossman and Rossi-Hansberg (2008) provide a simple model of trade in production tasks and, as mentioned, this model will serve as the framework for our paper. It is worth mentioning that this theory owes much to previous work on trade in intermediates, including seminal work by Jones and Kierzkowski (1990) and Feenstra and Hanson (1996), both of whom describe models in which trade in intermediate goods has consequences for the demand for labor much like that described in Grossman and Rossi-Hansberg (2008). Recent and relevant empirical work includes Crinò (2010), Harrison and McMillan (2008), Hummels et al. (2010) and Wright (2010), each of whom have tested some of the implications of existing theories with respect to the wage and employment effects of offshoring. Crinò (2010), which focuses on services offshoring, and Hummels et al. (2010), which focuses on Denmark, both find positive wage and employment effects of offshoring for relatively skilled workers, especially those performing more complex production tasks, but find that less skilled workers may suffer displacement. Wright (2010) finds a positive productivity effect of offshoring for domestic firms but, on net, an aggregate decline in low-skill employment. Harrison and McMillan (2008) find that a crucial distinction is between horizontal and vertical offshoring (the first aimed at serving the foreign destination market and the second aimed at producing goods that the multinational will then re-import), with the first hurting and the second stimulating domestic employment.

The present paper combines the above literature with the literature on the labor market effects of immigrants (e.g. Card 2001, Borjas 2003). We propose a common structure to think about these two phenomena (offshoring and immigration), both consequences of increased globalization. In particular, our model and empirical analysis address two, previously unanswered questions. First, are offshore workers primarily competing with natives or with immigrants? And, conversely, is hiring immigrant workers an alternative to offshoring jobs, or do immigrants compete directly with natives? Second, is the opportunity to hire immigrants and move jobs offshore a way to increase productivity (by cutting costs) and hence expand production (and possibly total employment) in an industry? We begin by extending the model from Grossman and Rossi-Hansberg (2008) which provides a simple way to think of these two phenomena within a unified framework. While the immigration literature has also analyzed the impact of immigrants on task allocation and productivity (e.g. Peri and Sparber 2009 and Peri 2009), here we expand on these models by introducing a multi-sector environment and an open economy. What we find is that the joint analysis of immigration and offshoring provides novel insights. In particular, the model predicts that when production tasks are arranged on a scale reflecting their relative complexity, immigrants end up competing on the low-complexity margin with offshore workers, while native workers are assigned more complex tasks. As we demonstrate, this result has important and testable implications concerning the consequences of immigration and offshoring on native employment.

The only other papers that we know of that tackle the analysis of immigration and offshoring in a joint framework are Olney (2009) and Barba-Navaretti, Bertola and Sembenelli (2008). The first paper assumes that immigrants are identical to natives and that their variation across U.S. states and industries is exogenous. Moreover, native workers are assumed to be immobile across states and industries so that increased immigration or offshoring manifests entirely through wages. We think our model and its derived empirical implementation constitute a significant improvement on the reduced form approach of that study. The second paper presents a model of immigration and offshoring and tests its implications on firm-level data for Italy but does not look at the skill-level of workers and tasks nor at industry-level employment effects.

3 A Labor Market Model of Task Allocation

Consider a small open economy that is active in several perfectly competitive sectors, indexed $s = 1, .., S$. We focus on one of these sectors and leave both the sector index s and the time dependence of variables t implicit for ease of notation. We will make them explicit when we get to the empirics.

The sector employs two primary factors, high skill workers (with employment level N_H) and low skill workers (with employment level N_L), with the former being sector-specific. The sector is small enough not to affect the wage of low skill workers.[1] Each worker is endowed with one unit of labor. High and low skill workers are employed in the production of high skill intermediates (called 'H-tasks') and low skill intermediates (called 'L-tasks'), which are then assembled in a high skill composite input (H) and a low skill composite input (L), respectively. The two composite inputs are then transformed into final output (Y) by the following Cobb-Douglas production function

$$Y = AL^{\alpha}H^{1-\alpha} \tag{1}$$

where A is a technological parameter and $\alpha \in (0, 1)$. Since the economy is small, the price of final output p_Y is set in the international market.

Each composite input is produced by assembling a fixed measure (normalized to 1) of differentiated tasks (indexed $i \in [0, 1]$). In particular, the low skill composite is assembled through the following CES technology

$$L = \left[\int_0^1 L(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} \tag{2}$$

where $L(i)$ is the input of task i and $\sigma > 0$ is the elasticity of substitution between tasks. An analogous expression holds for the high skill composite.[2]

[1] See Appendix B for an extension of the model in which this assumption does not hold. There we show that, while with an endogenous native wage immigration and offshoring also have wage effects, the corresponding employment effects discussed in Section 3.4 remain qualitatively the same.

[2] In Grossman and Rossi-Hansberg (2008) tasks are not substitutable. This corresponds to the limit case of $\sigma = 0$ where (2)

3.1 Production Choices

Each L-task can be managed in three modes: domestic production by native workers (D), domestic production by immigrant workers (M) and production abroad by offshore workers (O). As we are focusing on a small sector in a small open economy, the supplies of native, immigrant and offshore workers to the sector are infinitely elastic at corresponding wages w, $\widetilde{w}$ and w^*. We assume that firms can discriminate between natives and immigrants, which implies that w and $\widetilde{w}$ are not necessarily equal.[3] If a foreign worker immigrates, she incurs a frictional cost $\delta \geq 1$ in terms of foregone productivity. In other words, an immigrant endowed with one unit of labor in her country of origin is able to provide only $1/\delta$ units of labor in the country of destination. Accordingly, the migration decision entails a choice between earning w^* in the country of origin or $\widetilde{w}/\delta$ in the country of destination. Positive supply of both immigrant and offshore workers then requires the indifference condition $\widetilde{w} = w^*\delta$.

Low skill native, immigrant and offshore workers are perfectly substitutable in L-tasks so that in equilibrium any L-task will be performed by only one type of worker: the one that yields the lowest marginal cost.[4] In contrast, H-tasks are assumed to be prohibitively expensive to perform by immigrant and offshore workers. The underlying idea is that H-tasks require language and relational skills that foreign-born workers lack or find too expensive to acquire.[5]

L-tasks are defined so that they all require the same unit labor requirement a_L when performed by native workers. If task i is offshored, its unit input requirement is $\beta t(i)a_L$, with $\beta t(i) \geq 1$ and $t'(i) \geq 0$ so that higher i corresponds to higher offshoring costs. We can think of the index i as capturing the complexity of the task. Tasks with low i tend to be manual and routine while those with large i are non-manual and complex. The cost of offshoring the task (its "offshorability") is positively associated with the index. The marginal productivity of offshore workers is equal to $1/[\beta t(i)a_L]$ and varies across tasks depending on their offshorability. A lower value of the parameter $\beta \geq 1$, which is common to all tasks, can be used to capture technological progress that decreases the cost of offshoring. Due to perfect substitutability among the three groups of low skilled workers,

becomes a Leontief production function.

[3] There is much empirical evidence that, for similar observable characteristics, immigrants are paid a lower wage than natives. Using data from the 2000 Census, Antecol, Cobb-Clark and Trejo (2001), Butcher and DiNardo (2002) and Chiswick, Lee and Miller (2005) all show that recent immigrants from non-English speaking countries earn on average 17 to 20% less than natives with identical observable characteristics. Hendricks (2002) also shows that the immigrant-native wage differential, controlling for observable characteristics, is highly correlated with the wage differential between the US and their country of origin. See, however, Section 3.4 and Appendix B for a detailed discussion of how the predictions of the model would change were firms assumed to be unable to discriminate between native and immigrants workers.

[4] If native, immigrant and offshore workers were imperfectly substitutable, each task could be performed by 'teams' consisting of the three types of workers. Then, rather than full specialization of workers' types in different tasks, one would observe partial specialization, with the shares of the three types in each task inversely related to the corresponding marginal costs. While in reality several tasks are indeed performed by a combination of differ types of workers, nonetheless the intuition behind the key results of the model is better served by assuming perfect substitutability.

[5] We focus on the extreme case in which H-tasks can be performed only by native workers for parsimony. By simply inverting the L and H indices, our results apply symmetrically to a situation in which L-tasks can be performed only by native workers whereas H-tasks can be performed also by immigrant and offshore workers. By analogy the analysis of these extreme cases can be readily extended to the intermediate case in which immigrant and offshore workers can perform both types of tasks.

a task is offshored rather than performed by natives whenever offshoring is cheaper:

$$w \geq w^* \beta t(i) \tag{3}$$

Assuming $w > w^* \beta t(0)$ is necessary for at least some task to be offshored.

Additionally, when assigning tasks to immigrants firms face a task-specific cost $\tau(i) \geq 1$ implying that immigrants' marginal productivity in task i is $1/a_L \tau(i)$. We assume that $\tau'(i) \geq 0$ so that there is a negative correlation between the complex-non routine intensity of a task and the productivity of an immigrant worker at performing it. The underlying idea is that immigrants with low levels of education are better at manual-routine tasks than at complex-communication tasks. We will come back to this issue in the empirics.

A task is assigned to an immigrant rather than a native whenever it is cheaper to do so. This is the case whenever $w \geq \widetilde{w}\tau(i)$, which can be rewritten as

$$w \geq w^* \delta \tau(i) \tag{4}$$

recalling the indifference condition $\widetilde{w} = w^* \delta$. Assuming $w > w^* \delta \tau(0)$ is necessary for at least some task to be assigned to immigrants.

To conclude the comparisons between the different production modes we need to state the condition under which a task is offshored rather than performed by immigrants. This is the case whenever offshore workers are more productive than immigrants:

$$\beta t(i) \leq \delta \tau(i) \tag{5}$$

3.2 Task Allocation

Conditions (3), (4) and (5) clearly suggest that the allocation of tasks among the three types of workers depends on the wages (w and w^*), the sector-specific frictional cost parameters (β and δ), and the shapes of the task-specific costs ($t(i)$ and $\tau(i)$). To avoid a tedious taxonomy of sub-cases, we characterize the equilibrium of the model under a set of "working hypotheses" whose relevance will be discussed in the empirics. Nonetheless, as the following arguments are general, they can be readily applied to alternative hypotheses.

In particular, we assume that $\tau'(i) \geq \beta t'(i)$ so that as i increases the difficulty of assigning a task to immigrants rises faster than the difficulty of offshoring it. We further assume that $\delta\tau(0) < \beta t(0)$ so that the first task is more difficult to offshore than to assign to immigrants. These two assumptions capture the idea that assigning simple tasks to immigrants incurs a lower set-up cost than offshoring them. However, as the variety and complexity of tasks increases it is hard to find immigrants able to do them, whereas once set-up costs are paid it is relatively easy to access the marginal offshore worker.

Denote native, immigrant and offshore marginal costs as $c_D = wa_L$, $c_M(i) = w^*\delta\tau(i)a_L$ and $c_O(i) = w^*\beta t(i)a_L$, respectively. Then, our working hypotheses ensure that, when represented as a function of i, $c_M(i)$ and $c_O(i)$ cross only once, with the former cutting the latter from below. Single crossing then implies that there exists only one value of i such that $c_O(i) = c_M(i)$ and (5) holds with equality. This value defines the "marginal immigrant task" I_{MO} such that

$$\beta t(I_{MO}) = \delta\tau(I_{MO}) \tag{6}$$

For all tasks $i \leq I_{MO}$ it is cheaper to employ immigrants than offshore workers (i.e. $c_M(i) < c_O(i)$). For all tasks with $i \geq I_{MO}$ employing immigrants is more expensive (i.e. $c_M(i) > c_O(i)$).

Finally, for all three modes to be adopted for some tasks in equilibrium we assume that $c_O(I_{MO}) = c_M(I_{MO}) < c_D < c_M(1)$. This allows us to determine the "marginal offshore task" I_{NO} satisfying (3) with equality:

$$w = w^*\beta t(I_{NO}) \tag{7}$$

with $\beta t(I_{NO}) \geq 1$.

The allocation of tasks among the three groups of workers is portrayed in Figure 1, where the task index i is measured along the horizontal axis and the production costs along the vertical axis. The flat line corresponds to c_D and the upward sloping curves correspond to $c_M(i)$ and $c_O(i)$, with the former starting from below but steeper than the latter. Since each task employs only the type of workers yielding the lowest marginal cost, tasks from 0 to I_{MO} are assigned to immigrants, tasks from I_{MO} to I_{NO} are offshored, and tasks from I_{NO} to 1 are assigned to natives.

3.3 Employment Levels and Shares

Given the above allocation of tasks, marginal cost pricing under perfect competition implies that tasks are priced as follows

$$p(i) = \begin{cases} c_M(i) = w^*\delta\tau(i)a_L & 0 \leq i < I_{MO} \\ c_O(i) = w^*\beta t(i)a_L & I_{MO} \leq i < I_{NO} \\ c_D = wa_L & I_{NO} < i \leq 1 \end{cases}$$

Then, by (1) and (2), the demand for task i is

$$L(i) = \left[\frac{p(i)}{P_L}\right]^{-\sigma} (P_L)^{-\frac{1}{1-\alpha}} (\alpha p_Y A)^{\frac{1}{1-\alpha}} H$$

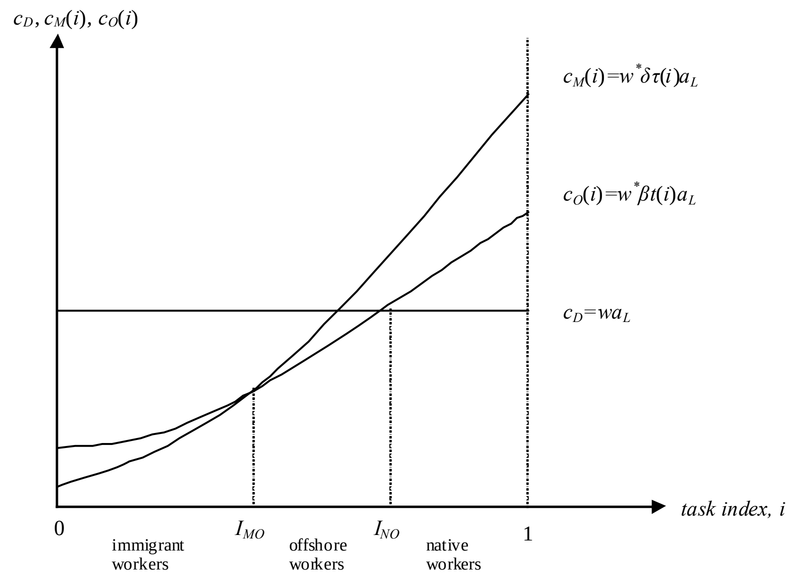


Figure 1: Unit Costs Over the Range of Tasks

where P_L is the exact price index of the low skill composite, defined as

$$P_L = a_L \left\{ \int_0^{I_{MO}} [\delta\tau(i)w^*]^{1-\sigma}\, di + \int_{I_{MO}}^{I_{NO}} [\beta t(i)w^*]^{1-\sigma}\, di + (1 - I_{NO})w^{1-\sigma} \right\}^{\frac{1}{1-\sigma}}$$

Since $i \in [0, 1]$, P_L is also the average price (and average marginal cost) of low skill tasks. Using (7) we can rewrite it as $P_L = wa_L\Omega(I_{MO}, I_{NO})$ with

$$\Omega(I_{MO}, I_{NO}) = \left\{ \int_0^{I_{MO}} \left[\frac{\delta\tau(i)}{\beta t(I_{NO})}\right]^{1-\sigma} di + \int_{I_{MO}}^{I_{NO}} \left[\frac{t(i)}{t(I_{NO})}\right]^{1-\sigma} di + (1 - I_{NO}) \right\}^{\frac{1}{1-\sigma}} \quad (8)$$

This highlights the relationship between P_L and the bundling parameter Ω in Grossman and Rossi-Hansberg (2008), which we encompass as a limit case when σ goes to zero and δ goes to infinity—that is, when tasks are not substitutable and migration is prohibitively expensive. It shows that changes in the migration cost δ and the offshoring cost β that decrease $\Omega(I_{MO}, I_{NO})$ imply improved efficiency in low skill labor usage. This is the source of the productivity effects of migration and offshoring discussed in Section 3.4.

Taking into account the different marginal productivity of the three groups of workers, the amount of labor demanded to perform task i is

$$N(i) = \begin{cases} a_L \delta \tau(i) L(i) & 0 \leq i < I_{MO} \\ a_L \beta t(i) L(i) & I_{MO} \leq i < I_{NO} \\ a_L L(i) & I_{NO} < i \leq 1 \end{cases}$$

so that immigrant, offshore and native employment levels are given by

$$\begin{aligned} N_M &= \int_0^{I_{MO}} N(i)\, di = \frac{1}{w^*}\left(\frac{P_M}{P_L}\right)^{1-\sigma} (P_L)^{-\frac{\alpha}{1-\alpha}} B \\ N_O &= \int_{I_{MO}}^{I_{NO}} N(i)\, di = \frac{1}{w^*}\left(\frac{P_O}{P_L}\right)^{1-\sigma} (P_L)^{-\frac{\alpha}{1-\alpha}} B \\ N_D &= \int_{I_{NO}}^{1} N(i)\, di = \frac{1}{w}\left(\frac{P_D}{P_L}\right)^{1-\sigma} (P_L)^{-\frac{\alpha}{1-\alpha}} B \end{aligned} \tag{9}$$

where $B = (\alpha p_Y A)^{\frac{1}{1-\alpha}} H > 0$ is a combination of parameters and exogenous variables and the exact price indices of immigrant, offshore and native tasks are given by

$$P_M = a_L \left\{ \int_0^{I_{MO}} [\delta \tau(i) w^*]^{1-\sigma} di \right\}^{\frac{1}{1-\sigma}}, \; P_O = a_L \left\{ \int_{I_{MO}}^{I_{NO}} [\beta t(i) w^*]^{1-\sigma} di \right\}^{\frac{1}{1-\sigma}}, \; P_D = a_L \left\{ (1 - I_{NO})\, w^{1-\sigma} \right\}^{\frac{1}{1-\sigma}} \tag{10}$$

Note that N_M is the number of immigrants employed whereas, due to the frictional migration cost, the corresponding number of units of immigrant labor is N_M/δ. Hence, sector employment is $N_L = N_M + N_O + N_D$. The shares of the three groups of workers in sectoral employment are thus

$$\begin{aligned} s_M &= \frac{(P_M)^{1-\sigma}}{(P_M)^{1-\sigma} + (P_O)^{1-\sigma} + (P_D)^{1-\sigma} (w^*/w)} \\ s_O &= \frac{(P_O)^{1-\sigma}}{(P_M)^{1-\sigma} + (P_O)^{1-\sigma} + (P_D)^{1-\sigma} (w^*/w)} \\ s_D &= \frac{(w^*/w)(P_D)^{1-\sigma}}{(P_M)^{1-\sigma} + (P_O)^{1-\sigma} + (P_D)^{1-\sigma} (w^*/w)} \end{aligned} \tag{11}$$

While (6) and (7) identify the marginal tasks as cutoffs between tasks performed by different groups of workers, the distinction is not so stark in reality. For the empirical analysis, it is therefore also useful to characterize the "average task" performed by each group. This is defined as the employment-weighted average across the corresponding i's:

$$\begin{aligned} I_M &= \frac{\int_0^{I_{MO}} iN(i)\,di}{N_M} = \frac{\int_0^{I_{MO}} i\tau(i)^{1-\sigma}di}{\int_0^{I_{MO}} \tau(i)^{1-\sigma}di} \\ I_O &= I_{MO} + \frac{\int_{I_{MO}}^{I_{NO}} iN(i)\,di}{N_O} = I_{MO} + \frac{\int_{I_{MO}}^{I_{NO}} it(i)^{1-\sigma}di}{\int_{I_{MO}}^{I_{NO}} t(i)^{1-\sigma}di} \\ I_D &= I_{NO} + \frac{\int_{I_{NO}}^{1} N(i)\,di}{N_D} = \frac{I_{NO}+1}{2} \end{aligned} \tag{12}$$

3.4 Comparative Statics

We are interested in how marginal and average tasks, as well as employment shares and levels, vary across the three types of workers when offshoring and migration costs change.

From (6) and (7), our working hypotheses imply that marginal tasks exhibit the following properties:

$$\begin{aligned} \frac{\partial I_{NO}}{\partial \beta} &< 0, \frac{\partial I_{MO}}{\partial \beta} > 0 \\ \frac{\partial I_{NO}}{\partial \delta} &= 0, \frac{\partial I_{MO}}{\partial \delta} < 0 \end{aligned}$$

These highlight the adjustments in employment occurring in terms of the number of tasks allocated to the three groups of workers. They can be readily interpreted using Figure 1. For example, a reduction in offshoring costs (lower β) shifts $c_O(i)$ downward, thus increasing the number of offshored tasks through a reduction in both the number of tasks assigned to immigrants ($\partial I_{MO}/\partial\beta > 0$) and the number of tasks assigned to natives ($\partial I_{NO}/\partial\beta < 0$). Analogously, a reduction in the migration costs (lower δ) shifts $c_M(i)$ downward, thus increasing the number of tasks assigned to immigrants through a decrease in the number of offshored tasks (higher I_{MO}). Accordingly, given (12) we also have the following properties for average tasks:

$$\begin{aligned} \frac{\partial I_D}{\partial \beta} &< 0, \frac{\partial I_M}{\partial \beta} > 0 \\ \frac{\partial I_M}{\partial \delta} &< 0, \frac{\partial I_O}{\partial \delta} < 0 \end{aligned} \tag{13}$$

These are driven by compositional changes due to adjustments both in the number of tasks allocated to the three groups and in the employment shares of the different tasks allocated to the three groups. Note that changes in migration costs have no impact on the average native task ($\partial I_D/\partial\delta = 0$). The impact of offshoring costs on the average offshore task ($\partial I_O/\partial\beta$) is, instead, ambiguous. This is due to opposing adjustments in the allocation of tasks given that when β falls some of the additional offshore tasks have low i (i.e. I_{MO} falls) while others have high i (i.e. I_{NO} rises).

Looking at (11), the impacts of declining β and δ on employment shares are all unambiguous. By making offshore workers more productive and therefore reducing the price index of offshore tasks relative to all tasks, a lower offshoring cost β reallocates tasks from immigrants and natives to offshore workers. By reducing the price index of immigrant tasks relative to all tasks, a lower migration cost δ moves tasks away from offshore and native workers toward immigrants:

$$\begin{aligned} \frac{\partial s_M}{\partial \beta} &> 0, \frac{\partial s_O}{\partial \beta} < 0, \frac{\partial s_D}{\partial \beta} > 0 \\ \frac{\partial s_M}{\partial \delta} &< 0, \frac{\partial s_O}{\partial \delta} > 0, \frac{\partial s_D}{\partial \delta} > 0 \end{aligned} \tag{14}$$

We call these the "relative productivity effects" on low skill workers.

Finally, turning to the impact of declining β and δ on employment levels, expressions (9) reveal an additional effect beyond the substitution among groups of workers in terms of employment shares. This is due to the fact that lower β and δ ultimately cause a fall in the price index P_L of the low skill composite because, as a whole, low skill workers become more productive. We call this the "absolute productivity effect" on low skill workers. Specifically, as is evidenced by the term $(P_L)^{-\frac{1}{1-\alpha}}$ on the right hand side of (9), a fall in the price index of the low skill composite has a positive impact on sectoral employment (through the absolute productivity effect), which is then distributed across groups depending on how the relative price indices P_M/P_L, P_O/P_L and P_D/P_L vary (via the relative productivity effect). Note that, given $(P_L)^{1-\sigma} = (P_M)^{1-\sigma} + (P_O)^{1-\sigma} + (P_D)^{1-\sigma}$, P_L cannot change when P_M, P_O and P_D are all fixed. This is why we have chosen not to collect the P_L terms in (9), allowing us to disentangle the absolute and relative productivity effects.

The impact of declining β and δ on employment levels can be signed only when the absolute productivity effect and the relative productivity effect go in the same direction. In particular, since $\partial P_L/\partial \beta > 0$ and $\partial P_L/\partial \delta > 0$, we have

$$\frac{\partial N_O}{\partial \beta} < 0, \frac{\partial N_M}{\partial \delta} < 0$$

while the signs of $\partial N_M/\partial \beta$, $\partial N_D/\partial \beta$, $\partial N_O/\partial \delta$ and $\partial N_D/\partial \delta$ are generally ambiguous. In other words, whether the absolute productivity effect is strong enough to offset the relative productivity effect for all groups of workers is an empirical question that we will address in the next sections. Lower β and δ certainly raise sector employment $N_L = N_M + N_O + N_D$, since only the absolute productivity effect matters in this case.

As a final comment, it is worth pointing out that firms' ability to discriminate between natives and immigrants is crucial for the productivity effects of easier immigration to materialize. Indeed, when firms are able to discriminate, they pay immigrant wages $\widetilde{w} = w^*\delta$ so that any reduction in the migration cost δ allows them to reduce their payments to immigrants. This generates a cost saving effect both at the intensive margin of tasks already assigned to immigrants and at the extensive margin of new tasks shifted from offshore to immigrant workers. If firms were, instead, unable to discriminate, immigrants would always be paid native wages w earning rents $w - w^*\delta$. Thus, any reduction in δ would simply increase immigrants' rents with no impact on firms' costs. The difference between falling costs of immigration with and without discrimination is that in the former case they create rents for domestic firms whereas in the latter case they create rents for the immigrants. Note, however, that our assumption of perfect discrimination is not crucial to generate the productivity effect due to immigration since even partial discrimination generates rents for the firm. See Appendix B for additional details.

4 Data

In order to make the predictions of the model operational we need to provide an empirical definition and empirical measures for three sets of variables. First, we need to measure the employment of less-skilled workers in each industry-year, identifying separately native workers operating in the U.S. (D for domestic), immigrant workers operating in the U.S. (M for migrants) and workers operating abroad for U.S. multinationals or sub-contracting for them (O for offshore). Second, we need a measure of the average intensity of production tasks performed by less-skilled native workers (I_D), offshore workers (I_O) and immigrant workers (I_M). Third, we need to construct an index or a proxy for the offshoring costs β and for the immigration costs δ by industry in each year. It turns out that to produce these variables using a consistent and comparable industry classification we need to merge data on multinational employment from the BEA, data on imports of intermediate goods from Feenstra et al. (2002) and data on native- and foreign-born workers from the IPUMS samples of the Census and the American Community Survey. The only years for which this merge can be done consistently and reliably are the years 2000-2007, and we therefore use these as our sample. We will describe each set of variables and their trends and summary statistics in the sections 4.1, 4.2 and 4.3 below. Section 5 then uses these variables to test empirically the main predictions of the model.

4.1 Employment and Shares

The data on offshore employment are obtained by adding up two groups of workers. We start with data on U.S. Direct Investment Abroad from the BEA which collects data on the operations of U.S. parent companies and their affiliates. From this dataset we obtain the total number of employees working in foreign affiliates of U.S. parent companies, by industry of the U.S. parent. These are jobs directly generated abroad by multinationals. However, of growing importance are jobs created as multinationals offshore production tasks to foreign sub-contractors that are unaffiliated with the multinational, so-called *arm's length* offshoring (see Antras, 2003). We would also like to include these offshored jobs in the count of total offshore employment but we do not have a direct measure of them. Hence this second group of offshored jobs is calculated as follows. Assuming that a large part of the production output of these offshored tasks is subsequently imported as intermediate inputs by the U.S. parent company, we calculate the ratio of imports of intermediates by the U.S. parent coming from affiliates and employment in those affiliates. We then scale the imports of the U.S. parent coming from *non-affiliates* (data that are also available from the BEA) by this ratio to impute the employment in sub-contracting companies. This procedure assumes that the labor content per unit of production of sub-contracted intermediate inputs is the same as for production in U.S. affiliates in the same industry. Then we add the employment in affiliates (first group) and the imputed offshore employment (second group) to obtain total offshore employment. Adding the imputed employment increases offshore employment by 60-80% in most industries, confirming the importance of arm's length offshoring of production tasks.

The employment of less-skilled native and immigrant workers in the U.S. is obtained from the American Community Survey (ACS) and Census IPUMS samples (2000-2007)[6] obtained from Ruggles et. al. (2008). We added up all workers not living in group quarters who worked at least one week during the year and have a high school diploma or less, weighting them by the sample weight assigned by the ACS in order to make the sample nationally representative. We define as immigrants all foreign-born workers who were not a citizen at birth. The relevant industry classification in the Census-ACS data 2000-2007 is the INDNAICS classification which is based on the North American Industry Classification System (NAICS). Since the BEA industries are also associated with unique 4-digit NAICS industries we are able to develop a straightforward concordance between the two datasets. The 58 final industries on which we have data and their BEA codes are reported in Table A1 of the Appendix.

The evolution of the share of immigrants and offshore workers in total manufacturing employment and in some selected industries is shown in Table A2 in the Appendix. Figures 1 and 2 report the distribution of those shares in each year across the 58 industries and the connecting line shows their average over time. While during the 2000-2007 period there has been only a modest increase in the overall share of immigrants and offshore employment in total manufacturing employment (the first increases from 12.8% to 14% and the second from 22.3% to 29.3%) different industries have experienced very different changes in their share of immigrants and offshore labor among workers. For instance, "Apparel and Textile Mills" has experienced the largest increase among all industries in the share of immigrant workers (+7.6% of total employment) and at the same time has experienced an almost identical and negative (-7%) change in offshore employment. On the other hand, "Plastic Products" has experienced a decline in the share of immigrant employment (-2.3%) and a large increase (+16.8%) in offshore employment. "Basic Chemicals" experienced the largest increase in offshore employment as

[6] For year 2000 we use the 5% Census sample. For 2001 we use the 1-in-232 national random sample. For 2002, we use the 1-in-261 national random sample. For 2003 we use the 1-in-236 national random sample. For 2004 we use the 1-in-239 national random sample. For 2005, 2006 and 2007 the 1-in-100 national random samples are used.

a percentage of total employment over this period (+30%) and "Other Transportation Equipment" experienced the largest decline (-32%). The variation across industries, therefore, promises to be large enough to allow us to identify the differential effects of changes in the cost of immigration and offshoring on employment, even over a relatively short period. Table A3 in the appendix shows the percentages of native, immigrant and offshore employment as of 2007 for some representative industries spanning the range from very high to very low share of native workers. What can be seen, and is very relevant for our analysis, is that all industries, to different extents, hire immigrants and offshore production. Hence the joint analysis of these two processes can help us gain a better understanding of the evolution of manufacturing employment.

4.2 Average Task Intensity

Our model assumes that the contribution of less educated workers to production can be represented in a continuum of tasks that can be ranked from manual-non-complex to non-manual-complex. At the same time we assume that this ranking is negatively correlated with offshorability and with the productivity of immigrants in performing tasks. Recent empirical studies (Becker, Ekholm and Muendler, 2007, Blinder, 2007, Ebenstein, Harrison, McMillan, Phillips, 2009, Jensen and Kletzer, 2007, Levy and Murnane, 2006, Wright, 2010) have also argued that jobs that are intensive in more routine and codifiable types of tasks and less intensive in tasks requiring communication and cognitive interactions with other people are less costly to offshore. Moreover, Peri and Sparber (2009) have shown that due to their imperfect knowledge of language and local norms, immigrants have a comparative advantage in manual-intensive and simple physical tasks and a comparative disadvantage in communication-intensive and interactive tasks. Combining these two type of studies we rank the tasks "i" from 0 to 1 as progressively having a larger communication-interaction intensity and a lower manual and routine content. Hence 0 is a task with the highest content of manual-routine skills to be performed and 1 is a task that requires the highest content of interactive-cognitive skills to be performed. Our assumption is that the cost of offshoring tasks and the inverse productivity of immigrants in performing them are both positively correlated with the index, so that they increase as the index progresses from 0 to 1.

While the model identifies "marginal" tasks that establish a cut-off between production tasks performed by one group (say immigrants) and another (say offshore workers) the distinction between tasks performed by different groups is not so stark in reality. However, the predictions of the model regarding the impact of shifts in the cost-curves on the *average* task index performed by each group are more continuous in nature and can be empirically tested. Thus, the way in which we impute task performance in an industry is as follows. First, we associate with each worker (native or immigrant) in industry s the intensity (standardized between 0 and 1) of each one of five task-skill measures assigned to the worker's occupation by the Bureau of Labor Statistics via its O*NET database. As described in greater detail in the Appendix C we use the original O*NET variables to construct the indices for proxying "cognitive", "communication", "interactive", "manual" and "routine" skills. Those indices capture the intensity (between 0 and 1) of that skill as used in the productive activities performed in the occupation. By associating with each individual the indices specific to her occupation (classified using the Standard Occupation Classification (SOC)) we construct for each individual the index i =("cognitive"+ "communication"+ "interactive"-"manual"-"routine")/5+2/5, ranging between 0 and 1, which identifies on that scale the position of the typical task supplied by the individual (occupation)[7]. We then average the index (weighted by hours worked) across all U.S.-born workers with a high school diploma or less in industry s and year t to obtain I_{Dst} and across immigrant workers with a high school degree or less to obtain I_{Mst}. Our empirical analysis will be based on the implications derived using these two indices. Hence the range 0 to 1 for the index i spans a "task space" that goes from the most manual-routine intensive tasks to the most cognitive-non-routine intensive ones. Because the BEA database does not contain the occupations of offshore workers we are unable to calculate I_{Ost}.

Figures 3 and 4 show the range of variation across industries and the average values of the indices I_D and I_M. The average value of the index is quite stable (much more so than the share of employment) which indicates a slower change in the task-composition (occupational distribution) of natives and immigrants within each industry. The value of the index, averaging across all manufacturing industries, is around 0.33 for immigrants and 0.37 for natives. Moreover, averaging over the 7 years for each industry the complexity index is larger for natives than for immigrants in all but one case. This confirms that natives perform tasks ranked higher by this index. The standard deviation of the average native index across industries is around 0.025 and similarly the standard deviation of the average immigrant index is about 0.026. Also, the variation in the growth of the skill-index over the 7 years across industries is quite limited. For instance, the industry with the largest growth in I_D is "Semi-conductor and other electronic components", which experienced an increase in the index of 0.02, while the largest decrease was -0.009, experienced by "Coating, Engraving and Heat-treating". Hence, over the period considered (2000-2007) a change in the skill-index of 0.01 in an industry constitutes significant variation. Also notice that, on average, the index for natives I_D in the entire manufacturing sector increased by 0.003 while the index for immigrants I_M decreased by 0.003. While this may be due to many factors, an increase in offshore employment (and in its range of tasks) in the model presented above would have exactly this effect as offshored tasks would drive a wedge between those performed by natives (whose average index would grow) and those performed by immigrants (whose index would decrease).

[7] We have also constructed the index using a subset of those variables, namely omitting, alternatively, "communication", "interactive" or "routine" measures. The empirical results are largely unchanged.

4.3 Imputed Offshoring and Immigration

Driving the shifts in employment shares and average skill-indices are the changes in accessibility of offshore and immigrant workers. In particular, our model has a simple and parsimonious way of capturing changes in the overall cost of offshoring in an industry (β_s) and in the overall cost of immigration in an industry (δ_s). As we do not observe industry-specific offshoring and immigration costs, we construct a measure of imputed offshoring and imputed immigration that are likely to be driven by changes in those costs, and that also differ across industries. In particular, following Feenstra and Hanson (1999) we begin by constructing a measure of offshoring activity by imputing to each industry the share of imported intermediate inputs coming from other industries that share the same 3-digit NAICS code[8]. Thus, this measure varies according to the input-output structure of each manufacturing industry and the differential degree of offshoring of intermediate inputs. The data on U.S. imports come from Feenstra et. al. (2002) and are then restricted according to their End-Use classification to consist only of imports destined for use as production inputs.

Next, in order to isolate the variation in this measure that is due only to exogenous variation in offshoring costs, we alter the offshoring measure further. First, we first regress the offshoring measure on country-time and industry-time fixed effects, and then discard the resulting industry-time coefficients. The country-time coefficients are then used as the key variation in the new measure. The idea is that variation over time that is specific to industries, and that is not due to factors originating abroad, is likely to be "contaminated" with variation that is endogenous to employment and wages. Primarily we are concerned about U.S.-originating industry-specific demand shocks that both increase employment and wages and simultaneously increase the extent of offshoring.

For each country we then interact the variation over time in country-specific offshoring with the level of offshoring across industries in a country in 2000. Summing over countries results in our final industry- and time-varying offshoring measure. Thus, the implicit identifying assumption is that U.S. offshoring is driven by country-specific offshoring costs that affect different industries in different ways depending on their initial geographical distribution of offshoring. These can be thought of as "push" factors that vary independently of domestic U.S. demand shocks. We call this measure for industry s and year t "Imputed Offshoring$_{st}$", and because it depends negatively on offshoring costs (β_s) we will sometimes refer to it as the "ease of offshoring".

For immigrants we use an analogous idea. We exploit the observation that foreigners from different countries have increased or decreased their relative presence in the U.S. according to changes in the cost of migrating from their countries as well as with domestic conditions in their countries of origin. The different initial presence of immigrants from different countries in an industry makes that industry more or less subject to those shifts in

[8] This is the *narrow* definition of offshoring from Feenstra and Hanson (1999). As described in that paper this definition more closely captures the idea that offshoring occurs when a firm chooses to have inputs produced abroad that it could otherwise produce itself.

cost- and push-factors. Hence we impute the population of each of 10 main groups of immigrants[9] using the initial share of workers in the industry combined with their total population growth in the U.S., assuming that cross-country differences in immigration are solely driven by changes in cost- and push-factors. We calculate the imputed immigration index by industry as the imputed share of foreign-born in total employment. We call this measure for industry s and year t "Imputed Immigration$_{st}$", and because it depends negatively on immigration costs (δ_s) we will sometimes call it "ease of immigration". This index is similar to the constructed shift-share instrument often used in studies of immigration in local labor markets (e.g., Card, 2001, Card and DiNardo 2000, Peri and Sparber 2009), except that it exploits differences in the presence of immigrant groups (from different countries) across industries, rather than across localities. The changes in this index, which are due solely to changes in the country-of-origin specific immigration costs, will differ across industries due to the weighting of each country-specific change by the initial cross-country distribution of workers in an industry. Finally, we divide each index by its standard deviation across all observations so that the estimated coefficients can be easily compared.

5 Empirical Specifications and Results

The strategy in this section is to test the main empirical predictions of the model. In particular, we are interested in estimating the impact of decreasing offshoring and immigration costs, which should result in a larger amount of production carried out by offshore workers and foreigners within the U.S., on the employment and task specialization of natives. As suggested by the model, we will exploit differences in costs across industries and over time in order to identify the impact of reduced offshoring and immigration costs on native and immigrant employment as well as on native and immigrant task specialization.

5.1 Effects on Employment Shares

Our empirical strategy is to first estimate the effects of the ease of immigration and offshoring on the share of native, immigrant and offshore employees among less educated workers. We then analyze the impact on the employment levels of these groups and then on the task-specialization of natives and immigrants. Using the same notation as developed in the model we first estimate the following three equations:

$$s_{Dst} = \phi_s^D + \phi_t^D + b_{DO}(\text{Imputed Offshoring}_{st}) + b_{DI}(\text{Imputed Immigration}_{st}) + \varepsilon_{st}^D \tag{15}$$

$$s_{Mst} = \phi_s^M + \phi_t^M + b_{MO}(\text{Imputed Offshoring}_{st}) + b_{MI}(\text{Imputed Immigration}_{st}) + \varepsilon_{st}^M \tag{16}$$

[9] The ten countries/regions of origin are: Mexico, Rest of Latin America, Canada-Australia-New Zealand, Western Europe, Eastern Europe, China, India, Rest of Asia, Africa, Others.

$$s_{Ost} = \phi_s^O + \phi_t^O + b_{OO}(\text{Imputed Offshoring}_{st}) + b_{OI}(\text{Imputed Immigration}_{st}) + \varepsilon_{st}^O \quad (17)$$

Equation (15) estimates the impact of the ease of offshoring and immigration on native workers' share of less skilled employment. By including industry effects we only exploit variation within a 4-digit NAICS manufacturing industry (there are 58 of them) over time. We also control for common year-effects. Hence, any time-invariant difference in offshoring across industries and any common trend in offshoring over time will not contribute to the identification of the effect. Less skilled employment is calculated by adding the employment of natives and foreign-born in the U.S. to the employment of foreign affiliates of U.S. companies plus imputed employment of foreign sub-contractors of U.S. multinationals (arm's length employment). At first we assume that all offshore employment is less skilled so that the total employment of less skilled workers in an industry is the sum of native, immigrant and offshore employment. Equation (16) estimates the effect of the ease of offshoring and immigration on the immigrant share of less skilled employment, and equation (17) estimates the effect on offshore employment as a share of less skilled employment. From section 3.4 the predictions of the model are as follows: $b_{DO} < 0, b_{DI} \approx 0, b_{MO} < 0, b_{MI} > 0, b_{OO} > 0$ and $b_{OI} < 0$. Table 1 reports the estimated effects on employment shares. Specifications 1 show the effects of imputed immigration and offshoring on the share of native workers. Specifications 2 shows the effects on the share of immigrants, and specifications 3 report the effects on the share of offshore employment. The upper part of the table reports the estimated coefficients obtained using employment of less educated workers to calculate the shares. The lower part of the table uses total employment to calculate shares[10]. Since the model predicts no impact on the employment of more educated workers the results presented in the lower part of the table should mirror those in the upper part. Moreover, as we are not able to separate more and less skilled offshore workers, the lower part of Table 1 provides a check of the overall employment impact of offshoring on native and immigrant workers when considering labor as one unique factor of production. The method of estimation used is OLS with industry and time fixed effects and the reported standard errors are heteroskedasticity robust.

The results are interesting and encouraging as all six predictions of the model are matched by the estimates that, in turn, are very similar across specifications (using either less educated or all workers). Looking along the first row we see that increased offshoring in one industry implies a significant decline in the share of native employment in that industry, a significant decline in the share of immigrant employment and a significant increase in the share of offshore employment. The sign of these three effects is exactly as predicted in equations (14) and all the estimates are significantly different from 0. The intuition for such effects is obtained by considering a downward shift in the offshoring curve in Figure 1. An increase in the share of offshored jobs, caused by falling offshoring costs, takes place at the expense of both a lower share of immigrant *and* native

[10] In all the reported tables we use the definition of offshore employment that includes the imputed offshore employment from non-affiliates as defined in section 4.1. We have run the same analysis using only employment in the affiliates as offshore employment and we obtain similar, but weaker, results.

employment (both margins are affected). Also of quantitative interest is the fact that an increase in the ease of offshoring erodes a larger share of native employment relative to immigrant employment. In other words, it is possible that over the seven years considered (2000-2007) the phases of production that were offshored were more in competition with native workers than with immigrant workers.

On the other hand, focusing on the second row of Table 1, which reports the effects of the ease of immigration on employment shares, we observe that an increase in imputed immigration has no effect on the share of native employment whereas it reduces the share of offshore employment and increases the share of immigrant employment, both significantly. Again, this is as predicted by the model and the intuition for the results is provided again by Figure 1. A downward shift in the immigration cost curve will increase the share of tasks performed by immigrants and reduce the share of offshored tasks. However, it will leave the share of native tasks unchanged because those workers are performing tasks that are higher in the skill-index and not affected by the shifting margin of immigrant tasks[11]. This is interesting since it may provide a new explanation for why a large part of the labor literature (e.g., Card, 2001 or Ottaviano and Peri, 2008) does not find a significant negative impact of immigrants on native employment: on the margin immigrants compete more with offshore workers than with natives. Conversely, if the share of immigrants were to decrease due to an increase in the cost of immigration–for instance, due to more restrictive immigration laws–our results imply that the production tasks relinquished by immigrants are more likely to be substituted by offshore workers than by native workers. Such a differential impact of offshoring and immigration on the native share of employment confirms the intuition and results of the model, which implies that offshored tasks are predominantly in an intermediate position along the task continuum, between those performed by natives and those performed by immigrants.

The estimated coefficients in the lower part of the table (third and fourth row) and their significance are very similar to those in the first and second row. This confirms that most of the effect of offshoring takes place through its impact on less skilled workers in the U.S. An increase in the ease of offshoring reduces the share of natives and immigrants in total employment by substituting for those workers via an increase in the share of offshore workers. On the other hand, an increase in the ease of immigration has only a negative impact on the share of offshore employment, leaving the native share unchanged.

5.2 Effects on Employment Levels

A second important implication of the model is the existence of a "productivity effect" from hiring immigrant labor or offshore workers. This arises from the infra-marginal cost-savings generated by their lower wages, from which it follows that an increase in the ease of offshoring or immigration will result in an increase in the overall

[11] While the relative productivity effect of a decrease in the cost of offshoring would also imply a decrease in the share of native workers in employment (as predicted by the comparative statics in 14) this effect is likely to be small. In the findings here there is no narrowing of the task range performed by natives, suggesting that the effect is certainly smaller than the negative effect on the share of immigrant workers.

demand for less skilled labor. This positive overall effect, combined with the effect on shares described in the previous section, implies a mitigated, null, or perhaps even a positive effect of offshoring on native employment or a positive effect of immigration on native employment, as demonstrated in section 3.4. Table 3 presents the estimated coefficients from the following 4 regressions:

$$N_{Dst} = \phi_s^D + \phi_t^D + B_{DO}(\text{Imputed Offshoring}_{st}) + B_{DI}(\text{Imputed Immigration}_{st}) + \varepsilon_{st}^D \tag{18}$$

$$N_{Mst} = \phi_s^M + \phi_t^M + B_{MO}(\text{Imputed Offshoring}_{st}) + B_{MI}(\text{Imputed Immigration}_{st}) + \varepsilon_{st}^M \tag{19}$$

$$N_{Ost} = \phi_s^O + \phi_t^O + B_{OO}(\text{Imputed Offshoring}_{st}) + B_{OI}(\text{Imputed Immigration}_{st}) + \varepsilon_{st}^O \tag{20}$$

$$N_{Lst} = \phi_s^L + \phi_t^L + B_{LO}(\text{Imputed Offshoring}_{st}) + B_{LI}(\text{Imputed Immigration}_{st}) + \varepsilon_{st}^L \tag{21}$$

Following the notation used in section 3, N_{Dst} is the total employment of less skilled native workers in industry s and year t, N_{Mst} is the employment of less skilled immigrant workers in industry s and year t and N_{Ost} is the total offshore employment in the industry-year. Finally, $N_{Lst} = N_{Dst} + N_{Mst} + N_{Ost}$ is what we call overall less skilled employment in the industry-year. Keep in mind that it includes jobs performed in the U.S. by all firms and abroad by affiliates of U.S. parents and by subcontractors working for affiliates of U.S. parents. From the results of section 3.4 we see that B_{LO} and B_{LI} are strongly related to the intensity of the productivity effect due to increased offshoring and increased immigration, while the other effects combine this productivity effect with the relative share effects estimated in Table 1.

The results presented in Table 2 are also very much in line with the predictions of the model. First, both when considering the employment of less educated workers as well as the total employment impact (last column of Table 2) we estimate a positive and significant productivity effect of imputed immigration and offshoring. An increase of one standard deviation in the ease of offshoring increases the total employment of less educated workers by 2% and increases total employment by 1.53%. An increase in the ease of immigration of one standard deviation increases employment of less educated workers by close to 1% and total employment by 1.25%. These productivity effects together with the effects on shares imply that offshoring has a null effect on employment of less educated natives, while immigration actually increases this employment by 1.2 to 1.3% (coefficients in the first column of Table 2). Moreover, while increased offshoring has a negative effect on employment of less educated immigrants (-2.75% for one standard deviation, but only in the estimates that use less educated workers), an increase in immigration does not affect total offshore employment (the productivity effect cancels out the negative share effect). Lastly, increased ease of offshoring and immigration significantly increase the employment of offshore workers and the employment of immigrants, respectively.

Interestingly, the presence of such a productivity effect due to immigration and offshoring, as predicted by our model, implies that even taken together these two forms of globalization of labor have not harmed native employment in the manufacturing industries that have been most exposed to them. To the contrary, allowing these industries to save on the tasks supplied by immigrants and offshore workers has promoted an expansion of these industries relative to others and has ultimately led to increased demand for native workers, relative to a scenario in which all tasks were performed by natives. Using the estimates in Table 2 for all workers, we can also gauge the magnitude of these effects: an industry whose ease of offshoring and ease of immigration increased by 2 standard deviations above the average (which would be a relatively large increase in globalization) would have experienced employment growth of 2-3% above average growth over the 2000-2007 period. This is a significant effect, particularly if we keep in mind that manufacturing employment actually decreased over this period.

5.3 Effects on Average Skill Intensity

Our model also carries predictions regarding the effect of increased offshoring and immigration on the average task "index" performed by natives and immigrants. To make these predictions empirically operational we have followed the lead of previous empirical studies (Blinder, 2007; Jensen and Kletzer, 2007; Peri and Sparber, 2009) that have indicated that tasks that intensively use cognitive-communication and non-routine skills are harder to offshore and, furthermore, that immigrants have a comparative disadvantage (lower productivity) in performing them. Similarly, we follow the literature (Levy and Murnane, 2006; Becker, Ekholm and Muendler, 2007; Peri and Sparber, 2009) that indicates that jobs that are more intensive in routine and manual tasks are easier to offshore and immigrants have higher productivity in them. Hence, as described in section 4 above, we construct the averages I_D and I_M for each industry and for domestic and immigrant workers separately. Thus, the distribution of workers across tasks is based on the task-skill content of each occupation, as assessed by O*NET, and on the distribution of workers across occupations within industries, as revealed in the American Community Survey data. We then run the following regressions:

$$I_{Dst} = \phi_s^D + \phi_t^D + d_{DO}(o_{st}) + d_{DI}(m_{st}) + \varepsilon_{st}^D \tag{22}$$

$$I_{Mst} = \phi_s^M + \phi_t^M + d_{MO}(o_{st}) + d_{MI}(m_{st}) + \varepsilon_{st}^M \tag{23}$$

where the explanatory variables are the share of offshore employment, o_{st}, and the share of immigrant employment, m_{st}, and the dependent variables are the average task indices. Both task indices and shares are calculated for workers with a high school degree or less. We estimate the effect on the average skill index, in Table 3, by 2SLS using the imputed offshoring and immigration indices (described in section 4.3) as instruments for the shares o_{st} and m_{st}. Empirically, then, we observe the average intensity of tasks used by workers in an industry where we have ranked those tasks on a zero to one interval according to the index I, which increases as the cognitive-non-routine intensity grows and decreases as the manual-routine intensity grows. As a result, if the costs of offshoring and the inverse productivity of immigrants are positively correlated with this index then the predictions of the model can be tested using this index.

Table 3 focuses only on the effects on the summary indices I_D and I_M. We have also performed analysis of the effect on each index separately (communication, cognitive, manual, routine) obtaining results consistent with those described below. However, sometimes the results using individual indices are not statistically significant. Since the index is a latent variable, combining the information from the five variables described in section 4.2 may improve the fit with the theoretical model, hence the stronger significance of the results. The method of estimation is 2SLS, using imputed offshoring and immigration as an instrument for the share of offshore employment and for the share of immigrant employment. The first stage is only moderately strong, as the F-test of the instruments is 8.75 for the share of offshore employment and 10.79 for the share of immigrant workers. The first column in Table 3 shows a positive effect of offshoring on the skill-index of natives but a negative effect of immigration on the skill-index of natives. Neither effect, however, is significant. The second column shows the opposite effect with respect to the index of immigrants: increased offshoring decreases the average skill index of immigrants (-0.07) while an increase in immigration increases the average skill index of immigrants (+0.20). This time the effects are significant. In conformance with the model, an increase in the share of offshore employment has opposing effects on the average index of natives (increased) and immigrants (decreased). Offshored jobs place a wedge in the skill-index between jobs performed by natives and those performed by immigrants. In contrast, an increase in the ease of immigration has a positive effect on the average index of immigrants (pushing them to more complex tasks) and a negative and not significant effect on the index of natives. This is consistent with the model in which offshore workers take the "intermediate" tasks so that an increase in immigrant employment shares will increase the average skill index of immigrants, pushing it closer to that of natives, but have no effect on the average native skill index. The last column reports the effect of increased immigration and offshoring on *the difference* in the average (native-immigrant) index. As predicted by the model, and confirming the results in columns 1 and 2, a higher share of offshore employment increases the difference in the average native-immigrant skill index ($I_D - I_M$). In contrast, an increase in the share of immigrants is associated with a decrease in that index. Both effects are significant and, once again, in line with the idea that increased offshoring will polarize the specialization of natives and immigrants, while increased immigration will push the average immigrant task closer to that of natives.

5.4 Extensions and Checks

5.4.1 Horizontal versus Vertical Offshoring

A recent study by Harrison and McMillan (2008) has emphasized that in order to correctly identify the effects of offshore employment on domestic employment one needs to distinguish between horizontal and vertical offshoring. In particular, increased horizontal offshoring, in which companies move production abroad to serve the local market (and reduce or eliminate trade costs) hurts domestic jobs in their analysis. Combined with the fact that horizontal offshoring is not explicitly captured by our model, this suggests effort should be made to eliminate this effect from our data. On the other hand, vertical offshoring, in which companies transfer abroad some stages of production and then re-import the intermediate goods, corresponds more closely to our model of tasks offshoring. This form of offshoring is found to be beneficial to domestic employment by Harrison and McMillan (2008).

In our sample we are able to identify those industries for which re-exporting to the headquarters, as opposed to generating purely local sales, is the more important activity for the affiliates. Using the BEA data we calculate the aggregate value of exports from affiliates to headquarters as well as the total value of local sales of affiliates. Then we consider as vertically integrated those industries that exhibit an import-to-local-sales ratio larger than the median value for manufacturing (0.2). Table 4 reports the effects of ease of immigration and ease of offshoring when we limit the sample to vertical offshoring, as measured in this way. This reduces the sample to 168 observations. The patterns identified in Table 4 reproduce the aggregate patterns from the previous section, with some differences. First, for these industries the positive overall employment (productivity) effect of offshoring (last column) is stronger than in Table 2 and stronger than for immigration. Second, this strong overall productivity effect produces a positive and significant (rather than a null) effect of offshoring on native employment, a result that was not observed when considering all manufacturing industries. Third, the effects of increasing ease of immigration are smaller. The corresponding estimates for industries that practice horizontal offshoring, i.e. are defined by a low import-to-local-sales ratio (not reported) show instead a weak (not significant) productivity effect due to offshoring and a small negative effect (also not significant) on native employment. Hence, and in accordance with our model, the productivity effect seems to proceed from an international segmentation of productive tasks motivated by the desire to lower production costs, as evidenced by the results for the case of vertical (rather than horizontal) offshoring.

Finally, Table 5 shows the effects on the average task indices for natives and immigrants when we split the sample between industries that practice vertical or horizontal offshoring. The estimates in the upper part of the table, referring to industries engaged in vertical offshoring, are similar to those of Table 3. There is, possibly, an even larger effect due to vertical offshoring (relative to all offshoring) in increasing the difference between the average task index of natives and immigrants, while the effect of increased ease of immigration is as before.

This confirms that vertically integrated firms tend to offshore intermediate tasks, assigning to natives the most complex tasks and to immigrants the most routine ones. In contrast, this pattern is not present across industries that are engaged in horizontal offshoring. These results confirm those of Harrison and McMillan (2008) while also confirming that the mechanism described in our model is more akin to the process of vertical offshoring.

5.4.2 Wage Effects

Our model and empirical strategy have examined employment across industries in order to capture the productivity consequences of immigration and offshoring. However, in the presence of imperfect mobility of workers, or barriers to transferring skills from one industry to another, a portion of the industry-specific effects of immigration and offshoring could be captured by wage (rather than employment) differentials. While the American labor force is highly mobile geographically, as well as across industries, in the short run wages may not be perfectly equalized.

To address this issue we perform three checks, shown in Table 6. In that table we focus on the effects on native employment among less educated workers as the variable of interest. In specification (2) we estimate the effects of variation in the ease of offshoring and the ease of immigration on native employment while controlling for native wages (in the industry-year)[12]. The data on wages by industry can be constructed from individual data available from the IPUMS ACS 2000-2007 (Ruggles et al, 2008). While this regression should identify the impact on employment, once we control for wage changes, wages are endogenous in the model and this may induce bias in the estimates. Nevertheless the estimated coefficients on native employment are very similar to those obtained in the basic specification: they show a positive and significant effect of ease of immigration, and no effect of ease of offshoring, on native employment. An alternative method is to check directly whether industry wages are affected by offshoring and immigration by running a specification like 18, except using the average wage of less educated natives (rather than their employment) in the industry as the dependent variable. This is what we do in specification (3). Finally, we can run regression 18 using as the dependent variable the total labor income to less educated workers in the industry (the product of the average wage times employment) and interpret the coefficients as the effects on total native labor demand. This is what we do in specification (4). The results are quite clear and consistent. They show a positive effect of ease of immigration on native labor demand and no effect of ease of offshoring on it. The positive effect of immigration is reflected in a positive employment effect and no wage effect, while offshoring has neither employment nor wage effects on natives. These results confirm that the assumption of inter-sector mobility of workers is reasonable and that the cross-sector productivity effects take the form of employment (rather than wage) differentials.

[12] Specification (1) in Table 6 reports the reference estimates that are identical to those in Table 2 column 1.

6 Conclusions

This paper analyzes the effect of increased globalization, in the form of less-costly offshoring and increased immigration into the U.S. labor market, on employment in U.S. manufacturing. As mentioned in the introduction there are very few attempts to combine analyses of immigration and offshoring on labor markets. However, analyzing each of these in isolation misses the possibility that hiring immigrants or offshoring productive tasks, rather than hiring a native worker, may be alternatives that are simultaneously available to firms. Here we develop a simple extension to the model by Grossman and Rossi-Hansberg (2008) in order to analyze the allocation of productive tasks (arrayed from the most manual and routine-intensive to the most cognitive and non-routine intensive) between native, immigrant and offshore workers. We test the predictions of the model on U.S. data from 58 manufacturing industries over the years 2000-2007. The results are interesting and point to an interpretation that is consistent with our model. First, less educated immigrants are employed in the more manual-routine tasks and on average do not compete within the occupations in which the bulk of native workers are employed, which tend to be more non-routine and cognitive intensive. In fact, immigrants compete more with offshore workers. This implies that increased immigration induces firms to move production from offshore workers to immigrants. At the same time, and as predicted by our model, immigration seems to generate cost-savings for firms, and thus a corresponding increase in productivity, so that its aggregate effect on the level of low skilled native employment is positive.

Similarly, we find that increased offshoring reduces the share of native employment in an industry while, at the same time, also stimulating overall industry employment via the productivity effect such that offshoring has no aggregate impact on the level of native employment. Thus, in spite of the widely held belief that immigrants and offshoring are reducing the job opportunities of natives, we instead find that industries with a larger increase in global exposure (through offshoring and immigration) fared better than those with less exposure in terms of native employment growth. One important qualification is that both the productivity effect and the shift of native workers towards more complex tasks are found to be stronger in those industries that are engaged in vertical offshoring rather than horizontal offshoring. This corresponds to the structure of our model which focuses on the international fragmentation of different stages (tasks) of production by cost-minimizing, vertically integrated firms.

References

Antecol, Heather, Deborah A. Cobb-Clark and Stephen J. Trejo, (2001). "Immigration Policy and the Skills of Immigrants to Australia, Canada, and the United States," Claremont Colleges Working Papers 2001-26, Claremont Colleges.

Antras, Pol (2003) "Firms, Contracts, and Trade Structure" *Quarterly Journal of Economics,* Vol. 118 No. 4, pp. 1375-1418

Barba Navaretti, Giorgio, Giuseppe Bertola and Alessandro Sembenelli (2008) "Offshoring and Immigrant Employment - Firm-Level Theory and Evidence" Centro Studi Luca d'Agliano Development Studies Working Paper No. 245.

Becker, Sasha O., Ekholm, Karolina and Marc-Andreas Muendler (2009) "Offshoring and the Onshore Composition of Tasks and Skills" EFIGE Working Paper.

Blinder, Alan (2007) "How Many U.S. Jobs Might Be Offshorable?" CEPS Working Paper No. 142.

Borjas, George J. (2003) "The Labor Demand Curve is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market" *Quarterly Journal of Economics*, CXVIII (4), 1335-1374.

Butcher, Kristin F. and John DiNardo (2002) "The Immigrant and native-born wage distributions: Evidence from United States censuses," *Industrial and Labor Relations Review*, ILR Review, ILR School, Cornell University, vol. 56(1), pages 97-121.

Card, David (2001) "Immigrant Inflows, Native Outflows, and the Local labor Market Impacts of Higher Immigration" *Journal of Labor Economics*, XIX (2001), 22-64.

Card, David & John DiNardo, (2000). "Do Immigrant Inflows Lead to Native Outflows?," *American Economic Review*, American Economic Association, vol. 90(2), pages 360-367.

Chiswick Barry R., Yew Liang Lee and Paul W. Miller (2005) "Immigrant Earnings: A Longitudinal Analysis," Review of Income and Wealth, Blackwell Publishing, vol. 51(4), pages 485-503.

Crino' Rosario (2010) "Service Offshoring and White-Collar Employment" The Review of Economic Studies, forthcoming (DOI: 10.1111/j.1467-937X.2009.00586.x).

Ebenstein, Avraham, Harrison, Ann, McMillan, Margaret and Shannon Phillips (2009) "Estimating the Impact of Trade and Offshoring on American Workers Using the Current Population Surveys", NBER Working Paper No. 15107.

Feenstra, Robert, Romalis, John and Peter K. Schott (2002) "U.S. Imports, Exports and Tariff Data" The Center for International Data, UC Davis

Feenstra, Robert and Gordon Hanson (1996) "Foreign Investment, Outsourcing and Relative Wages" in R.C. Feenstra, G.M. Grossman and D.A. Irwin, eds., *The Political Economy of Trade Policy: Papers in Honor of Jagdish Bhagwati*, Cambride, MA: MIT Press

Feenstra, Robert and Gordon Hanson (1999) "The Impact of Outsourcing and High Technology Capital on Wages: Estimates for the United States 1979-1990" *Quarterly Journal of Economics.*

Grossman, Gene and Esteban Rossi-Hansberg (2008) "Trading Tasks: A Simple Theory of Offshoring." *American Economic Review*, 98 (5), pp. 1978-1997.

Harrison, Ann and Margaret McMillan (2008) "Offshoring Jobs? Multinational and U.S. Manufacturing Employment" NBER Working Paper.

Hummels, David, Rasmus Jorgenson, Jackob Munch and Chong Xiang (2010) "Wage and Employment Effects of Outsourcing: Evidence from Danish Matched Worker-Firm Data" Manuscript, Purdue University, May 2010.

Jensen, Bradford J. and Lori Kletzer (2007) "Measuring Tradable Services and the Task Content of Offshorable Services Jobs" Manuscript, University of California, Santa Cruz.

Jones, Ronald W. and Henryk Kierzkowski (1990) "The Role of Services in Production and International Trade: A Theoretical Framework" in R. Jones and A. Kruegers, eds., *The Political Economy of International Trade: Essays in Honor of Robert E. Baldwin*, Oxford: Basil Blackwell

Levy, Frank and Richard J. Murnane (2006) "How Computerized Work and Globalization Shape Human Skill Demands" First International Conference on Globalization and Learning Conference Volume.

Mataloni, Raymond J. and Daniel R. Yorgason (2002) "Operations of U.S. Multinational Companies" Survey of Current Business March 2002, Bureau of Economic Analysis.

Olney William W. (2009) "“Offshoring, Immigration, and the Native Wage Distribution” Manuscript, University of Colorado, Boulder, Social Science Research Network (SSRN) Working Paper No. 1365288, September 2009.

Ottaviano Gianmarco I.P. and Giovanni Peri (2008) "Immigration and National Wages: Clarifying the Theory and the Empirics” National Bureau of Economic Research Working Paper #14188, July 2008.

Peri, Giovanni (2009) "The Effect of Immigration on Productivity: Evidence from U.S. states" NBER Working Paper, November 2009.

Peri, Giovanni and Chad Sparber (2009) "Task Specialization, Immigration and Wages", *American Economic Journal*: *Applied Economics,* Vol 1:3.

Ruggles, Steven , Matthew Sobek, Trent Alexander, Catherine A. Fitch, Ronald Goeken, Patricia Kelly Hall, Miriam King, and Chad Ronnander (2008). *Integrated Public Use Microdata Series*: Version 3.0 [Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor], 2004. http://www.ipums.org.

Wright, Greg C. (2010) "Revisiting the Employment Impact of Offshoring", UC Davis Dissertation

A Appendix: Endogenous Native Wages

In the main text we have assumed that each sector is not large enough to affect the domestic wage w. Here we discuss how w would react if such an assumption did not hold.

Intuition is better served by focusing on the simple case of an economy with only two sectors indexed $s = i, j$. In each sector immigrant, offshore and native labor demands are given by expressions like (9) with corresponding price indices like (10). The two sectors may differ in terms of offshoring and immigration costs, technological parameters, demand parameters, goods prices, and specific factor endowments. As in the model in the main text, goods prices p_Y^s are exogenously determined in international markets and foreign workers are in infinitely elastic supply at foreign wage w^*. Their utility maximizing decisions determine whether they are employed as immigrants or offshore workers in the two sectors, or in some other non-modeled occupation abroad. In contrast to the model in the main text, native workers are now in fixed supply $\overline{N}_D$ and their allocation between sectors is determined, together with their wage w, by the clearing of the native labor market: the sum of the two sectors' native labor demands has to equal native labor supply ($N_D^i + N_D^j = \overline{N}_D$). The equilibrium native wage then determines immigrant and offshore employment levels in the two sectors, N_M^i and N_O^j, through the corresponding labor demands as in (9).

Specifically, given (9), (10) and (8), native labor demand in sector s can be rewritten as

$$w = (N_D^s)^{-(1-\alpha^s)} (a_L^s)^{-\alpha^s} (1 - I_{NO}^s)^{1-\alpha^s} [\Omega^s(I_{MO}^s, I_{NO}^s)]^{(\sigma^s-1)(1-\alpha^s)-\alpha^s} (B^s)^{1-\alpha^s}$$

with $B^s = (\alpha p_Y^s A^s)^{\frac{1}{1-\alpha}} H^s$ and

$$\Omega^s(I_{MO}^s, I_{NO}^s) = \left\{ \int_0^{I_{MO}^s} \left[\frac{\delta^s \tau^s(i)}{\beta^s t^s(I_{NO})} \right]^{1-\sigma^s} di + \int_{I_{MO}^s}^{I_{NO}^s} \left[\frac{t^s(i)}{t^s(I_{NO}^s)} \right]^{1-\sigma^s} di + (1 - I_{NO}^s) \right\}^{\frac{1}{1-\sigma^s}} .$$

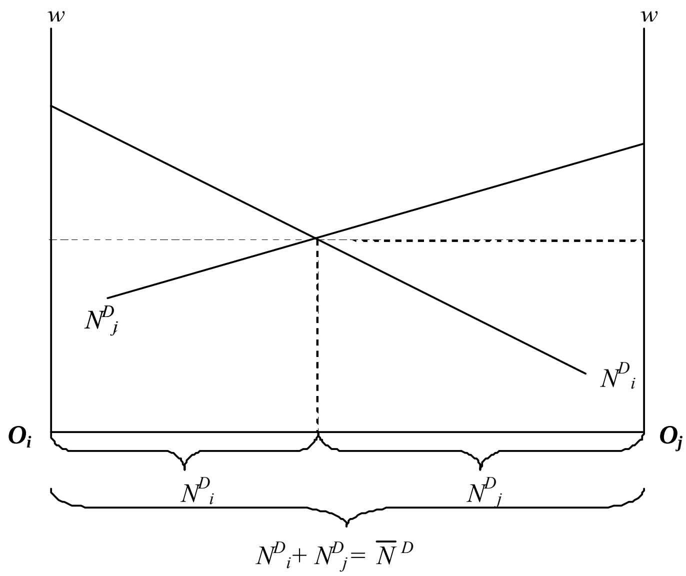


Figure 2: Endogenous wage determination

The equilibrium of the native labor market is represented in Figure 2. This depicts a standard box diagram in which the horizontal dimension measures native labor supply $\overline{N}_D$, the vertical dimension measures the native wage, and (log-linearized) labor demands in the two sectors are depicted as decreasing in the native wage from their respective origins O_i and O_j. Accordingly, the equilibrium allocation of native workers between the two sectors and the corresponding common wage are to be found at the crossing of the two labor demand schedules where, by graphical construction, the native labor market clears. Figure 2 can be used to assess the effects of changes in migration and offshoring costs on the wage of native workers as well as on their sectoral allocation. For example, under our working assumptions, a fall in migration costs in sector i (lower δ^i) does not affect I^i_{NO} and increases I^i_{MO}. This leads to a fall in $\Omega^i(I^i_{MO}, I^i_{NO})$. What then happens in the figure depends on whether $\left(\sigma^i - 1\right)$ is larger or smaller than $\alpha^i / \left(1 - \alpha^i\right)$, with the former measuring the substitutability of tasks and the latter the importance of the task bundle for final production. When tasks are not easily substitutable (small σ^i) and the task bundle contributes a lot to final production (large α^i), so that $\left(\sigma^i - 1\right) < \alpha^i / \left(1 - \alpha^i\right)$, a lower $\Omega^i(I^i_{MO}, I^i_{NO})$ shifts the labor demand schedule of sector i upwards increasing the wage of natives and their employment in sector i. The opposite happens when tasks are easily substitutable (larger σ^i) and the task bundle does not contribute much to final production (small α^i), so that $\left(\sigma^i - 1\right) > \alpha^i / \left(1 - \alpha^i\right)$.

The effect of lower offshoring costs is, instead, more complex as a fall in β^i not only decreases I^i_{MO} but also increases I^i_{NO}, thus reducing $\Omega^i(I^i_{MO}, I^i_{NO})$. However, additionally, the native labor demand schedule shifts upward when tasks are not easily substitutable (small σ^i) and the task bundle contributes a lot to final production (large α^i), and vice-versa. So, whether easier migration and easier offshoring lead to higher employment and a higher native wage is, in the end, an empirical question that depends on sectoral characteristics.

B Appendix: No Discrimination between Natives and Immigrants

In the model presented in the main text, the productivity effect due to easier immigration stems from the fact that falling costs of immigration create rents for domestic firms $c_D - c_M(i) = wa_L - w^*\delta\tau(i)a_L$ per unit task for $i \in [0, I_{MO}]$, just as the productivity effect due to easier offshoring stems from the fact that falling costs of offshoring create rents for domestic firms $c_D - c_O(i) = wa_L - w^*\beta t(i)a_L$ per unit task for $i \in [I_{MO}, I_{NO}]$. These effects arise because we have assumed that firms can discriminate between immigrants and natives since they know the wage w^* in the country where immigrants come from as well as their common migration cost δ.

This ability to discriminate is crucial for the productivity effect due to easier immigration to materialize. The argument can be spelled out following Grossman and Rossi-Hansberg (2008). In discussing the different effects of easier offshoring and easier immigration, these authors assume, as we also do, that foreign workers can stay in the foreign country and earn the wage w^* or can move to the home country, at the cost of a fraction of their working time, and earn the wage $\widetilde{w}$. To avoid the existence of corner outcomes with no migration or infinite migration, they also assume that foreign workers are heterogeneous in terms of their moving costs. Specifically, a foreign worker z captures only a fraction $1/\delta\mu(z)$ of $\widetilde{w}$ when she moves to the home country. Without loss of generality, foreign workers can be indexed in increasing order of moving costs so that $\mu'(z) > 0$. Moreover, Grossman and Rossi-Hansberg (2008) assume that immigrants are as productive as natives and that domestic firms are not able to discriminate between natives and immigrants nor between immigrants with different moving costs.

In terms of our notation, all these assumptions imply $\tau(i) = 1$ and $\widetilde{w} = w$. They also imply that the marginal immigrant Z earns the same net income in both locations so that $w = w^*\delta\mu(Z)$. This replaces our condition $\widetilde{w} = w^*\delta$ in the main text and uniquely determines Z, which in turn determines the number of immigrants given some distribution of foreign workers across moving costs.

To sum up, when firms are unable to discriminate, native, immigrant and offshore marginal costs become $c_D = wa_L$, $c_M(i) = w^*\delta\mu(Z)a_L = wa_L$ and $c_O(i) = w^*\beta t(i)a_L$, respectively. Accordingly, an inframarginal immigrant $z < Z$ earns rents $w - w^*\delta\mu(z)$. This implies that as the common immigration cost δ falls, additional rents are created at both the intensive and the extensive task margins. Accordingly, new immigrants enter the home country (Z increases). More rents also accrue to the incumbent immigrants, but not to the home firms whose profitability, therefore, does not change. "The difference between falling costs of offshoring and falling costs of immigration is that the former create rents for domestic firms ... whereas the latter create rents for the immigrants" (Grossman and Rossi-Hansberg, 2008).

In contrast, when firms can discriminate between natives and immigrants they fully appropriate the rents.

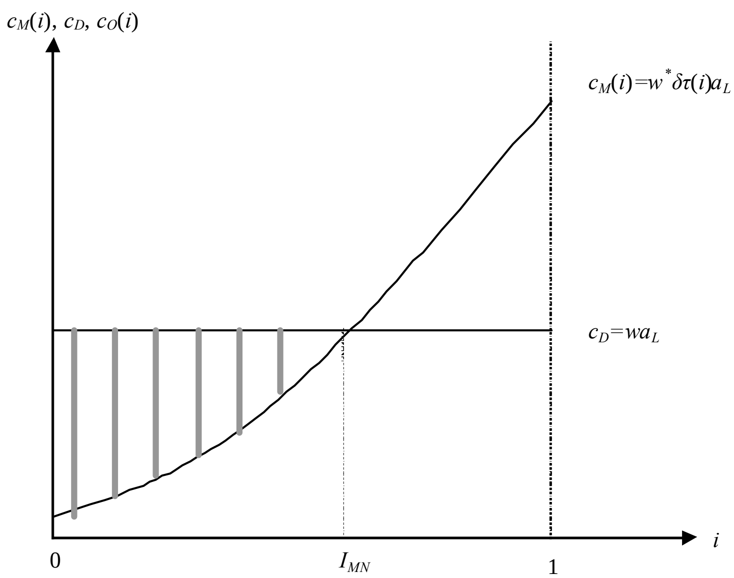


Figure 3: Immigration rents

Ruling out offshoring for simplicity, in our model the rents per unit task when cheaper immigrants are employed instead of natives amount to

$$c_D - c_M(i) = wa_L - w^*\delta\tau(i)a_L$$

so that total rents correspond to the striped area in Figure 3. Being entirely appropriated by firms, these rents are the source of the productivity effect due to immigration. Note that our assumption of perfect discrimination is not crucial in order to generate a productivity effect due to immigration—as long as there is any degree of discrimination some rent is generated.

C Appendix: Task Data

By merging occupation-specific task values with individuals across years, we are able to obtain these task-intensity measures for natives and immigrants by education level in each state over time. The U.S. Department of Labor's *O*NET* abilities survey provides information on the characteristics of occupations. This dataset assigns numerical values to describe the importance of 52 distinct employee abilities (skills) required by each occupation[13] as well as 40 distinct employee "Activities" (tasks). We then re-scale each skill and task variable so that it equals the percentile score in 2000 (between 0 and 1) representing the relative importance of that skill-task among all workers in 2000. For instance, an occupation with a score of 0.02 for a specific skill

[13] Classified using the Standard Occupation Classification (SOC).

indicates that only 2 percent of workers in the U.S. in 2000 were supplying that skill less intensively. We then assign these *O*NET* percentile scores to individuals from 2000 to 2007 using the ACS variable *occ1990*, which provides an occupational crosswalk over time. The indices "cognitive", "communication" and "manual" are constructed by averaging the Ability variables. Specifically, "cognitive" includes 12 variables classified as "Cognitive and Analytical", "communication" includes four variables capturing written and oral expression and understanding, and "manual" includes 19 variables capturing dexterity, strength and coordination. Finally, the variable "interactive" includes three activities that emphasize person-to-person interaction while "routine" includes four activities that emphasize the importance of doing routine tasks.

D Appendix: Construction of Offshoring Cost Variable

We use an updated version of the offshoring measure described in Feenstra and Hanson (1999), defined formally for any industry k purchasing inputs j as:

$$\frac{\sum_j (\text{industry k purchases of good j})\left(\frac{\text{intermediate imports of good j}}{\text{total domestic intermediates consumption of j}}\right)}{\sum_j (\text{industry k purchases of good j})}$$

Here, we need to separate imports of final goods from imports of intermediates in constructing the ratio in the numerator. The data source for these imports and their classifications is Feenstra et al (2002). While the measure itself is constructed at the 4-digit North American Industry Classification System (NAICS) level, within these NAICS categories are more disaggregate Harmonized System (HS) categories, and these are associated with end-use codes that characterize imports according to their final use. In short, these end-use codes are used by the BEA in generating the National Income and Product Accounts, and here we use them to select only goods intended for use as intermediates (see Wright, 2010 for more details).

Next, domestic consumption of intermediates by industry is constructed as imports of intermediates minus exports of intermediates (restricted in the same manner as imports) plus domestic shipments of intermediates. This final value needs a brief explanation. Rather than use the total domestic shipments of industry j, we instead apportioned those domestic shipments into various HS products by assuming that the share of domestic shipments for each HS product within industry j equals the share of U.S. exports in that HS product and industry. We then sum domestic shipments over just those HS products that are also intermediate inputs (as defined by their end-use classification).

The other component of the measure consists of industry input purchases, which are obtained from the Materials Purchases tables in the1997, 2002 and 2007 Economic Censuses, with values in intervening years obtained via interpolation between these. Finally, the 4-digit NAICS measure is merged to BEA industries using a concordance created by the authors.

E Appendix: Construction of Offshore Employment Variables

Our measures of offshore employment draw from data on the employment and exports of affiliates of U.S. multinational corporations (MNCs) from the BEA, U.S. Direct Investment Abroad: Operations of U.S. Parent Companies and Their Foreign Affiliates, 2000-2007. According to Mataloni and Yorgason (2006), MNC output in 1999 accounted for around half of manufacturing output and 63 percent of manufacturing exports. We also restrict the sample further by using only majority-owned, non-bank MNC affiliates, however this restriction is minor. The quality of this data has been investigated by Harrison and McMillan (2008) using inward FDI data from Germany and Sweden, and while the authors find some discrepancies, these seem to be at least somewhat explained by differences in the timing of reporting.

Specifically, we collect information on multinational affiliate employment by industry and year (58 manufacturing industries over 2000-2007), imports from MNC affiliates to their parents by industry and year, and imports from non-affiliates to U.S. MNCs by industry and year. Affiliate employment is also available separately for "Managerial, professional, and technical employees" and "All other employees", which we use to distinguish high- and low-skill affiliate workers.

In order to calculate total offshore employment due to U.S. MNC offshoring, we begin with the actual employment of multinational affiliates and the aggregate exports of those affiliates to the multinational parent firm. We then take the ratio of affiliate employment to affiliate exports for each industry and year. This ratio is then set aside as a scaling factor, or an export labor requirement, for each industry and year. Next, we multiply U.S. parent firm imports from non-affiliates with respect to this scaling factor and the result is our imputed arm's length offshore employment. This is then combined with the affiliate employment values. As mentioned in the text above, this value assumes an equivalent labor requirement per unit of exports for affiliates and non-affiliates.

Table 1:

Effects on the shares of natives, immigrants and offshore workers

58 manufacturing industries, 8 years: 2000-2007

Dependent variable: **Explanatory variable:**	**Percentage of US-nationals in industry employment**	**Percentage of immigrants in employment**	**Percentage of offshore employees in employment**
	(1)	**(2)**	**(3)**
	Only less educated workers (High school degree or less)		
Imputed (gravity-based) offshoring	**-0.66**** **(0.20)**	**-0.23**** **(0.10)**	**0.90**** **(0.24)**
Imputed (shift-share) immigration	0.02 (0.21)	**0.34**** **(0.09)**	**-0.36*** **(0.21)**
	All Workers		
Imputed (gravity-based) offshoring	**-0.59**** **(0.21)**	**-0.16**** **(0.08)**	**0.75**** **(0.24)**
Imputed (shift-share) immigration	0.04 (0.20)	**0.30**** **(0.08)**	**-0.30** **(0.20)**
Observations	464	464	464
Industry fixed effects	Yes	Yes	Yes

Note: The dependent variable in each regression is specified in the first row. The explanatory variables are specified in the first column. The method of estimation is Ordinary Least Squares; Imputed offshoring is calculated as the predicted share of intermediate imported in the industry, using the Feenstra and Hanson (1999) definition, and a gravity regression with country-specific offshoring costs. Imputed immigration is calculated using the initial employment composition in each industry by country and overall population growth by nationality in the US. Both indices are divided by their standard deviation in the sample so that a change in one unit of the explanatory variable corresponds to a change of one standard deviation. Heteroskedasticity-robust standard errors are reported in parentheses. ****=significant at the 5% level**

Table 2

Effects on the employment of natives, immigrants and offshore workers

58 manufacturing industries, 8 years: 2000-2007

Dependent variable: **Explanatory variable:**	**Total employment of US-born (1/100 log points)**	**Total employment of immigrants (1/100 log points)**	**Total offshore employment (1/100 log points)**	**Total employment, native plus immigrants plus offshore (1/100 log points)**
	(1)	**(2)**	**(3)**	**(4)**
		Only less educated workers (High school degree or less)		
Imputed (gravity-based) offshoring	-0.20	**-2.75***	**0.52****	**2.03****
	(0.74)	**(1.50)**	**(0.12)**	**(0.69)**
Imputed (shift-share) immigration	**1.30****	1.11	0.97	**0.96***
	(0.58)	(0.90)	(1.20)	**(0.54)**
		All Workers		
Imputed (gravity-based) offshoring	0.43	0.01	**5.22***	**1.53****
	(0.60)	(0.10)	**(1.27)**	**(0.57)**
Imputed (shift-share) immigration	**1.17****	**2.37****	0.97	**1.25****
	(0.53)	**(0.76)**	(1.20)	**(0.43)**
Observations	464	464	464	464
Industry fixed effects	Yes	Yes	Yes	Yes

Note: The dependent variable in each regression is specified in the first row. The explanatory variables are specified in the first column. The method of estimation is Ordinary Least Squares; Imputed offshoring is calculated as the predicted share of intermediate imported in the industry, using the Feenstra and Hanson (1999) definition, and a gravity regression with country-specific offshoring costs. Imputed immigration is calculated using initial employment composition in an industry by country and overall population growth by nationality in the US. Both indices are divided by their standard deviation in the sample so that a change in one unit of the explanatory variable corresponds to a change of one standard deviation. Heteroskedasticity-robust standard errors are reported in parentheses. ****=significant at the 5% level**

Table 3:

Effects on average task intensity of natives and immigrants.

2SLS estimates using imputed offshoring and immigration as IV for shares

58 manufacturing industries, 8 years: 2000-2007.

Dependent variable: **Explanatory Variable:**	**Average Skill Index "I_D" for less educated Natives**	**Average Skill Index "I_M" for less educated Immigrants**	**Average Skill Index "I" difference between less educated (Natives- Immigrants)**
Share of Immigrants in employment	-0.08 (0.06)	0.20* (0.10)	**-0.27**** **(0.12)**
Share of Offshore employment	0.03 (0.02)	-0.07* (0.035)	**0.10**** **(0.04)**
Observations	464	464	464
Industry Effects	Yes	Yes	Yes
Year effects	Yes	Yes	Yes

Note: The dependent variable in each column is the average (employment-weighted) skill index standardized between 0 and 100. In the first column it is measured for less educated native workers and in column 2 for less educated immigrant workers. In Column 3 it is the difference of the two. The index is constructed by averaging five indicators in order to produce a variable whose range of variation is one unit, that increases with the intensity of cognitive-communication-routine type of tasks and decreases with the intensity of manual-routine tasks. The explanatory variables are the share of immigrant and offshore low-skilled workers. The estimation method is 2SLS using the indices of offshoring and of immigration as IV for the shares in employment. ****=significant at the 5% level**

Table 4
Effects on employment: Vertical offshoring industries
2SLS estimates using imputed offshoring and immigration as IV for shares

Dependent variable: **Explanatory variable:**	**Employment of US-Born**	**Employment of Immigrants**	**Offshore Employment**	**Employment Native plus Immigrants plus Offshore**
	(1)	**(2)**	**(3)**	**(4)**
		Effects on Shares		
Imputed (gravity-based) offshoring in non-OECD countries	**-0.88**** **(0.31)**	-0.03 (0.12)	0.23 (0.25)	**0**
Imputed (shift-share) immigration	0.52 (0.37)	**0.28**** **(0.10)**	-0.02 (0.23)	**0**
		Effects on Levels		
Imputed (gravity-based) offshoring shoring in non-OECD countries	**2.66**** **(0.82)**	-2.77 (2.02)	**3.44*** **(1.80)**	**2.63**** **(1.24)**
Imputed (shift-share) immigration	0.90 (0.80)	0.90 (1.33)	1.90 (1.22)	**1.56**** **(0.52)**
Observations	168	168	168	168
Industry fixed effects	Yes	Yes	Yes	Yes

Note: The dependent variable in the first two rows is the share of (respectively) US-born, immigrant and offshore workers among less educated in the industry-year. The dependent variable in the third and fourth row is the logarithmic employment of the corresponding groups by industry-year. The explanatory variables are specified in the first column. The method of estimation is Ordinary Least Squares; Imputed offshoring is calculated as the predicted share of intermediate imported in the industry, using the Feenstra and Hanson (1999) definition, and a gravity regression with country-specific offshoring costs. Imputed immigration is calculated using initial employment composition in an industry by country and overall population growth by nationality in the US. Both indices are divided by their standard deviation in the sample so that a change in one unit of the explanatory variable corresponds to a change of one standard deviation. Heteroskedasticity-robust standard errors are reported in parentheses. ****=significant at the 5% level**

Table 5

Effects on average task intensity: Horizontal versus Vertical offshoring industries

2SLS estimates using imputed offshoring and imputed immigration as IV for shares

Dependent variable: **Explanatory Variable:**	**Average Skill Index "I_D" for less educated Natives**	**Average Skill Index "I_M" for less educated Immigrants**	**Average Skill Index "I" difference between less educated (Natives- Immigrants)**
	2SLS estimates, Vertical Offshoring Industries		
Share of Immigrants in employment	-0.08 (0.06)	0.20* (0.10)	**-0.27**** **(0.12)**
Share of Offshore employment	0.03 (0.02)	**-0.08*** **(0.03)**	**0.11**** **(0.04)**
	2SLS estimates, Horizontal Offshoring Industries		
Share of Immigrants in employment	-0.08 (0.06)	0.20* (0.10)	**-0.27**** **(0.12)**
Share of Offshore employment	0.11 (0.22)	0.19 (0.58)	-0.08 (0.05)
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

Note: Variables and Specification as in table 3. We separate the estimates of the effect of immigrants and offshoring in industries with high level of import from affiliates relative to local sales of affiliates (Vertical offshoring), reported in the first and second row, from those with low level of import from affiliates relative to local sales (Horizontal offshoring), reported in the third and fourth row. The index is constructed by averaging five indicators in order to produce a variable whose range of variation is one unit, that increases with the intensity of cognitive-communication-routine type of tasks and decreases with the intensity of manual-routine tasks. The explanatory variables are the share of immigrant and offshore low-skilled workers. The estimation method is 2SLS using the indices of offshoring and of immigration as IV for the shares in employment. ****=significant at the 5% level**

Table 6
Focus on the demand for native labor

Dependent variable:	Total Employment of US Born (1/100 log points)	Total Employment of US Born (1/100 log points)	Average wages	Total Labor compensation of US born (1/100 log points)
Specification:	**Basic**	**Controlling for wage**		
	(1)	**(2)**	**(3)**	**(4)**
Imputed (gravity-based) offshoring	-0.20 (0.74)	0.21 (0.78)	-0.01 (0.21)	0.20 (0.80)
Imputed (shift-share) Immigration	**1.30**** **(0.58)**	**1.29**** **(0.57)**	0.01 (0.20)	**1.40**** **(0.61)**
Observations	464	464	464	464
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Other Controls	**NO**	Wages of natives	No	No

Note: The dependent variable in specifications (1) and (2) is employment of less educated US-born workers. In specification (3) it is the average wage of less educated US born workers and in specification (4) it is the total compensation of less educated US-born workers (wages*employment). The method of estimation is Ordinary Least Squares; Imputed offshoring is calculated as the predicted share of intermediate imported in the industry, using the Feenstra and Hanson (1999) definition, and a gravity regression with country-specific offshoring costs. Imputed immigration is calculated using initial employment composition in an industry by country and overall population growth by nationality in the US. Both indices are divided by their standard deviation in the sample so that a change in one unit of the explanatory variable corresponds to a change of one standard deviation. Heteroskedasticity-robust standard errors are reported in parentheses. ****=significant at the 5% level**

Figure 1

Offshore workers as a share of total (US + offshore employment) in 58 manufacturing industries

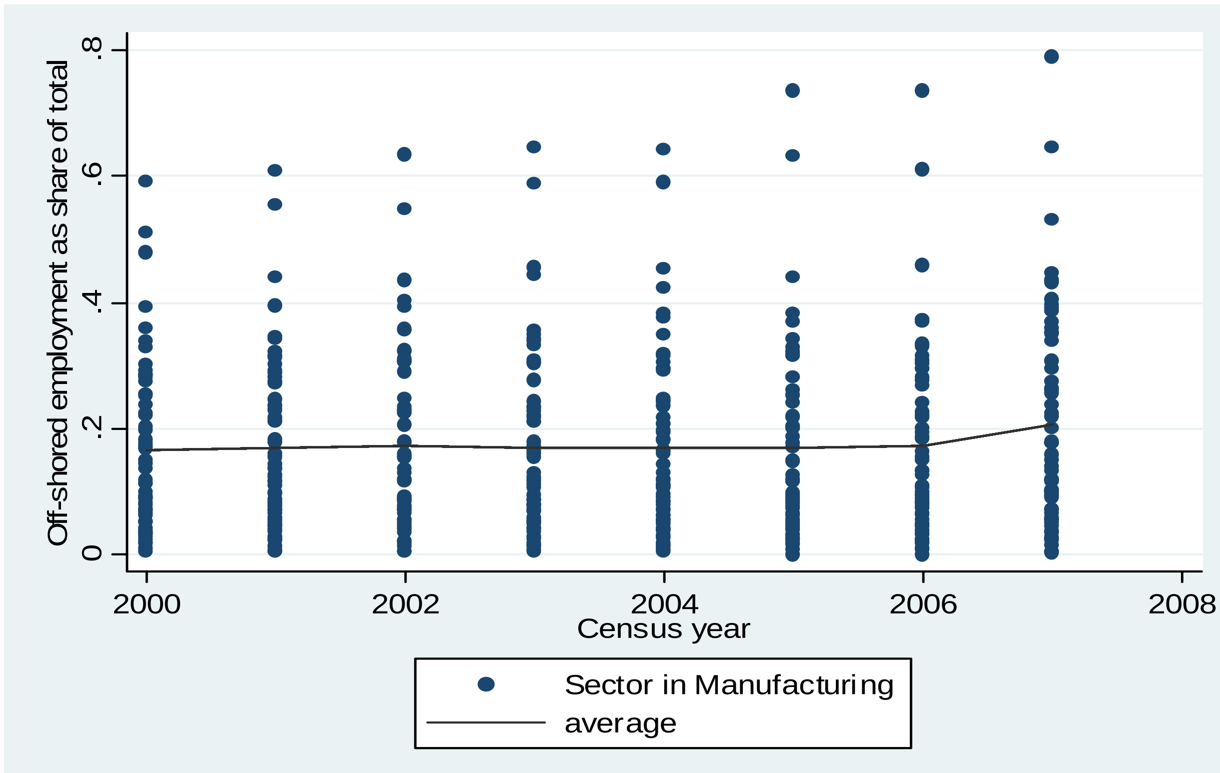


Figure 2

Immigrant workers as share of total (US + offshore employment) in 58 manufacturing industries

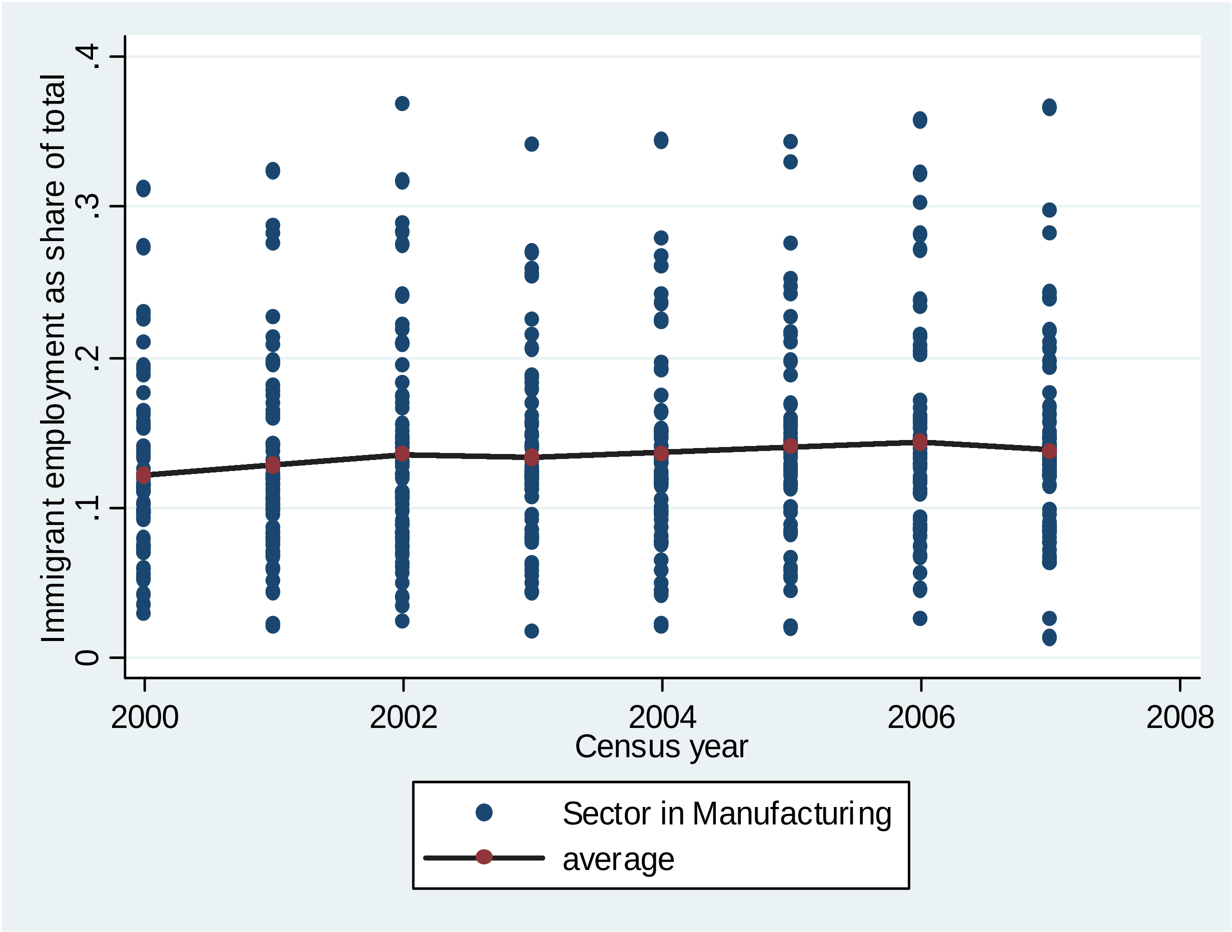


Figure 3
Average index for native workers with high school diploma or less (I_D)
58 industries, 8 years

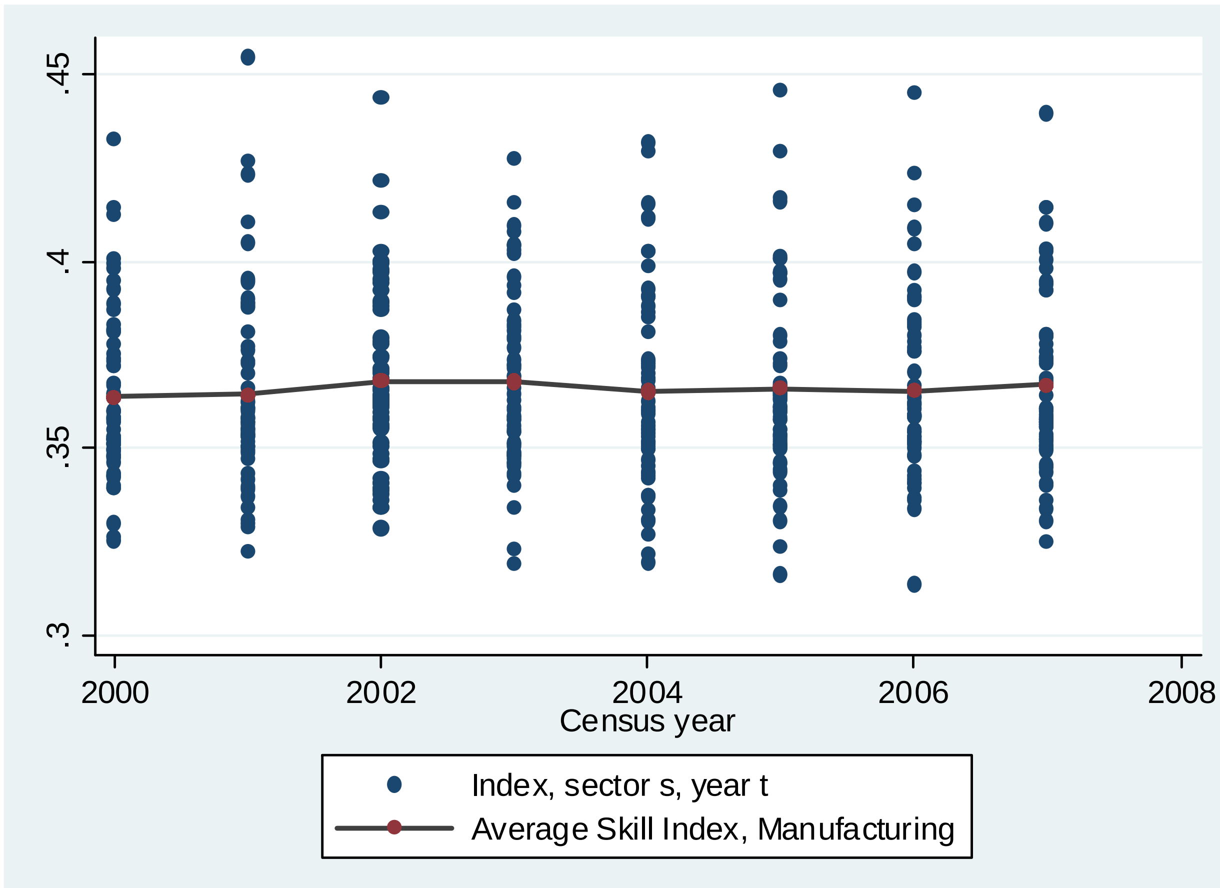
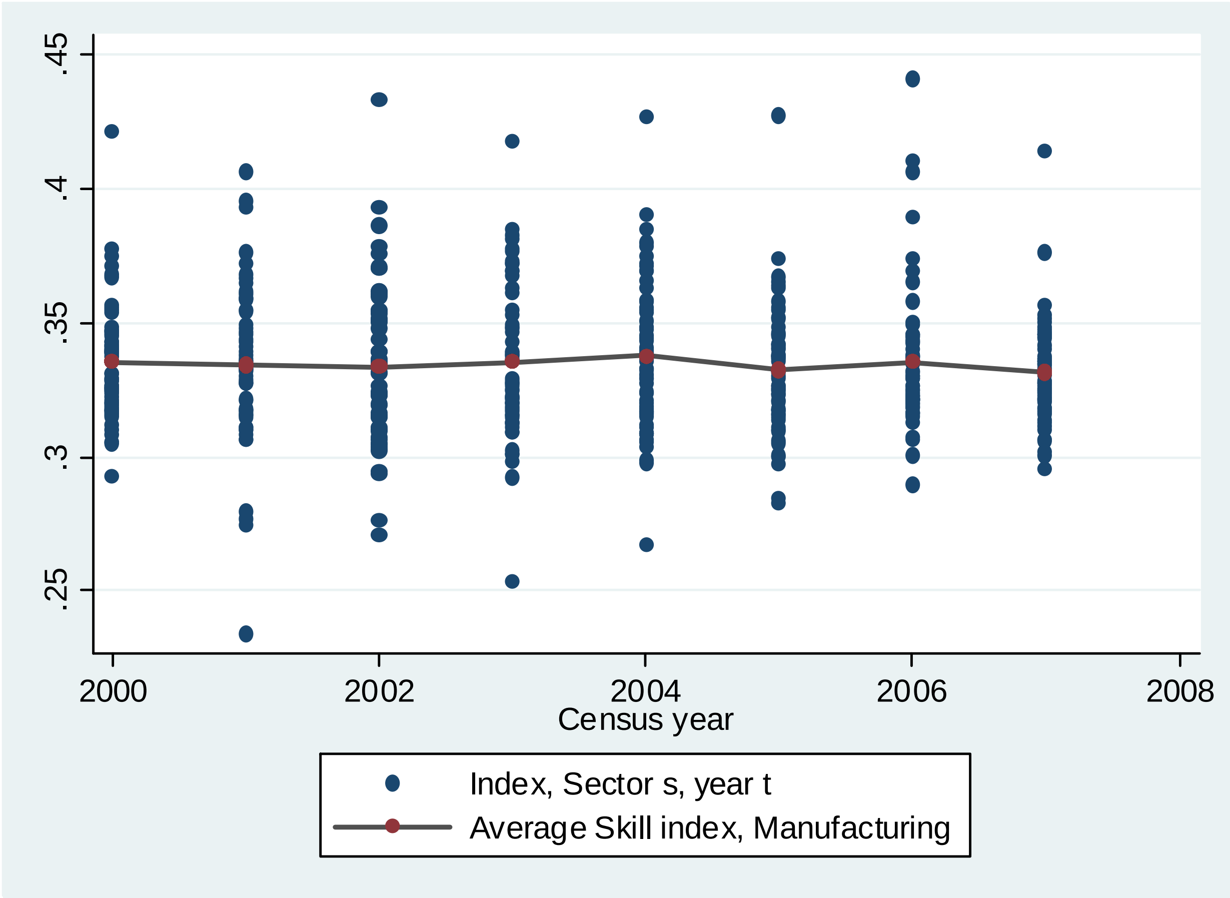


Figure 4

Average index for immigrant workers with high school diploma or less (I_M)

58 industries, 8 years



Appendix

Table A1					
BEA Industry Code	**Description**	**BEA Industry Code**	**Description**	**BEA Industry Code**	**Description**
1	Animal foods, Grain and oilseed milling	**28**	Paints, coatings, and adhesives	**54**	Metalworking machinery
3	Sugar and confectionery products	**30**	Plastics products	**55**	Engines, turbines, and power transmission equipment
4	Fruit and vegetable preserving and specialty foods	**31**	Rubber products	**57**	Computers and peripheral equipment
5	Dairy products	**32**	Clay products and refractory	**58**	Communications equipment, Audio and video equipment
6	Animal slaughtering and processing	**33**	Glass and glass products	**60**	Semiconductors and other electronic components, Magnetic and optical media
7	Seafood product preparation and packaging and Other food products	**34**	Cement and concrete products, Lime and gypsum products	**61**	Navigational, measuring, and other instruments
8	Bakeries and tortillas	**36**	Other nonmetallic mineral products	**64**	Electric lighting equipment, Electrical equipment, Other electrical equipment and components
10	Beverages	**37**	Iron and steel mills and ferroalloys, Steel products from purchased steel	**65**	Household appliances
11	Tobacco products	**39**	Alumina and aluminum production and processing	**68**	Motor vehicles, Motor vehicle parts
12	Apparel and Textile mills	**40**	Nonferrous metal (except aluminum) production and processing	**71**	Aerospace products and parts
13	Textile product mills	**41**	Foundries	**72**	Railroad rolling stock
15	Leather and allied products	**42**	Forging and stamping	**73**	Ship and boat building
16	Wood products	**43**	Cutlery and hand-tools	**74**	Other transportation equipment
17	Pulp, paper, and paperboard mills	**44**	Architectural and structural metals, Boilers, tanks, and shipping containers	**75**	Furniture and related products
18	Converted paper products	**46**	Hardware, Spring and wire products and Other fabricated metal products	**76**	Medical equipment and supplies
19	Printing and related support activities	**48**	Machine shops, turned products, and screws, nuts, and bolts	**77**	Other miscellaneous manufacturing
23	Basic chemicals and Other chemical products and preparations	**49**	Coating, engraving, heat treating, and allied activities		
24	Resins and synthetic rubber, fibers, and filaments	**50**	Other fabricated metal products		
25	Pharmaceuticals and medicines	**51**	Agriculture, construction, and mining machinery		
26	Soap, cleaning compounds, and toilet preparations	**52**	Commercial and service industry machinery		
27	Pesticides, fertilizers, and other agricultural chemicals	**53**	Ventilation, heating, air-conditioning, and commercial refrigeration equipment and Other general purpose machinery		

Table A2

Percentage of offshore and immigrant employment in total manufacturing, and selected industries within it

	2000	2001	2002	2003	2004	2005	2006	2007
Percentage of offshored employment in **Manufacturing**	**23.3**	**22.7**	**22.5**	**23.9**	**24.4**	**23.3**	**22.4**	**29.3**
Percentage of immigrant employment in **Manufacturing**	**12.8**	**13.7**	**14.5**	**14.0**	**14.1**	**14.8**	**15.2**	**14.0**
Percentage of immigrants (and offshored) in the industry with the *fastest* growing immigrant share **Apparel and Textile Mills**	**27.1 (14.4)**	**28.5 (13.8)**	**33.6 (10.6)**	**31.5 (9.2)**	**30.1 (13.9)**	**30.6 (12.1)**	**31.6 (13.1)**	**34.7 (7.5)**
Percentage of immigrants (and offshored) in the industry with the *slowest* growing immigrant share **Plastics Products**	**14.7 (12.2)**	**16.0 (15.9)**	**16.3 (17.4)**	**14.4 (22.8)**	**12.5 (25.0)**	**13.6 (26.7)**	**14.1 (22.9)**	**12.4 (29.4)**
Percentage of offshored (and immigrants) in the industry with the *fastest* growing offshored share **Basic Chemicals**	**18.3 (6.8)**	**22.1 (7.5)**	**19.5 (8.3)**	**19.3 (7.6)**	**18.3 (8.7)**	**31.1 (6.9)**	**33.0 (6.8)**	**48.5 (5.4)**
Percentage of offshored (and immigrants) in the industry with the *slowest* growing offshored share **Other Transportation Equipment**	**54.9 (4.8)**	**61.6 (6.9)**	**57.5 (5.5)**	**39.4 (6.5)**	**20.7 (4.0)**	**14.5 (9.0)**	**15.0 (7.6)**	**21.0 (8.1)**

Note: Immigrant, native and offshore employment are calculated as described in the text. These statistics include all workers in the computation of native and immigrant employment.

Table A3

Native, immigrant and offshore workers as share of employment in 2007: representative industries

Immigrant workers as percentage of employment	US-born workers as percentage of employment	Offshore workers as percentage of employment	Industry
Industries with highest share of US-born employment			
9	89	2	Ship and boat building
9	87	4	Cement and concrete products, Lime and gypsum products
9	84	7	Wood products
12	82	6	Hardware, Spring and wire products and Other fabricated metal products
5	81	14	Pulp, paper, and paperboard mills
9	80	10	Dairy products
13	80	7	Machine shops, turned products, and screws, nuts, and bolts
7	80	14	Iron and steel mills and ferroalloys, Steel products from purchased steel
11	79	10	Architectural and structural metals, Boilers, tanks, and shipping containers
13	78	9	Other nonmetallic mineral products
Industries with intermediate share of US-born employment			
5	68	27	Agriculture, construction, and mining machinery
12	68	20	Navigational, measuring, and other instruments
9	67	24	Glass and glass products
17	65	18	Other miscellaneous manufacturing
9	65	26	Converted paper products
11	**63**	**26**	**average**
4	62	34	Pesticides, fertilizers, and other agricultural chemicals
20	62	18	Bakeries and tortillas
8	61	32	Railroad rolling stock
Industries with lowest share of US-born employment			
13	52	36	Communications equipment, Audio and video equipment
5	51	44	Household appliances
15	51	34	Computers and peripheral equipment
10	50	40	Pharmaceuticals and medicines
16	49	35	Leather and allied products
8	45	48	Cutlery and hand tools
12	43	45	Sugar and confectionery products
18	43	39	Fruit and vegetable preserving and specialty foods
5	40	55	Other transportation equipment
10	37	53	Soap, cleaning compounds, and toilet preparations
4	28	68	Beverages
1	19	80	Tobacco products