The Interactive Effect of Immigration and Offshoring on U.S. Wages

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Abstract

We jointly analyze the effects of low-skilled immigration and offshoring on wages of American workers of different skill levels and task specializations. We show that offshoring affects native wage response to immigration and explain the likely economic mechanism responsible. Focusing on commuting zone outcomes and analyzing a period of high immigration and offshoring exposure growth, between 1990 and 2000, we find that wages of low-skilled natives increase in response to offshoring, decrease in response to low-skilled immigration, and that the wage effect of immigration becomes more negative with more offshoring. We present a theoretical model to demonstrate how this interactive effect of immigration and offshoring can come about. Specifically, we show that offshoring increases native wage elasticity in response to immigration if it increases immigrant wage share; this happens if a relatively larger share of native jobs than immigrant jobs is offshored, causing natives to shift to performing tasks in which they have lower comparative advantage and immigrants to concentrate in tasks for which they have greater comparative advantage.

JEL Classification: F22, F16, J24, J30
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1 Introduction

The effects of immigration[1] and, more recently, offshoring on the domestic labor market have been subject to growing academic and policy interest, which is likely to continue in the future. Part of the reason is the rapid increase in offshoring and immigration over the past three decades, combined with falling employment and wages of the low-skilled American workers in manufacturing. As of 2014, out of all workers employed by U.S. (multinational) manufacturing companies directly or through affiliates over 30% were located abroad, up from 18% in 1990 (Figure 1). During the same time period, the share of non-college educated workers in manufacturing who are of immigrant origin doubled, going from 9% to 18% (Figure 2). Contemporaneously, total manufacturing employment of native (non-immigrant) workers without college degree decreased from 15.4 million to less than 9 million (Figure 3), and wages of the same group decreased in real terms and relative to higher-educated workers (Figure 4). These rapid and significant changes spurred a rich and growing literature investigating the consequences of immigration and offshoring for American workers, particularly the low-skilled.

An important aspect of the growing knowledge about the consequences of these processes is the increasing understanding of the heterogeneity of impact depending on native and foreign worker characteristics, occupation and industry type, as well as other factors. In this study, we show that an important source of the heterogeneity of immigration effect on wages of low-skilled natives is the extent of offshoring exposure.[2] The key insight is that since the pattern of specialization between natives and immigrants affects immigration impact on native wages, offshoring, by differently affecting native and immigrant workers and thereby shifting the specialization pattern, can also affect the wage impact of immigration.

To understand why offshoring may influence immigration wage consequences for natives, it is instructive to first understand how immigration affects natives on its own. The two main channels through which immigration is found to impact wages of natives are factor supply (which operates

[1] Here, we focus on low-skilled immigration, and, for brevity, generally refer to low-skilled immigration when we say "immigration," unless otherwise specified.

[2] This is superficially similar but substantially different from a contemporaneous work by Burstein et al. (2017), who investigate the role of (potential) tradability within the U.S., as opposed to actual exposure to offshoring in affecting native wage response to immigration, and who examine a very different economic mechanism.

in a similar fashion to what we term price effect here) and productivity, which operate differently in different specifications and can be individually or both at play. The extent to which an increase in immigrant labor affects native wages through factor supply channel depends, among other aspects, on the degree of substitutability between the two types of workers in question, with relatively more negative effect on wages of workers who are the closest substitutes in production. This proximity is most commonly empirically proxied by skill level of workers or task content of jobs performed. The degree of similarity between skills workers possess is usually measured through the level of education completed (Card (2001)) or education-experience cells (Borjas (2003)); skill-wise more similar workers (who tend to be low-skilled given that immigrants tend to be disproportionately low-skilled) generally see negative, although small, wage effects (Altonji and Card (1991), Borjas (2003), Card (2001), Longhi, Nijkamp and Poot (2005)). Similarity between tasks performed is measured in terms of whether occupation entails heavy use of manual, routine, communication (or, relatedly, interpersonal) or abstract (or, relatedly, cognitive) tasks (Peri and Sparber (2009), Peri and Sparber (2011)). Among the low-skilled in the U.S., immigrant and native workers tend to concentrate in jobs requiring completion of different tasks. In particular, immigrants tend to work in more manual- and less communication-intensive occupations, and when the share of immigrants increases, natives tend to increase concentration in tasks in which they have comparative advantage, which limits the downward wage pressure (Peri and Sparber (2009)). Thus, native wages depend on both ratio of overall low-skilled factor input in production to high-skilled and task concentration of immigrants and natives (in particular, the extent of comparative advantage), both of which are affected by immigration. Importantly, in a way explained in detail in Section 2, the size of these two effects is positively related to immigrant wage share. Immigrant wage share, in turn, depends on both immigrant share in employment and immigrants' task specialization/comparative advantage.

The latter, namely average comparative advantage of immigrants (and natives),–and this is generally overlooked in the literature–can be altered by offshoring, as the latter affects immigrant in addition to native labor, potentially differentially and in an *a priori* unknown way. Conceptualizing offshoring as trade in tasks (along the lines of Grossman and Rossi-Hansberg (2008)(GRH)), we highlight the fact that the tasks offshored may be native- or immigrant-task intensive (proportionately more native vs. immigrant tasks may be offshored), which will shift comparative advantage patterns, potentially affecting immigrant wage share and native wage elasticity with respect to immigration.

Most of the existing offshoring literature considers only the effect of offshoring on natives. It stresses that since offshoring leads to some tasks[3] being performed abroad, while others are performed at home, workers who previously performed the tasks now done abroad switch to different tasks within the firm or switch firms/industries/locations/become unemployed. Other workers are forced to compete with workers whose task were offshored, putting downward pressure on wages. On the other hand, if (enough) of the gains from cheaper offshoring accrue to firms rather than foreign workers, the higher productivity of labor composite has a positive effect on wages, making the overall effect theoretically ambiguous.

The empirical literature is generally consistent with manufacturing offshoring generally having greater impact–sometimes positive, more often negative–on wages of low- or middle-skilled workers, those in most routine, least interactive occupations and those in the middle or at the low end of the wage distribution (Ebenstein et al. (2014), Oldenski (2014), Tempesti (2015), Olney (2012) in the U.S.; Baumgarten, Geishecker and Görg (2013), Geishecker and Görg (2008) in Germany; Hummels et al. (2014) in Denmark), suggesting that these are the workers "whose jobs" are being offshored or competing workers. Interestingly, Ebenstein et al. (2014) find that offshoring to low-income countries decreases native wages and offshoring to high-income countries increases them, while Olney (2012) finds the opposite to be true, yet the effects are greatest on the competing workers (in most routine occupations in the former case and in lower wage percentiles in the latter) in both papers. Studies focused not on wages but employment also find greater, but mainly negative, effects on the competing workers (Harrison and McMillan (2011), Wright (2014)), as do studies that look at labor task composition, which is shifted to more skilled, non-routine and interactive occupations (Baumgarten (2015), Carluccio et al. (2015)).

Thus, taken separately, immigration and offshoring literatures suggest that both processes affect

[3]Importantly, as we note later, a fraction of a task of a specific kind can be offshored, since there is no natural definition of a task, and it can be defined more broadly or more narrowly; additionally, a fraction of a task can be conceived of as a fraction of the number of repetitions of the same task.

native wages through changes in the factor supply ratio and productivity/comparative advantage.[4] Due to the similarity of the effects of the two processes, it is natural to ask whether joint analysis leads to new insights. Three papers stand out as having looked at the effects of immigration and offshoring together, both theoretically and empirically. Barba Navaretti, Bertola and Sembenelli (2008) use Italian firm-level data and find that offshoring decreases the share of unskilled workers in domestic employment and immigrant share of employment, suggesting that offshore workers are closest substitutes for unskilled natives and immigrant workers. A more closely related study to ours is that by Ottaviano, Peri and Wright (2013), who extend Grossman and Rossi-Hansberg (2008) framework, modeling task allocation among natives, immigrants and offshore workers in such a way that immigrants specialize in low-complexity tasks, offshore workers perform the intermediate tasks, and natives specialize in most complex tasks. Due to this assumption, an increase in offshoring leads to an increase in native task complexity, a decrease in immigrant task complexity, and lower relative productivity of immigrant workers (this is a crucial assumption, and our results in large part depend on relaxing it). The empirical results obtained by examining industry-time variation suggest that offshoring decreases immigrant and native employment shares, but does not significantly affect wages. Immigration, on the other hand, decreases offshoring employment share, but does not affect native employment share or wages. This suggests that offshore workers, in a way, isolate natives from competition with immigrant workers; significantly, the empirical result considers all native workers together, without separating those most likely affected–the less-skilled natives. Another closely related study is by Olney (2012), who also extends GRH framework, but by modeling immigration as an increase in low-skilled labor supply in addition to offshoring. An important assumption in the latter paper is that offshoring increases effective labor supply of a given factor, with no difference in the extent of offshoring between native and immigrant jobs within the factor. Empirically, the paper exploits state-industry-year variation to simultaneously estimate the effects of low- and high-skilled immigration and of offshoring to low- and high-income countries on wages of natives along wage percentile spectrum, but not how/whether the two interact.

Additionally, in a purely theoretical paper with occupational choice between "worker" and en-

[4] Additionally, (Grossman and Rossi-Hansberg (2008)) show that a price effect of offshoring (of a different kind than in this paper) can also take place.

trepreneur," Unel (2017) obtains a similar insight to Ottaviano, Peri and Wright (2013), in that lowering of offshoring costs "downgrades" tasks performed by immigrants and "upgrades" tasks performed by natives; the paper also predicts that immigration increases the number of entrepreneurs, firm productivity and welfare, while having no effect on entrepreneur/worker inequality. In a stochastic growth model, Mandelman and Zlate (2016) use structural estimation to show that in a general equilibrium context, offshoring increases job polarization by affecting mainly middle-skilled jobs, while low-skilled immigration decreases wages of the low-skilled workers.

Lastly, it is also useful to address a contemporaneous study that looks not at immigration and offshoring but immigration and tradability, and which we consider complementary to our work. The paper by Burstein et al. (2017) finds that "a local influx of immigrants crowds out employment of native-born workers in more relative to less immigrant-intensive nontradable jobs, but has no such effect within tradable occupations." The proposed mechanism is that within tradables, adjustment occurs more through output rather than prices. In particular, occupations are "traded" across regions within the U.S. In contrast, our paper asks what happens to the effect of immigration when offshoring increases. The different assumptions underlying each paper and the different questions asked provide rather different insights. Burstein et al. (2017) focus on immigration-induced native employment (and, to a lesser extent, wage) changes at the occupational level within region as affected by a more permanent characteristic of tradability. In contrast, we concentrate on how native wage response to immigration changes due to actual/imputed offshoring exposure, reflecting substantial occupational mobility among natives (Kambourov and Manovskii (2008)) in the spatial approach taken, but not investigating it as the subject of primary interest. Thus, the two papers provide somewhat different insights about somewhat different determinants of the way immigration affects native labor market outcomes.

In sum, existing literature does not directly consider the impact of offshoring on the wage response of natives to immigration. We tackle this hitherto unaddressed issue here. We theoretically formalize the approach by following the literature in using general GRH framework, but deviating from it in how we do it. In particular, we build on Grossman and Rossi-Hansberg (2008) and Ottaviano, Peri and Wright (2013) by modifying/extending them in two ways: in the full version of the model, we do not assume that tasks that are offshored are offshored completely and we do not posit the location[5] of tasks most affected by offshoring, letting the empirics speak to that instead.[6] The model in the paper has two factors of production, one being high-skilled labor[7] and the other–low-skilled labor composite, the production of which includes tasks performed by low-skilled native workers, low-skilled immigrants, whose comparative advantage differs across tasks, and offshore workers, with the share of offshore workers varying across tasks. By increasing the supply of low-skilled workers, and hence overall input of low-skilled worker tasks (with the other factor being fixed), immigration decreases marginal product of low-skilled labor composite, which has a negative effect on native wages. On the hand, with more tasks completed by immigrants, natives specialize in tasks where they have greater comparative advantage, which positively affects wages. Both effects are reinforced by immigrant wage share, as is the net effect–native wage elasticity with respect to immigration (assuming one channel sufficiently dominates the other). Offshoring can either increase or decrease immigrant wage share by affecting native tasks relatively more or less than immigrant ones; it may, thus, increase or decrease native wage elasticity with respect to immigration.

To address the question empirically, we use geographic and time variation across U.S. commuting zones in exposure to immigration and offshoring to investigate the presence, extent and nature of the potential interactive effect of the two processes on native wages. We primarily focus on the manufacturing sector, because it has experienced far greater offshoring exposure and exposure increase than non-manufacturing, while seeing similar levels of immigration exposure change. Plausibly exogenous Bartik-type (Bartik (1991)) instruments, based on past settlement patterns for immigration (Card (2001)) and on pre-existing industrial composition for offshoring, address the problem of immigration and/or offshoring being potentially related to local labor demand shocks that affect wages. We find that low-skilled immigration, on average, decreases wages of low-skilled natives, while offshoring increases them. The results also reveal a robust negative interactive effect of low-skilled immigration and offshoring on the wages of low-skilled natives in manufacturing,

[5]Location, here, means the place on the spectrum of tasks that are performed by immigrants and natives. In case of Ottaviano, Peri and Wright (2013), the analog is task complexity spectrum.

[6]In the appendix with a special case of the model, we follow the literature in assuming full offshoring of tasks and utilizing the location of offshored jobs. This simpler setting produces similar insights to the main model.

[7]We are primarily interested in the other factor.

whereby a negative effect of immigration is reinforced by offshoring. Additionally, offshoring is associated with an increase in immigrant wage share, providing support for native task intensive offshoring as the channel for the interactive effect. The results hold for wages of the middle- and low-skilled workers, and those in most routine, most manual, least abstract, less cognitive and less communication-intensive occupations. They are robust to including controls for local labor demand shocks, import competition, demographic variables, and using alternative definitions of immigration and offshoring.

The findings here provide first evidence that offshoring may be exacerbating the negative effect of low-skilled immigrants on low-skilled natives in local labor markets, with supporting theory and evidence. They suggest that since immigration and offshoring effects are not independent, they are more accurately understood when studied together. The rest of the paper proceeds as follows: Section 2 provides a theoretical model, Section 3 discusses empirical specification and data, while Section 4 presents results and Section 5 concludes.

2 Theoretical model

2.1 Part A: Immigration

We propose a simple task-based model of the labor market and investigate the role of offshoring as a determinant of the native wage impact of low-skill immigration. To illustrate the intuition of the model in a simple setting and because there is relatively little offshoring outside of the manufacturing sector, there is only one sector in the model. We begin with a setting in which there is only native and low-skilled immigrant employment. Specifically, let aggregate output Q be a function of a composite low-skilled labor input Y,[8] and an exogenously given level of high-skilled

[8]We can also think of tasks in Y as those that are more manual and routine and less abstract, communication-intensive and cognitive-intensive–tasks more likely performed by low-skilled immigrants and offshore workers, and by natives that compete with the two latter types of labor.

labor input H,[9] henceforth normalized to unity:

$$\ln Q = \alpha \ln Y + (1-\alpha)\ln H,$$

where one unit of the composite low-skilled labor input Y is the result of the completion of a unit each of a continuum of tasks $y(i), \;\; i \in [0,1]$. We assume that $\alpha(\in (0,1))$ is the share of low-skilled labor input in aggregate output.

Task $y(i)$ can be completed either by native low-skilled workers n, or immigrant low-skilled workers m:

$$y(i) = n(i)/a_n + m(i)/a_m(i).$$

Thus, each low-skilled task can be accomplished by a_n units of native work or $a_m(i)$ units of immigrant work. We assume that the ratio $B(i) = a_n/a_m(i)$ is continuously differentiable and monotonically increasing in i, and consequently natives have comparative advantage in low index tasks, while immigrant workers have comparative advantage in high index tasks.

Let w_n and w_m denote native and immigrant wages. Define the threshold task I as:

$$I \equiv \{i | w_m a_m(i) = w_n a_n\}.$$

It follows that the unit cost of task i is minimized for $i \leq I$ by hiring only native workers, and for $i > I$ by hiring only immigrant workers. Summing across all tasks $i \in [0,1]$, the unit cost of the composite low-skilled labor input is thus:

$$\begin{aligned} c(w_n, w_m) &= w_n a_n I + w_m \int_I^1 a_m(i) di \\ &= w_n \left(a_n I + B(I) \int_I^1 a_m(i) di \right) \equiv w_n \phi(I) \qquad \text{(A1)} \end{aligned}$$

Note that $\phi(I) < a_n$ whenever $I < 1$. Thus $\phi(I)$ denotes the cost savings achieved by hiring

[9] We are primarily interested in the low-skilled labor in the Y factor, and H plays little role. It could also be conceived of as a composite of exogenous inputs.

immigrant workers. This is analogous to the productivity effect of offshoring defined in Grossman and Rossi-Hansberg (2008).

Let M and N denote the exogenously given supply of low-skilled immigrants and native workers. Given the threshold task i, it follows that total labor supply is equal demand for immigrants and natives if and only if

$$N = Y a_n I, \quad M = Y \int_I^1 a_m(i)di.$$

Define σ as the share of low-skilled immigrant workers:

$$\sigma = \frac{M}{M+N}.$$

It follows, therefore, that the threshold value task is determined whenever σ is given, since by definition

$$\frac{\sigma}{1-\sigma} = \frac{\int_I^1 a_m(i)di}{a_n I}.$$

Now let θ denote the immigrant wage share:

$$\theta \equiv w_m \int_I^1 a_m(i)di/c(w_n, w_m) = \frac{w_m M}{w_m M + w_n N} = \frac{B(I)M}{B(I)M + N}. \tag{A2}$$

Since $B(I)$ is monotonically increasing in I, the wage share of immigrants is strictly increasing in the threshold I, at constant supply of immigrant and native workers. All else equal, as I increases, immigrant workers become more specialized in tasks in which they have comparative advantage, while native workers spread out and begin to take on some high index tasks in which they have less comparative advantage. As the relative wage of immigrant workers

$$\frac{w_m}{w_n} = B(I)$$

increases with I, the relative wage share of immigrant workers also increases.

The immigrant wage share, or equivalently, one minus the native wage share, plays an important role in what follows. First, the threshold task elasticity of immigration, where $\hat{x} = dx/x$ denotes proportionate change, can be expressed as:

$$\frac{\hat{I}}{\hat{\sigma}} = -\frac{\theta}{1-\sigma}. \tag{A3}$$

Thus, the threshold task is more responsive to changes in immigrant supply when the immigrant wage share is high. The same is true for the output elasticity of immigrant supply:

$$\frac{\hat{Y}}{\hat{\sigma}} = \frac{\theta}{1-\sigma}. \tag{A4}$$

Intuitively, the more immigrant workers specialize in tasks where they have comparative advantage, the higher their impact on the allocation of tasks as well as the supply of composite labor input Y.

These intuitions carry over to the responsiveness of the native wage with respect to immigrant inflow as well. To see this, note that with competitive input markets, workers are hired until the marginal product of the composite labor input equals marginal cost:

$$p \equiv \alpha Y^{\alpha-1} = w_n \phi(I), \tag{A5}$$

where p denotes the competitively determined price of the composite labor input. Making use of (A1) and (A5),

$$\frac{\hat{w_n}}{\hat{\sigma}} = \frac{\hat{p}}{\hat{\sigma}} - \frac{\widehat{\phi(I)}}{\hat{\sigma}}.$$

Simply put, the native wage impact of an increase in the share of immigrant workers depends on the interplay between the price effect, $\hat{p}/\hat{\sigma}$, and productivity effect $\widehat{\phi(I)}/\hat{\sigma}$. Naturally, the former depends on the output impact of immigration, since from (A5)

$$\frac{\hat{p}}{\hat{\sigma}} = (\alpha - 1)\frac{\hat{Y}}{\hat{\sigma}}.$$

The productivity effect can also be derived using (A3), giving

$$\frac{\hat{\phi}(I)}{\hat{\sigma}} = \varepsilon \frac{\theta^2}{1-\sigma},$$

where $\varepsilon = dlnB(I)/dlog(I) > 0$ parameterizes the size of the productivity effect of immigration. Taken together, we have:

$$\frac{\hat{w_n}}{\hat{\sigma}} = (\alpha - 1 + \varepsilon\theta)\frac{\theta}{1-\sigma}. \tag{A6}$$

We summarize these findings as follows:

Proposition 1. *The native wage impact of low-skilled immigration is negative (positive) if (and only if) the productivity effect is small (large) relative to the price effect. In both cases, if the difference between productivity parameter ε and price effect $\alpha - 1$ is sufficiently large, a higher immigrant wage share magnifies the native wage impact of low-skilled immigration, all else equal.*

Thus, low-skilled immigration may increase or decrease the native wage, depending on the relative size of the price and productivity effects. A higher immigrant wage share magnifies both the price effect and the productivity impact of immigration. The balance of the two depends on whether the price or the productivity effect dominates.

Of course, the immigrant wage share itself is endogenous. Our next task is to demonstrate that the nature of offshoring, in the sense of whether offshoring is native or immigrant tasks intensive, is a key determinant of the immigrant wage share.

2.2 Part B: Immigration and Offshoring

We next assume that a fraction of any task in Y can be offshored. Unlike most models (notably, (Ottaviano, Peri and Wright, 2013)), we do not assume full offshoring of tasks and do not posit a particular location of the "more offshorable" tasks along the i spectrum; instead, we allow for the possibility of full offshoring and for any particular location of offshored tasks with respect to natives and immigrants. This makes the model more flexible and generalizable (as well as, arguably, more realistic), with some of the assumptions of the existing models being special cases of this one (we provide one illustrative example of a special case of the theoretical model in Appendix 2). Specifically, the production of task i can be written as

$$(1 - \beta s(i))y(i) = n(i)/a_n + m(i)/a_m(i), \tag{B1}$$

where $\beta s(i)$ - fraction of task offshored, $\beta <= 1$ is common to all tasks and $s(i)$ indicates heterogeneity in offshorability across different tasks. The threshold task between natives and immigrants is still given by

$$w_m a_m(I) = w_n a_n, \tag{B2}$$

which, again, means $\frac{w_m}{w_n} = \frac{a_n}{a_m(I)} = B(I)$.

A potential division of tasks between natives, immigrants and offshore workers is graphically illustrated in Figure 5. The right axis represents the unit cost of performing a task. The cost of producing any task with native labor is $w_n a_n$, represented by the flat solid line. The cost of producing with immigrant labor decreases with i, as immigrant labor becomes more productive ($a_m(i)$ decreases). The intersection represents the threshold task above which immigrant labor is used domestically and below which native labor is used. The left axis measures the share of task offshored. For the sake of example, the share of task offshored, $\beta s(i)$, is represented by the parabola-like line bounding shaded areas. The figure is deliberately drawn to have a greater share of tasks offshored in the middle of the i spectrum. If we think of i spectrum as equal but reverse of the "complexity" scale in Ottaviano, Peri and Wright (2013), the figure is consistent with greater offshorability of middle-complexity jobs. As drawn, the figure also features a greater extent of offshoring of native tasks than immigrant ones. However, this need not be the case, as offshoring function $\beta s(i)$ can take any form (with values between 0 and 1). Figure 6 represents another possibility, where offshorability increases with i index and a greater fraction of immigrant tasks (than native) is offshored.

Let now the unit labor cost abroad $w_o a_o$ be a fraction (1-γ) of the local labor cost (e.g., as a result of Nash bargaining). Then the unit cost of task i, c(i), is

$$(1-\gamma)min\{w_n a_n, w_m a_m(i)\} = w_o a_o(i), \gamma \in (0,1) \tag{B3}$$

The unit cost of Y, summing across all tasks, is

$$P = C_y = \int_0^1 c(i)di = w_n[\int_0^I (1-\beta s(i)\gamma)a_n di + B(I)\int_I^1 (1-\beta s(i)\gamma)a_m(i)di] \equiv w_n\phi(I,\beta) \tag{B4}$$

Note that $\phi(I,\beta) < a_n$ whenever there is some immigration and/or offshoring. Thus $\phi(I,\beta)$ denotes the cost savings achieved by hiring immigrant and offshore workers.

Labor market clearing is now given by

$$N = Y\int_0^I (1-\beta s(i))a_n di, \;\; Y\int_I^1 (1-\beta s(i))a_m(i)di = M, \tag{B5}$$

which can also be written as

$$\frac{N}{\int_0^I (1-\beta s(i))a_n di} = Y, \;\; \frac{M}{\int_I^1 (1-\beta s(i))a_m(i)di} = Y,$$

from which it is evident that both effective labor supply of natives and effective labor supply of immigrants, as well as the labor composite, are expanded with greater offshoring.

The ratio of immigrant to native labor is now given by

$$\frac{\sigma}{1-\sigma} = \frac{\int_I^1 (1-\beta s(i))a_m(i)di}{\int_0^I (1-\beta s(i))a_n di} = \frac{M}{N}. \tag{B6}$$

From (B6), we can obtain the relationship between proportionate changes in immigrant wage share, threshold task and offshoring :

$$\frac{\hat{\sigma}}{(1-\sigma)} = -(\frac{1}{\zeta\theta})\hat{I} + (\frac{O_n}{N} - \frac{O_m}{M})\hat{\beta}, \tag{B7}$$

where $\hat{I} = dI/I$, $\hat{\beta} = d\beta/\beta$, $O_m = Y\int_I^1 \beta s(i)a_m(i)di$, $O_n = Y\int_0^I \beta s(i))a_n di$, and $\zeta = \frac{\int_0^I (1-\beta(s(i)))di}{I(1-\beta s(I))}$, the share of native tasks offshored divided by the share of the threshold task offshored. Note that without offshoring, $\zeta = 1$, the second term above is 0 and we are back to the result with just immigration. Alternatively expressed, (B7) gives

$$-\hat{I} = \theta\zeta[\frac{\hat{\sigma}}{1-\sigma} - (\frac{O_n}{N} - \frac{O_m}{M})\hat{\beta}],$$

which can be used to assess the effect of offshoring on threshold task:

$$\frac{\hat{I}}{\hat{\beta}} = (\frac{O_n}{N} - \frac{O_m}{M})\zeta\theta.$$

Thus, threshold task is increasing in offshoring exposure if a relatively larger share of native than immigrant tasks is offshored. Using (B5), proportionate change in Y can be expressed as

$$\hat{Y} = -1/\zeta\hat{I} + \frac{O_n}{N}\hat{\beta} \tag{B8}$$

or, using (B7),

$$\hat{Y} = \theta\frac{\hat{\sigma}}{1-\sigma} + (1-\theta)\frac{O_n}{N}\hat{\beta} + \theta\frac{O_n}{M}\hat{\beta}. \tag{B9}$$

Thus, both higher immigrant and offshore shares increase the labor composite. Proportionate change in productivity term, using (B4), can be epxressed as

$$\hat{\phi} = \varepsilon\tilde{\theta}\hat{I} - \Omega\hat{\beta}, \tag{B10}$$

where $\varepsilon = \frac{B'(I)I}{B(I)}$, $\tilde{\theta} = \frac{B(I)\int_I^1(1-\beta s(i)\gamma)a_m(i)di}{\phi(I,\beta)}$, $\Omega = \frac{1}{\phi(I,\beta)}[\int_0^I(\beta s(i)\gamma)a_n di + B(I)\int_I^1(\beta s(i)\gamma)a_m(i)di]$. Turning to the change in native wages, since $p \equiv \alpha Y^{\alpha-1} = w_n\phi(I,\beta)$, change in native wages depends on both the change in the labor composite and the productivity term:

$$\hat{w_n} = (\alpha-1)\hat{Y} - \hat{\phi}$$

$$= [(\alpha - 1)\theta + \varepsilon\tilde{\theta}\theta\zeta]\frac{\hat{\sigma}}{1-\sigma} + [\Omega + (\alpha - 1)((1-\theta)\frac{O_n}{N} + \theta\frac{O_m}{M})]\hat{\beta}. \quad \text{(B11)}$$

Consequently, change in native wages in response to greater immigrant labor share is

$$\frac{\hat{w_n}}{\hat{\sigma}} = [(\alpha - 1) + \varepsilon\zeta\tilde{\theta}]\frac{\theta}{1-\sigma}. \quad \text{(B12)}$$

The first term in the square brackets represents the price/labor supply effect and the second– productivity effect. The native wage response to immigration can again be summarized by restating Proposition 1, except whether the productivity effect is sufficiently large or small now also takes into account ζ and $\tilde{\theta}$:

Proposition 1. *The native wage impact of low-skilled immigration is negative (positive) if (and only if) the productivity effect is small (large) relative to the price effect. In both cases, if the difference between productivity parameter ε and price effect $\alpha - 1$ is* ***sufficiently*** *large, a higher immigrant wage share magnifies the native wage impact of low-skilled immigration, all else equal.*

Turning to the effect of offshoring, from (B11) we have

$$\frac{\hat{w_n}}{\hat{\beta}} = \Omega + (\alpha - 1)((1-\theta)\frac{O_n}{N} + \theta\frac{O_m}{M}), \quad \text{(B13)}$$

where Ω represents the positive productivity effect and the rest – negative labor supply effect. Similar to the effect of immigration, the direct effect of offshoring is summarized below:

Proposition 2. *The native wage impact of offshoring is negative (positive) if (and only if) the productivity effect is small (large) relative to the price effect.*

Lastly, the potential interactive effect is slightly more complicated. First, we point out that the relationship between immigrant cost share and offshoring (based on the definition of θ) can be expressed as

$$\frac{\partial\theta}{\partial\beta} = \theta(1-\theta)\varepsilon\frac{1}{B(I)}\frac{\hat{I}}{\hat{\beta}}$$

$$= (\frac{O_n}{N} - \frac{O_m}{M})[\zeta\theta^2(1-\theta)\varepsilon\frac{1}{B(I)}].$$

The term in square brackets is positive, while the sign of the first term depends on whether offshoring is more native or immigrant task intensive. Thus, offshoring increases immigrant wage share if it offshores a relatively larger fraction of native jobs than immigrant ones, leading us to the following inference:

Proposition 3. *If offshoring is native (immigrant) task intensive, it increases (decreases) the immigrant wage share. This reinforces (mitigates) the negative wage impact of immigration if the productivity effect is sufficiently small relative to the price effect; alternatively, this reinforces (mitigates) the positive wage impact of immigration if the productivity effect is sufficiently large relative to the price effect.*

We represent the main elements of the proposition in the table below:

	Immigration Effect	
Dominating Effect	Price ($\alpha - 1 \gg \varepsilon$)	Productivity ($\alpha - 1 \ll \varepsilon$)
Immigration Effect	Negative	Positive
	Interactive Effect	
Native task intensive ($\frac{O_n}{N} > \frac{O_m}{M}$)	Reinforcing (-)	Reinforcing (+)
Migrant task intensive ($\frac{O_n}{N} > \frac{O_m}{M}$)	Mitigating (+)	Mitigating (-)

The table shows that whether the effect of immigration is (sufficiently) positive or (sufficiently) negative, native task intensive offshoring reinforces it. However, the sign of the interactive effect (also the sign of the coefficient on the interaction term in the empirical results) will be negative if it reinforces the negative effect and positive if it reinforces the positive effect. Analogously, it will be positive if it mitigates the negative effect and negative if it mitigates the positive effect. In what follows, we take this question to the data.

3 Empirical Methodology

In the previous section we provided an explanation for how immigration and offshoring may affect native wages within the context of a single-sector economy where natives, immigrants and offshore workers can all perform tasks in one of the two composite labor inputs (where low-skilled workers are concentrated). In particular, the insights from the previous section suggest that the wage consequences of immigration and offshoring depend on the relative sizes of respective productivity and price[10] effects. Additionally, Proposition 2 suggests that native wage elasticity of immigration increases in offshoring exposure if offshoring is native task intensive. In the empirical analysis, we want to estimate the effects of changes in immigration and offshoring on wages of native workers likely to be in Y, as well as whether greater offshoring has an effect on native wage elasticity of immigration. Additionally, since the effects derived in the theory section apply to the low-skilled labor, we are interested in seeing whether immigration and offshoring change the ratio of high- to low-skilled labor wages. Lastly, since the channel through which the interactive effect is posited to take place in the model is the effect on immigrant wage share, we estimate whether offshoring increases or decreases immigrant wage share.

Spatial Approach

There are several decisions that need to be made when choosing the empirical methodology for estimating the wage effects of immigration and offshoring on natives. One important decision is the level of analysis. The observation levels that have been used in either immigration or offshoring literature include individual worker, occupation, industry, geographic area (spatial approach), and a combination of geographic area and worker category (by skill/education).

Of the papers that jointly analyze the effects of immigration and offshoring, Olney (2012) is the

[10] which, here, works in a similar fashion to a labor supply effect in other setting, in that it is generated by lower marginal productivity of the low-skilled labor composite.

one that focuses on wage outcomes. It uses BEA[11] 2-digit level NAICS[12] industry data across both manufacturing and non-manufacturing to construct state-industry offshoring exposure measure.[13] It then combines it with low- and high-skilled immigrant shares in state-industries and uses annual data (2000-2006) to test the separate effects of high- and low-skilled immigration and offshoring to high- and low-income countries on wage outcomes for natives at different wage percentiles.

The second paper closest to this one, Ottaviano, Peri and Wright (2013), also uses annual BEA industry-level employment data (4-digit manufacturing-only industries) and combines it with immigrant share data, but does not incorporate a geographic component. It is primarily interested in employment outcomes, but does test for wage effect, of which it finds none for either offshoring or immigration (using annual 2000-2007 data).

The third most relevant study is Burstein et al. (2017). Their level of analysis is commuting zone-occupation, with decadal changes in the outcomes of interest and immigration. However, instead of estimating the effects of offshoring in addition to immigration, they investigate the importance of "tradability," which is a more permanent characteristic and does not reflect actual trade or offshoring.

In contrast to these studies, here we take the spatial approach, looking at the effect of changes within a labor market (commuting zone) in immigrant share and offshoring exposure, as well as the interaction of the two on wage changes for native workers in manufacturing. Spatial approach is arguably more suited for studying wage effects after labor reallocation than either industry or state-industry (as well as occupation) approaches. To some extent, labor adjustment in response to labor demand shocks includes some switching of occupation, industry and work location, but, in practice, mostly the former two dimensions. In the United States, mobility responses to labor demand shocks are very limited spatially (Blanchard et al. (1992), Glaeser and Gyourko (2005)), especially for the less-skilled workers (Bound and Holzer (2000), Notowidigdo et al. (2011)). On the other hand, mobility between narrowly defined industries and occupations has been relatively

[11] Bureau of Economic Analysis.

[12] North American Industrial Classification System.

[13] using proportionality assumption that state's share of (national) industry GDP translates to the corresponding share of offshore employment in the industry. It is a similar assumption to what we use here, except for the geography level and aggregation across industries.

high and rising, particularly for low-skilled workers, who switch at much higher and slightly higher rates than high-skilled between occupations and industries, respectively (Kambourov and Manovskii (2008)). The broader the industry definition, the less the inter-industry mobility (Kambourov and Manovskii (2008)), and mobility between large sectors is especially difficult (Artuç, Chaudhuri and McLaren (2010)). Thus, for analysis of wage outcomes, industry-level analysis (as in Ottaviano, Peri and Wright (2013)) is likely both too narrow, in that the wage effect of immigration and offshoring would likely be mitigated by employment response out of and into the industry, and too broad, in that reallocation within industry but between geographic areas is limited. State-industry (as in Olney (2012)) and CZ-occupation (as in Burstein et al. (2017)) analysis would help the latter problem but still be subject to the former. In the spatial approach we take, labor mobility response is mitigated to better identify the wage effect. This is also consistent with the model of one large sector in a closed labor market with large occupational mobility that we posited in the model.

To minimize potential labor mobility effect even further, we choose commuting zones as the geographic area of analysis because they have the advantage of being defined in way that tries to capture the local labor market, rather than being merely an administrative unit, such as a state or a county. They are large enough that most competition among workers happens within CZs, but small and plentiful enough that there is enough of them to exploit inter-area variation and to exclude many non-competing workers. In this way, CZs are preferable to other areas that are frequently used—states, cities, metropolitan areas and counties.

In additional to concerns about the employment effect, an important aspect of estimation is whether the estimated effect is relative or absolute. Dustmann, Schönberg and Stuhler (2016) discuss three main types of empirical specifications to estimate the effect of immigration on native workers—pure spatial approach, national skill-level approach, and mixture approach. While the latter two estimate relative wage effects (compared to other native education-experience groups), the pure spatial approach estimates the total wage effect on a particular native skill group. Since, we are interested in the absolute wage effect (with relative wage effect as a secondary question), the spatial approach is the most appropriate from this point of view also.

3.1 Specification

For the reasons outlined above, empirical specification follows the pure spatial approach, similar to that discussed in Dustmann, Schönberg and Stuhler (2016). Here, low-skilled immigrant share is out of low-skilled, rather than total labor, as the theoretical model studies the importance of immigrant labor within the low-skilled labor composite,[14] and first difference of offshoring is added.[15] The specification has the following form:

$$\Delta ln(\text{wage}_{zg}) = b_g + b_g^{imm}\Delta\text{immshare}_z + b_g^{off}\Delta\text{offexp}_z + \epsilon_{zg},$$

where Δ is decadal change (1990-2000), $ln(wage_{zg})$ is the average manufacturing (log)wage of natives of group g (skill group, task intensity group, etc.) in commuting zone z, immshare_z[16] is the immigrant share of domestic (low-skilled) labor in the commuting zone, offexp_z is the offshoring exposure in CZ (defined further below), and ϵ_{zg} are potentially heteroskedastic errors.[17]

To estimate the potential interactive effect, we modify the equation above, obtaining

$$\Delta ln(wage_{zg}) = \tilde{b}_g + \tilde{b}_g^{imm}\Delta\text{immshare}_z + \tilde{b}_g^{off}\Delta\text{offexp}_z + \eta_g(\Delta\text{immshare}_z * \Delta\text{offexp}_z) + \tilde{\epsilon}_{zg}.$$

Thus, b_g^{imm}, b_g^{off}, and η_g are the main coefficients of interest in analyzing the joint effect of immigration and offshoring on native wages. There is a number of estimation concerns to address, including measurement, potential endogeneity, and robustness.

Measurement

The measures of immigration and offshoring should be such that they adequately estimate the

[14]It is worth mentioning that the results are similar with either measure.

[15]Additionally, since there are only two periods and first difference is taken, there is no additional group-specific time trend (other than the constant).

[16]defined as $\frac{M_z}{M_z+N_z}$, where M and N are immigrant and native numbers in CZ, respectively.

[17]Errors could also be potentially correlated–for example, within state. In practice clustering errors within state led to lower standard errors, suggesting a potentially negative correlation within clusters. On the other hand, the number of census divisions, at 9, is too small. We, therefore, do not cluster standard errors.

effects of the two processes on native wages and are sufficiently close to the relevant expressions in the theory section. Equation (B12) expresses native wage elasticity with respect to immigrant share. In the empirical specification above, wage is still estimated as a percent change, while the change in immigrant share is in the form of percentage points, thus making it not identical but similar to the relevant expression in the theory section. This way of defining immigrant share change is more in line with the literature, and the alternative of a "percent change" in the share would be subject to a severe scale effect. Potential endogeneity of this measure is addressed further below.

Measuring offshoring is more challenging. Offshoring refers to conducting part of the production process abroad. This has normally been done either through analyzing intermediate imports or employment of affiliates of multinational enterprises, or, in some cases, by defining occupational "offshorability"–job characteristics that make it easier or more feasible to perform abroad without significant loss of quality. We use a measure of offshoring rather than offshorability here, as using information on actual offshoring employment changes arguably brings one closer to measuring what we understand as offshoring than characteristics that suggest potential offshoring, or "offshorability." Perhaps the most common measure of the latter is an index by Blinder and Krueger (2013), and the evidence for presence of any labor market consequences of it is mixed: Blinder and Krueger (2013) do not find evidence that any of the measures of offshorability they consider affect wages or probability of layoff, while Goos, Manning and Salomons (2014) look at the effects of routiness and offshorability on labor demand, and find that the former decreases labor demand but the latter has no independent effect when controlling for routiness; in contrast, Burstein et al. (2017) find that tradability of occupations affects how natives respond to immigration. Relatedly to the latter, it has been shown that certain job characteristics that are associated with offshorability (such as routiness and interactivity) influence the effect of imputed/actual measures of offshoring exposure on labor market outcomes; that is, rather than being used as measures of offshoring themselves, they are used as measures of vulnerability to offshoring (or other shocks) in addition to other offshoring measures, which is similar to what we do here (when we measure effects for occupations with varying task intensities).

Since change in β in the theoretical model represents increase in the share of employment offshored, we operationalize this by using employment by affiliates of multinational enterprises to find offshoring exposure measure (as do Ottaviano, Peri and Wright (2013) and Olney (2012)), rather than intermediate input share. Except for a few firm-level studies and "offshorability" measures, offshoring exposure is usually derived from industry-level data, which is then proportionally allocated either to occupation or region. In our case, CZ level offshoring exposure is calculated as a the sum of national industry-level offshoring exposure weighted by local industry share in manufacturing; specifically, offshoring exposure is defined as

$$Offexp_{zt} = \sum_{u} [\frac{D_{uz,t}}{D_{z,t}} * \frac{O_{ut}}{D_{dt} + O_{ut}}],$$

where O_{ut} is offshore employment in industry u in year t, and $D_{uz,t}$ is domestic employment in industry u and commuting zone z.[18]

Endogeneity

Immigrant choice of location may not be exogenous to labor market conditions, as low-skilled immigrants, unlike natives, are quite mobile (Cadena and Kovak (2016)), and move to locations of positive labor demand shock. To address this problem, we use the shift-share instrument throughout, which allocates immigrant flow to specific CZs based on preexisting immigrant enclaves and national level immigrant flows by origin group, before aggregating over origin groups (similar to Ottaviano, Peri and Wright (2013)). Specifically, the instrument for immigrant share is constructed as follows (for those without bachelor's degree). First, predicted number of immigrants from each large region of origin (out of 10 regions) in year t (we end up mostly looking at 1990-2000, partly because the instrument is no longer strong after 2000) is calculated based on the share of all immigrants from region r in CZ z in 1980 and growth rate in the group r in the rest of the country (z^{-});

[18] This is an imperfect measure and relies on the proportionality assumption (similar rates of offshoring for industries in different locations), but is common in the literature (including Olney (2012)).

these numbers are then summed over all regions, i.e.

$$\hat{M}_{zt} = \sum_r \hat{M}_{rzt} = \sum_r [M_{rz,1980} + (M_{rtz^-} - M_{r,1980,z^-})\frac{M_{rz,1980}}{M_{r,1980}}].$$

Validity of this instruments relies on it affecting immigrant share change, but not other factors that may affect wages.

Because offshoring exposure change may be both due to national industry-level offshoring change as well as CZ industrial composition change, endogeneity concerns of a different kind than in the case of immigration may arise. Here, a productivity shock at the CZ level that is not industry-specific is not expected to be correlated with offshoring exposure change. However, if a negative CZ-industry productivity shock 1) leads to lower industry employment, 2) happens in a low-offshoring (high-offshoring) industry and 3) the industry is large enough to affect overall wages, then higher (lower) offshoring would be spuriously correlated with lower (higher) wages. Because of the above concern, we instrument for offshoring using initial period industrial distribution, so offshoring exposure change is only driven by national industry-level offshoring exposure change. Specifically,

$$\widehat{Offexp}_{zt} = \sum_u [\frac{D_{uz,t=1990}}{D_{z,t=1990}} * \frac{O_{ut}}{D_{dt} + O_{ut}}].$$

Consequently, instrumented offshoring exposure change is driven by national industry-level offshoring changes, which are likely uncorrelated with local labor market area demand shocks.[19] They can, however, be potentially correlated with industry-level import competition change or productivity shocks, which we address below. Lastly, to instrument for the product of immigration and offshoring, we use the product of their instruments.

Robustness Checks

In addition to the main specficiation, we conduct several robustness checks, including addi-

[19]Because after 1999 offshore employment is provided using NAICS classification and before–SIC (Standard Industrial Classification), we convert NAICS-based estimates into SIC industries.

tional controls and alternative definitions of immigration and offshoriong. First, since cheaper offshoring may be a result of tariff reduction or industry specific shock, it may be correlated with increased imports of final goods, and greater offshoring exposure change may be associated with greater import penetration; for this reason, in robustness checks, we include import penetration controls. Specifically, we focus on imports from China, and use import penetration change estimates from Acemoglu et al. (2016), defined as $\Delta IP_{zt}^{CZ} = \sum_d \frac{L_{zd,1991}}{L_{z,1991}} \Delta IP_{dt}$, where $\frac{L_{zd,1991}}{L_{z,1991}}$ is the industry d share of CZ employment in 1991, IP_{dt} is industry d import competition change (1991-1999), $\Delta IP_{dt} = \frac{\Delta M_{d,t}^{UC}}{Y_{d,91}+M_{d,91}-E_{d,91}}$, where $\Delta M_{d,t}^{UC}$ is change in imports from China over the period (1991-1999) in industry d, and the denominator is the initial absorption measure (ind. shipments+imports-exports). We use the instrument based on imports from China on the part of 8 other high income countries (from Acemoglu et al. (2016)).

Next, in case CZ offshoring exposure change is correlated with local labor demand shocks because of initial industrial composition,[20] we include control for labor demand shocks using a "Bartik" instrument (from Basso and Peri (2015)). Bartik control for growth in labor productivity (labor demand) predicts productivity growth based on national industry-level growth and initial composition; it is defined as $Bartik_{zt} = \sum_d (share_{zd,1970}^{empl} \Delta lnwage_{dt})$, where $share_{zd,1970}^{empl}$ is the initial employment share of industry d in commuting zone z and $\Delta lnwage_{dt}$ is the national wage growth from 1970. Lastly, we control for a number of demographic factors, although they may be endogenous due to push factors out of manufacturing being correlated with wages and also demographic characteristics, which is why we do not include them in the main specification.

Another robustness check entails using an alternative definition of offshoring–employment of majority-owned enterprises, since employment of all affiliate (including arm's-length) enterprises may be overestimating the total change in offshoring exposure (although, in practice, the two measures are very close), and trade with arm's-length affiliates may be different than with majority-owned ones. Additionally and relatedly, additional robustness check uses parent-based industry classification (instead of affiliate-based used in the main specification) to measure offshoring. The effect may be different if the local industry is engaging in offshoring rather than being offshored;

[20]For example, if industries that experience large offshoring increase also experience large labor productivity shocks.

in practice, a lot of offshoring is intra-industry when industry definition is sufficiently coarse and parent- and affiliate-based measures are very close.

The next robustness check uses an alternative definition of immigration change, one standardized by initial employment. One potential criticism of using immigrant share change is that it includes native worker number in the denominator, which may be affected by local demand shocks that also affect wages. An alternative approach is to define $\Delta imm\_stand_z = \Delta M_z/(M_{z,t-1} + N_{z,t-1})$, a change in the number of immigrants divided by lagged employment to take out potential native outflow, although, as mentioned, native mobility response to labor demand shocks is generally limited.

We primarily focus on manufacturing since it is subject to overwhelmingly greater extent of offshoring, but we broaden the scope in the last three variations on the main specification. Specifically, we use immigrant share change with respect to the entire CZ employment, rather than manufacturing, as this way movement (of natives) out of manufacturing is less likely to confound interpretation. Additionally, we investigate whether wage effects for the entire CZ are different compared to just manufacturing. Lastly, we incorporate non-manufacturing offshoring in measuring offshoring exposure to see if the results are robust to a much broader measure of offshoring.

Native vs. Immigrant Task Intensity of Offshoring

Since the channel through which offshoring may enhance the effect of immigration on native wages is through increasing immigrant wage share, we test for this explicitly. Specifically, we look at whether offshoring impacts change in immigrant wage share:

$$\Delta \text{immwageshare}_z = b^o + \gamma^o \Delta \text{offexp}_z + \epsilon_z^o, \tag{B14}$$

where immwageshare_z is the immigrant share of all low-skilled labor payments.

3.2 Data

Measures of wages by education level, wage percentiles, and by task characteristics are calculated based on data from the U.S. Census and American Community Survey (from IPUMS). We focus on hourly wages, imputed by dividing annual earnings by the product of the number of weeks worked and usual weekly hours of work, to avoid capturing employment intensity effect. The universe of individuals includes workers with positive income, aged between 18 and 65, not in group quarters and working at least 30 hours a week (not part-time workers). Cognitive and communication task intensity of occupations is from O*NET. "Communication" task intensity score for the occupation is the average population-weighted percentile (among occupations) of the importance of "Oral Comprehension," "Written Comprehension," "Oral Expression," and "Written Expression" in the occupation; the analog for "cognitive" score is calculated using questions on several cognitive abilities.[21] Manual, routine, and abstract task intensity of occupations is from Autor and Dorn (2013), who use Dictionary of Occupational Titles to calculate relevant occupational scores. Specifically, data on EYEHAND (eye, hand, foot coordination) requirements operationalizes manual task intensity score, STS (adaptability to work requiring set limits, tolerances, or standards) and FINGDEX (finger dexterity)–routine score, and DCP (direction, control, and planning of activities) and GED-MATH (quantitative reasoning requirements)–abstract score.

The time frame for empirical estimation is 1990-2000, because this was a period of large growth in immigration and offshoring, both in terms of employment shares and numbers, driven by macro-level, locally-exogenous factors (additionally, instrument for immigration, crucial for analysis, is no longer strong after 2000). Immigrant shares within CZs are calculated using data from U.S. Census for 1980, 1990, and 2000, and from American Community Survey beyond 2000 (all from IPUMS). Public Use Microdata Area-based data is aggregated up to CZs.[22]

Raw offshoring data comes from Bureau of Economic Analysis Activities of Multinational Enterprises, [23] where it is provided at the industry level. The main specification uses all non-bank affiliate

[21] "Fluency of Ideas," "Originality," "Problem Sensitivity," "Deductive Reasoning," "Inductive Reasoning," "Information Ordering," "Category Flexibility," "Mathematical Reasoning" "Number Facility" and "Memorization."

[22] using crosswalk from Autor and Dorn (2013).

[23] BEA data before 2009 is for non-bank majority owned affiliates; all vs non-bank makes a trivial or no difference in employment values in large manufacturing industries.

employment based on affiliate industry; the latter is provided at the most disaggregated level, which allows most accurate crosswalk between NAICS-based offshoring in 2000 and SIC-based industries used in 1990, employed for the instrument. In robustness checks we also use offshoring calculated from parent-based industries and only majority-owned (which tends to not change results).

3.3 Descriptive Statistics

Figure 1 shows change in manufacturing, non-manufacturing and overall offshoring exposure over time. The graph makes it clear that at a sectoral level offshoring is mainly a manufacturing sector phenomenon. Whereas manufacturing offshoring exposure grew from 18% in 1990 to 22% in 2000 and over 30% in 2014, non-manufacturing offshoring share at the same points was 3%, 5% and 9%. The difference is likely because a lot of services are local and/or require interpersonal contact, and thus cannot be offshored without severe loss of quality. This is the main reason for focusing on the manufacturing sector. Importantly, while many manufacturing industries saw offshoring exposure growth between 1990 and 2000, this process did not affect all industries equally, and there is a large variation in offshoring change over this period (Table 1), with some industries even seeing a decline (petroleum, for example, which saw new sources opening in the U.S.). This varying change in offshoring exposure growth across industries is likely unrelated to CZ-level shocks, creating an opportunity to exploit it for identification purposes.

Figure 2 shows that immigrant share for all skill levels is higher in manufacturing, and while it increased overall, it did so slightly more in manufacturing. Table 2 shows native and immigrant shares of domestic employment. Total immigrant share of employment increased from 0.07 in 1980 to 0.09 in 1990, 0.13 in 2000 and 0.17 in 2014. Meanwhile, the share of foreign-born in manufacturing increased from 0.08 in 1980 to 0.11 in 1990, 0.16 in 2000 and 0.19 in 2014. Thus, immigration increase was largest in the 1990s and especially in manufacturing, further motivating the selection of the sector and time frame for analysis.

Figure 3 illustrates the change in employment numbers rather than shares. Total domestic manufacturing employment went from 20.6 million in 1990 to 19.2 in 2000 and 14.9 in 2014. On the other hand, offshore employment increased from 4.6 million in 1990 to 5.5 in 2000 and over 6.6

in 2014. A somewhat different pattern is observed for immigration. Total (low-skilled) immigrant employment in manufacturing increased from less than 2 million to 2.5 between 1990 to 2000, but decreased to 2 million by 2014, despite the fact that immigrant share of domestic manufacturing labor grew throughout. Since we are interesting in studying the effect of *immigration*-driven increase in immigrant share in manufacturing, this reinforces the idea that studying increase in immigration in manufacturing is more appropriate before 2000 than after. The likely reason behind the decrease in immigrant employment in manufacturing after 2000 is that despite continued immigration into the country (as shown in the growth in immigrant number in non-manufacturing), trade shocks, primarily driven by China entering the WTO, together with technological change decreased demand for both domestic and immigrant workers. Interestingly, while the number of workers in manufacturing without college education decreased since 1990, the number of those with college education remained virtually the same (Figure 3) suggesting jobs losses primarily affected the low-skilled, decreasing native low-skilled share of all manufacturing jobs even further (Figure 7).

We next illustrate the geographic distribution of offshoring and immigration exposure in 2000 as well as change in exposure from 1990 to 2000 (Figure 8, Figure 9, Figure 10, Figure 11). The figures show that there is a great deal of variation in geographic exposure to immigration and offshoring: whereas Appalachia saw large increases in both immigration and offshoring, Southwest mainly experienced large increase in immigration and several commuting zones in the Northwest and Rockies were subject to growing offshoring exposure only,[24] while some CZs throughout the country saw little change in either. This provides useful geographic variation to exploit for empirical analysis. It is also useful to note that the geographic correlation between immigrant share change and offshoring exposure change is close to 0, at -0.007, which is consistent with the two processes being driven by different non-local factors, and one process not significantly affecting the other.

Lastly, Table 3 shows average decadal changes in the variables used for regressions. It is notable that the wages of those with at most high-school education increased by only about 1% (the table shows changes in log wages), while wages of those with some college education increased by 4%

[24]Offshoring exposure change was much more decentralized than what was documented for trade by Autor, Dorn and Hanson (2013) who showed trade exposure grew above the median rate mainly in the Midwest and areas east and northeast of Midwest.

and those with completed college education–9%. Most cognitive-intensive, communication-intensive and abstract occupations also saw slightly higher wage growth than others. We should also note that wages of those in most manual intensive occupations–those at greatest competition with low-skilled immigrants–increased at less than half the rate of those in least manual intensive ones (4% compared to 9%). On the other hand, workers who are seen as closest substitutes for offshore workers–those in the most routine occupations–saw changes generally not different from those in least routine occupations (at 7%). We approach the question of causal effect of immigration and offshoring on wages of various native groups in the next section.

4 Results

We begin by presenting OLS and 2SLS results for the main specification without and with the interaction term. Column 1 in Table 5 shows that without instrumenting immigration exposure change does not have a statistically significant effect on wages of natives with less than bachelor's degree, while offshoring tends to increase them. In column 2 we show 2SLS results, using the instruments for immigration and offshoring described earlier (with the first stage shown in Table 4). First stage Wald F-statistic of 152.5 suggests rejecting weak instrument hypothesis. As is common in the literature, 2SLS results suggest that OLS estimate of immigration effect on native wages is likely upward-biased, as it decreases from statistically insignificant -0.05 to significant -.5 in 2SLS. This means a 0.5 percent decrease in low-skilled native wages for a 0.01 point increase in low-skilled immigrant labor share (or 1 percentage point increase in percent of immigrants in low-skilled labor). This also suggests that price or labor supply effect, which is negative, dominates the positive productivity effect. To compare our estimated result to the literature, the average elasticity of native low-skilled workers with respect change in immigrant share in Longhi, Nijkamp and Poot (2005) meta-analysis is -0.2; it does, however, include all immigrants (inclusive of high-skilled) and incorporates studies using small geographic areas, which tend to see lower impact due to outmigration, as well as studies that do not instrument for immigrant share. In any case, the estimated coefficient here is not statistically different from -0.2, suggesting that the average estimated effect is in line with general findings in the literature of a negative but small effect of immigration on wages of low-skilled natives.

In contrast to immigration, the coefficient on offshoring becomes more positive, increasing from 0.3 to 0.6 (the difference not being statistically significant), further testifying to the productivity effect being dominant for offshoring. Given that Olney (2012) is the closest study to this one in terms of estimating the effect of offshoring on native wages, and it finds a positive effect of offshoring to low-income countries but the opposite for high-income, the result is consistent with change in offshoring to low-income countries dominating change in offshoring to high-income countries, which is possible, given that offshoring to low-income countries increased by more than offshoring to high-income during the period.

Column 3 in Table 5 adds the interaction term. Interpreting OLS specification results with caution, since we know at least immigration share variable is likely endogenous, we observe that the coefficients on both immigration and offshoring are positive. The coefficients on the level terms are not very informative, however, since they estimate the effect of one variable, when the other is 0, which rarely happens, since per descriptive statistics in Table 3, 0 is almost 2 standard deviations below offshoring change mean and 1.5 standard deviations below immigration mean. In this specification we are primarily interested in the interaction term, which is negative, at -9, and highly statistically significant. Column 4 provides 2SLS results with the interaction term. First stage Wald F-statistic of 52.7 suggests the instruments are strong. The coefficient on the interaction term is again negative, but is larger in magnitude, at -32, which means that with a 0.01 increase in offshoring exposure change the effect of immigration on native wages decreases by 0.32. Given the negative effect of immigration found in the specification without the interaction term, offshoring making the effect of immigration more negative is consistent with model scenario of offshoring reinforcing the effect of immigration via increasing immigrant wage share.

4.1 Independent Immigration and Offshoring Effects

We next look at the effects of immigration and offshoring at the same time on wages of natives by education level. The upper panel of Table 6 illustrates that the effect of immigration is most negative on those least educated. Wages of natives with at most high school education decrease by around 0.7 percent for a 1 percentage point increase in low-skilled immigrant share of CZ employment. For the same immigrant share change, wages of natives with less than college education decrease by 0.5. The effect becomes progressively less negative with higher education, and the coefficient is negative and insignificant for those with some college education and positive and insignificant for those with completed college education. This is consistent with immigrants with less than college education being closest substitutes for natives with high school education or less and price effect dominating. In contrast, offshoring increases wages of those with less than college education by 0.6 and those with high-school or less by 0.7, with no effect on those with some college or above. This, again, indicates that productivity effect dominates for offshoring, and that offshoring more strongly affects the low- and medium-skilled workers, who are likely to be part of the factor whose tasks are being offshored.

In panel B of Table 6 we turn to a different proxy for skill–wage percentiles. A one percentage point increase in low-skilled immigrants' share of employment leads to 1.2 percent reduction in 10th wage percentile, 0.6 percent reduction in the 25th percentile and an increase of 0.4 and 0.5 in 75th and 90th percentiles, indicating, again, negative price effect dominating for the low-skilled. The positive effect on the high-skilled is likely a result of the favorable change in factor ratio. Offshoring exposure increases wages of 25th and 50th percentiles among natives, corroborating the presence of the strongest effect on the low- and medium-skilled.

We next look at how task characteristics of workers affect the way they are impacted by immigration and offshoring. Panels C and D present results by routine, manual, abstract, cognitive and communication intensity. It is evident that the most routine, most manual, least abstract, cognitive and communication-intensive occupations are more strongly affected by immigration, seeing an effect size of about -0.6 to -0.7. This is consistent with workers in jobs with these task intensities being more likely to compete with immigrant workers, which echoes findings from Peri and Sparber (2009) and Peri and Sparber (2011). These task intensity groups are also most subject to the effect of offshoring, which ranges from 0.6 to almost 1, which is consistent with the literature findings of greatest offshoring effect on the most routine, although the sign in other empirical works varies and is often negative at least on some types of offshoring (Ebenstein et al. (2014),Baumgarten, Geishecker and Görg (2013)), suggesting productivity effect on most routine workers dominates in the context studied here but maybe not in others.[25]

4.2 Interactive Effect

Table 7 tests whether offshoring reinforces, mitigates or has no impact on how immigration impacts native wages for different native groups. The upper panel shows estimation results for the specification with the interaction term by education level. It reveals that there is a negative interactive effect on groups with less than college education. The point estimate of the interaction term is -0.32 on average for those with less than college education. This means that for a 1 percentage point increase in offshoring the effect of immigration becomes more negative by 0.32; consequently, going from offshoring exposure change of 1 standard deviation below mean (0.02) to 1 standard deviation above (0.08) decreases immigration effect from 0.55 (1.19-0.32*2) to -1.37 (1.19-0.32*8). Figure 12 illustrates the extent to which interactive effect matters graphically–it shows the effect of immigration on wages of natives with less than college education ranges from positive and significant to negative and significant, depending on the extent of offshoring. The interaction term is even more negative for those with less than high school education and less negative for those with some college, but is not statistically significant for college graduates.

Similar estimates arise from using wage percentiles as skill proxies, with the interaction term coefficient decreasing from -40 to -24 going from 10th to 90th. These results are further reinforced in the lower two panels. The interactive effect of offshoring and immigration on the most manual occupations is almost twice that on the least (-42 compared to -23). Slightly smaller but still large differences are present between least and most routine and least and most abstract occupations. Similarly, the most cognitive and communication-intensive occupations are least subject to the negative interactive effect.

Table 8 demonstrates one consequence of the unequal effects across skill/wage spectrum. The

[25] It is worth pointing out that part of the reason for the positive effect of offshoring may also be the selective employment effect, where the least productive workers (hence, the lowest paid) drop out of manufacturing.

table presents effects on the ratio of 90th to 10th wage percentile, the spread between the tails; 75th to 25th percentile, the spread in the middle; 90th to 50th, upper-tail spread; and 50th to 10th, lower tail spread. A monotonically more negative effect of immigration on lowest skilled workers as measured by wage percentile leads to increasing polarization. Additionally, the last column shows the effect on the ratio of wages of college-educated to non-college-educated workers. By all 5 measures, (low-skilled) immigration increases polarization, the lower tail more so than the upper tail. Offshoring, on the other hand, slightly decreases the spread, particularly in the upper tail. When it comes to the interactive effect of immigration and offshoring (lower panel), offshoring tends to increase the extent to which immigration increases polarization, but mainly for the upper tail, as well as the wage difference between those with college education and those without.

4.3 Additional Results and Robustness Checks

Offshoring Task Intensity

The negative interactive effect suggests that offshoring reinforces the negative effect of immigration, consistent with the model prediction in case of offshoring increasing immigrant wage share. It is useful, then, to asses whether offshoring does seem to increase immigrant wage share, which we address in Table 9. The results tend to confirm this prediction. We look at the effects of offshoring on immigrant wage share in manufacturing and all industries (since later on we also use immigrant share with respect to all CZ employment) separately, and estimate the impact for different subgroups of the low-skilled, with and without instruments for offshoring. The results suggest that a 1 percentage increase in offshoring exposure increases immigrant wage share by between 0.2-0.5 percentage points, depending on specification.

Additional Controls

Since the instrument for offshoring is based on local industrial composition and national industry-level changes in offshoring exposure, it may fail the exclusion restriction if national industry-level offshoring exposure is correlated with factors that may also affect wages. In particular, there is a potential problem if greater import exposure/competition change is positively correlated with offshoring change and also affects native wage changes. This may happen, since factors that promote import competition such as lower wages or higher productivity in a given industry abroad or lower tariffs within and industry may stimulate both offshoring and non-offshoring imports. On the other hand, improvements in communication technology may be more important for trade in tasks, where control over the production process abroad and coordination with tasks performed at home are paramount, than for trade in final goods. Since import competition tends to decrease native wages (Ebenstein et al. (2014)), if instrumented offshoring were to be positively correlated with it, it would be downward biased, and the actual positive wage effect of offshoring would be even greater. More importantly, the interaction term estimate would also be biased. To test this, we explicitly control for import competition in the first panel of Table 10. The results are very similar to those in Table 7, which does not control for imports, suggesting that it is unlikely that omitting import competition biases results. The cofficient on the import competition variable itself is generally negative and small, and is only marginally statistically significant for the college-educated natives.

Another possible reason for the instrument exclusion restriction to fail is if national industry-level offshoring exposure change is correlated with industry-level productivity shocks. If the correlation is positive, since higher labor productivity leads to higher wages, offshoring estimate from previous specifications would be biased upwards, and the interaction term would be biased as well. To address this issue, we add labor demand shocks proxy, a "Bartik" instrument as in Basso and Peri (2015), in the second panel of Table 10. The results, again, remain similar. The coefficient on Bartik instrument itself is positive and highly statistically significant, as is expected from a positive demand shock instrument.

Next, in Table 11, we include a variety of demographic controls, including average age, share male, black, single, college educated, Asian and Hispanic. Higher average age, share male, college educated, and Asian tend to increase wages, while share Hispanic tends to decrease them. The main outcome of interest, becomes slightly smaller, but is comparable in magnitude and is still highly statistically significant. However, since manufacturing saw a significant labor exit during the period of analysis, and exit out of manufacturing is non-random, with demographic incidence that also has repercussions for wages, it is possible that one or more of these variables are endogenous, which is why we do not include them in the main specification. This point also highlights the fact that even though mobility between large sectors and between CZs is limited, it does exist, as does movement into unemployment, so the estimated wage effects are after these potential adjustments.

Alternative Offshoring Measures

Next, since there is more than one way to define relevant offshore employment, we explore whether using alternative measures makes a difference for the results. In particular, since we include all non-bank employment, inclusive of arm's length affiliates, this may not be most representative of more narrowly defined offshoring–imports from majority-owned affiliates (although in practice the two measures produce similar offshoring exposure estimates). We use the latter definition and present results in the first column of the upper panel in Table 12; the estimates indicate that the interactive effect is similar to that in the main specification.

Another possibility is that attributing affiliates to industries based on affiliate industry classification may be different from parent-based industry classification. In theory, parent-based classification is more closely associated with industry engaging in offshoring rather than being offshored. In practice, at the 2-digit SIC level of analysis, a lot of offshoring is intra-industry, and affiliate-based measures are very close to parent-based. Column 2 of Table 12 shows that this alternative definition produces similar results to the main specification.

Alternative Immigration Measure

The next robustness check entails using an alternative definition of immigration, one that uses a change in the number of immigrants divided by lagged employment to take out potential native outflow; the issue with the latter is that it may be correlated with negative labor demand shocks that also affect wages (and not are not fully captured by "Bartik" labor demand shock instrument), although native outflow is generally limited at the level of analysis used here (and was more limited before 2000 than after). The third column of the upper panel of Table 12 shows that the sign of the coefficient on the interaction term is maintained, and it increases in magnitude, but the estimates become more noisy and are not statistically significant; part of the reason for the latter may be that it is the immigrant labor share change that interacts with offshoring (per the theoretical model), rather than the standardized change calculated here. Nevertheless, although noisy, this result is generally in line with the other results.

Lastly, in the lower panel of Table 12 we use measures of immigration, wages and offshoring that include non-manufacturing industries. The first column of the lower panel uses immigrant labor share in the entire commuting zone. While mobility between non-manufacturing and manufacturing is limited, it may still play a role in equilibrating local labor markets, and immigrant labor share in the entire CZ may matter differently (than within manufacturing); additionally, immigrant share in manufacturing is generally very similar to overall CZ share, and using the latter may decrease the problem of native outflow from manufacturing. The coefficient on the interaction term is slightly larger in size than in the main specification and is statistically significant, corroborating the main results. In column 2 of the lower panel we look at the effects on overall commuting zone wages, not just those in manufacturing, since part of the adjustment to trade and immigration shocks is switching to jobs outside of manufacturing. Here, too, the main results are echoed. Lastly, we calculate a measure of offshoring based on all the industries, not just manufacturing. While the results become very noisy, perhaps because non-manufacturing offshoring cannot be measured as accurately, the sign and size of the coefficient remains comparable to previous results.

5 Conclusion

The labor market implications of immigration and offshoring have been of interest to researchers, policy makers and the public for quite some time. While there is a fair amount that is known about the impacts of the two and is not controversial, other consequences are debated and some important questions have not been addressed at all. An important aspect of the growing knowledge about the consequences of these processes is the increasing understanding of the heterogeneity of impact depending on native an foreign worker characteristics, occupation and industry type, and other factors. In this study, we show that an important source of the heterogeneity of immigration effect is the extent of offshoring exposure. By analyzing the effects of immigration and offshoring jointly, looking at the effects on workers of different skill levels and task specialization, and focusing on local labor market area effects, we provide a novel contribution to the literature–we find a negative interactive effect between immigration and offshoring, whereby greater levels of offshoring exposure reinforce the negative effects of low-skilled immigration on the low-skilled native workers. The effect is especially salient for those least educated, those in the lowest wage percentiles, and those in the most routine, most manual, least abstract, less cognitive and less communication-intensive occupations in manufacturing (and, tentatively, across all industries within the commuting zone). In estimation, we use plausibly exogenous instruments that rely on pre-period immigrant settlement patterns and industrial composition, and the main results are robust to controlling for local labor demand shocks and import competition as well as to alternative definitions of immigration and offshoring shocks. In addition to evidence of negative interactive effect of immigration and offshoring on native wages, we provide estimates of the average immigration and offshoring effects on native wages, with immigration decreasing and offshoring increasing low-skilled wages, but with little effect on the high-skilled. Potential economic mechanisms behind the empirical results can be understood using the theoretical model developed.

The theoretical model developed provides potential explanation for both the average effects of immigration and offshoring and the interactive effect. Specifically, a task-based model that allows complete and incomplete offshoring of native and immigrant tasks provides several insights. First, increase in low-skilled immigrant labor increases the composite low-skilled labor input, which, in turn, decreases marginal product of labor and composite labor price, and consequently, native wages. At the same time, immigrant labor leads to more specialization on the part of natives in tasks in which they have comparative advantage, increasing wages. The balance of the latter productivity effect and the former price effect determines the net effect of immigration on low-skilled native wages. Empirical results suggest the price effect dominates. This net effect is reinforced by higher immigrant wage share. Labor wage share, in turn, is a function of relative wages, which depend on average comparative advantage of immigrants compared to natives. If offshoring affects natives relatively more than immigrants, it reduces average comparative advantage of natives and increases average immigrant comparative advantage and wage share. This way, offshoring increases the elasticity of native wage response to immigration, producing the negative interactive effect estimated. As an additional confirmation of this mechanism, we find empirically that offshoring is likely native task intensive, as it increases immigrant wage share. Lastly, the model shows that the average effect of offshoring on native wages depends on the relative magnitudes of its price and productivity effects, with the empirical results suggesting the latter dominates.

These findings suggest that there are reasons for researchers and policy makers alike to analyze the effects of immigration and offshoring together, rather than separately, and to take into account the extent of one when predicting the impact of the other. In particular, whereas we find that immigration reduces wages of low-skilled natives and offshoring reinforces this effect on average across all commuting zones, the theoretical model suggests that this need not be the case for every individual commuting zone: immigration can increase native wages in a given CZ if the productivity effect dominates there, while offshoring may mitigate immigration effect in some CZs if it is more immigrant task intensive there. This study provides both the estimates of how immigration and offshoring interact in affecting wages of low-skilled workers on average across all commuting zones, and the rational for why this effect may be heterogeneous across different labor markets.

It is worth acknowledging one of limitations of the model and empirical analysis, which is that while we assume no employment effect, it is part of the adjustment to labor supply and trade shocks. Hence, the role employment (especially, exit out of labor force) plays in the interactive effect of offshoring and immigration on native labor market outcomes warrants being part of a more comprehensive analysis. We leave this question for future research.

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6 Appendix 1: Tables and Figures

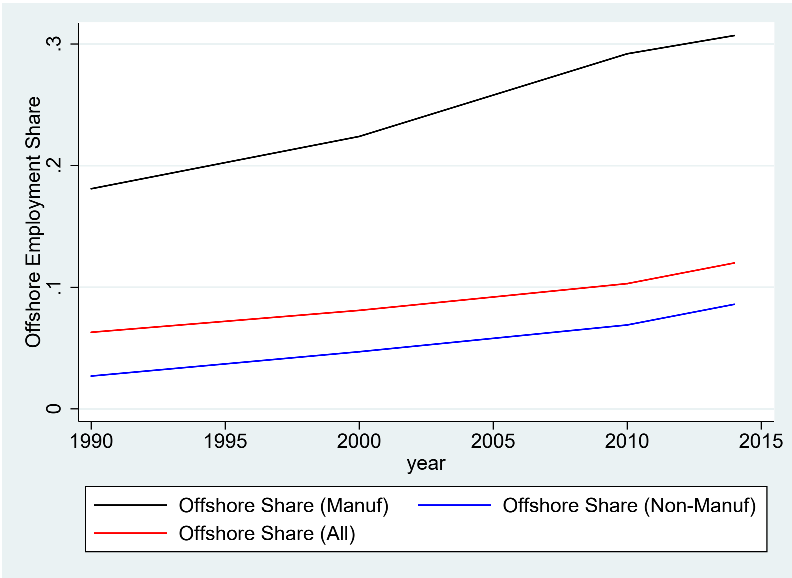

Figure 1: Offshore Share of Employment

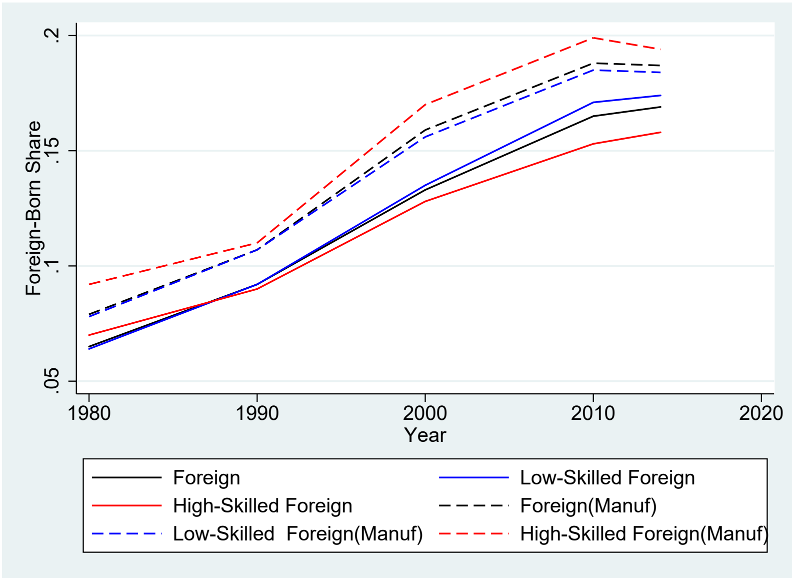

Figure 2: Foreign-born share of employment (Within Skill Group)

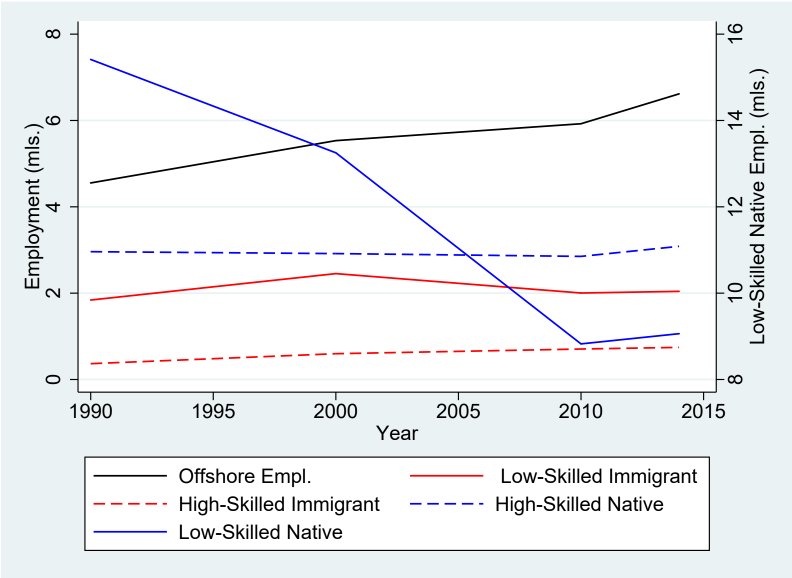

Figure 3: Manufacturing Employment Change

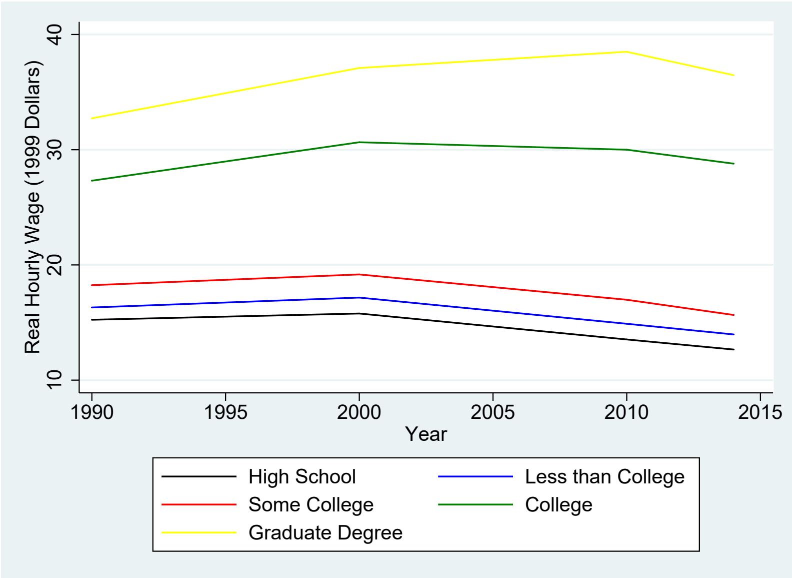

Figure 4: Hourly Wage in Manufacturing

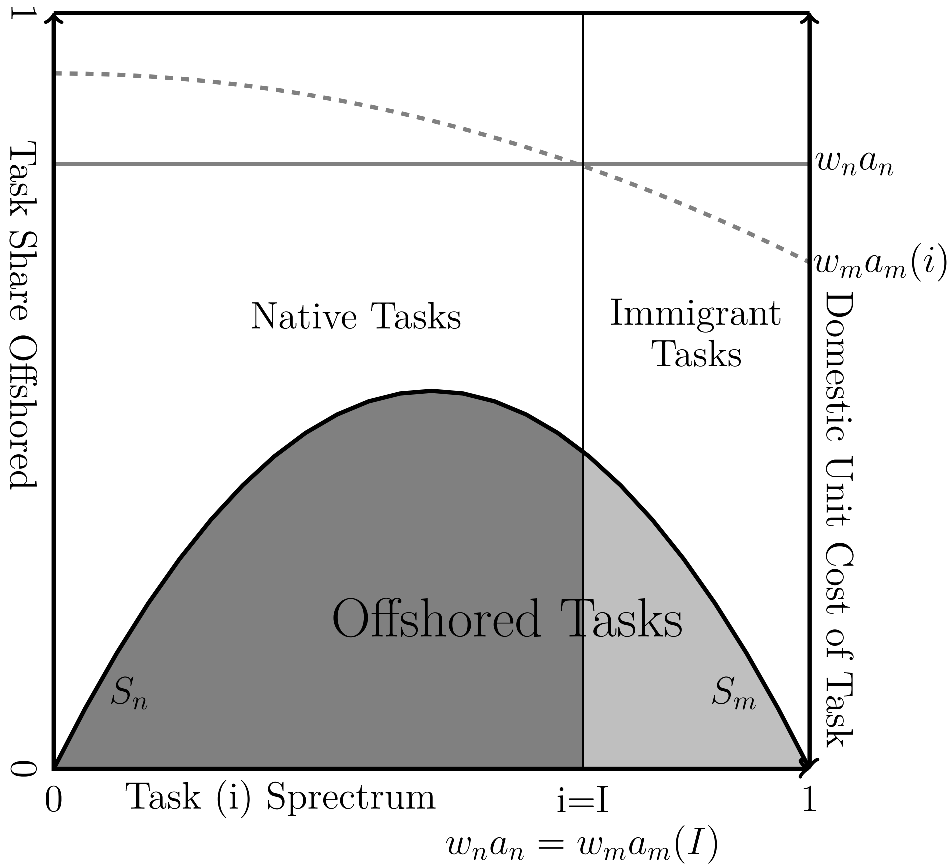

Figure 5: A Potential Task Division

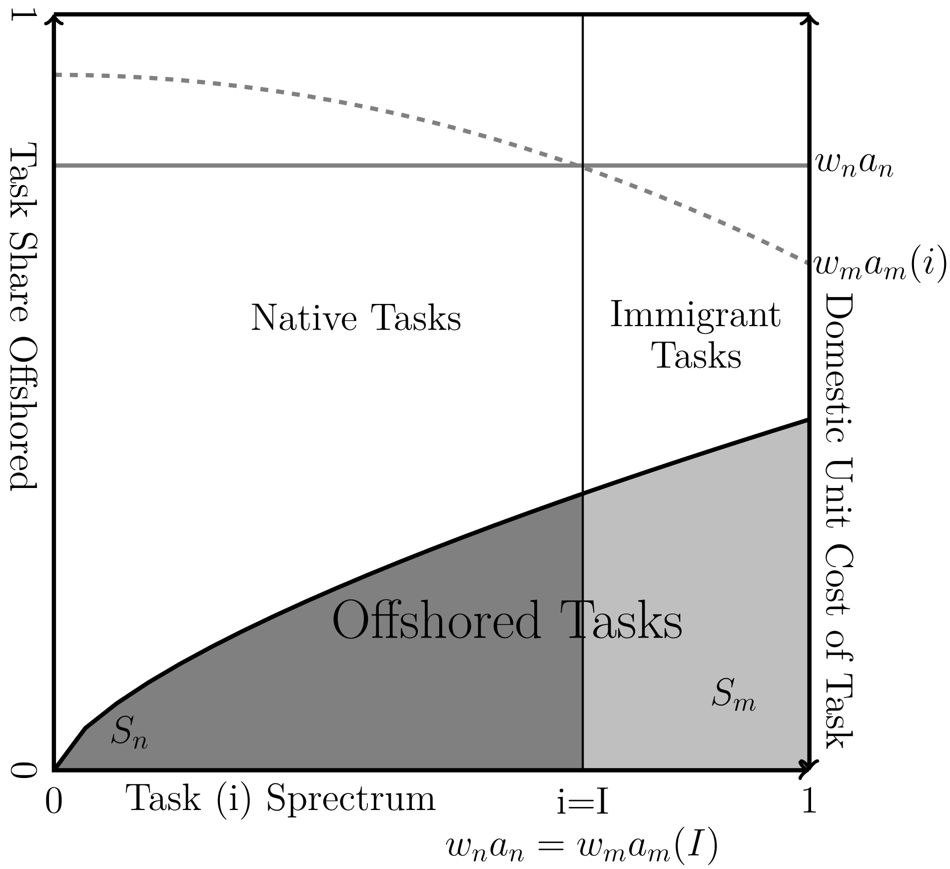

Figure 6: A Potential Task Division

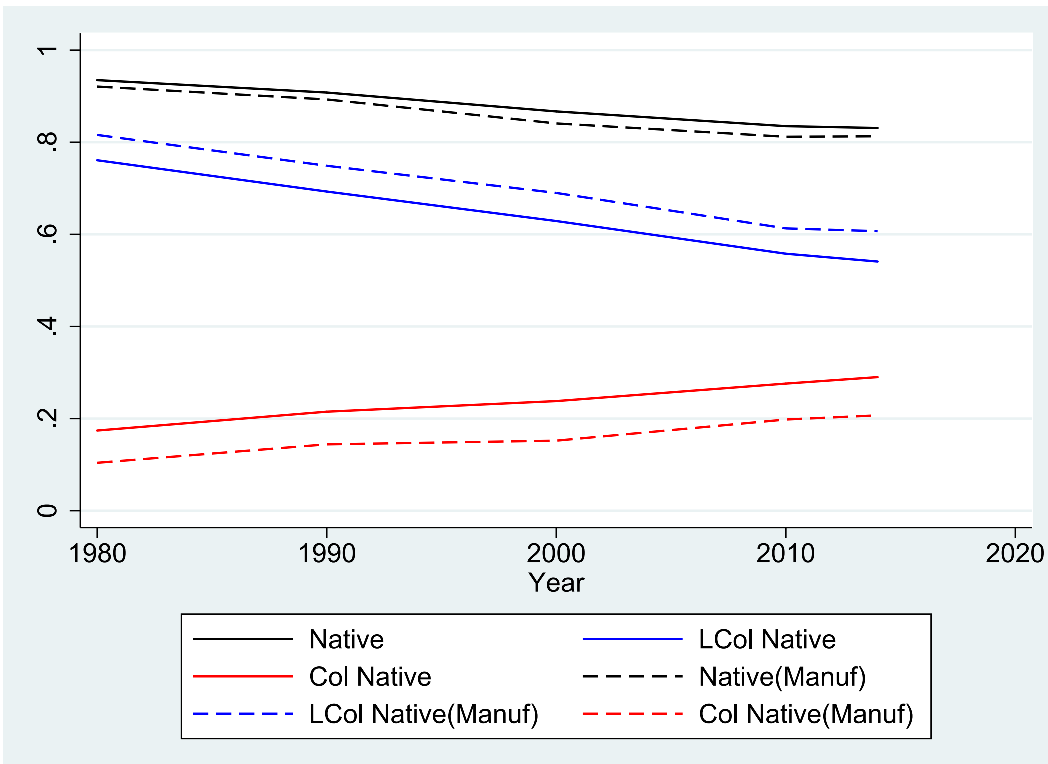

Figure 7: Native share of employment

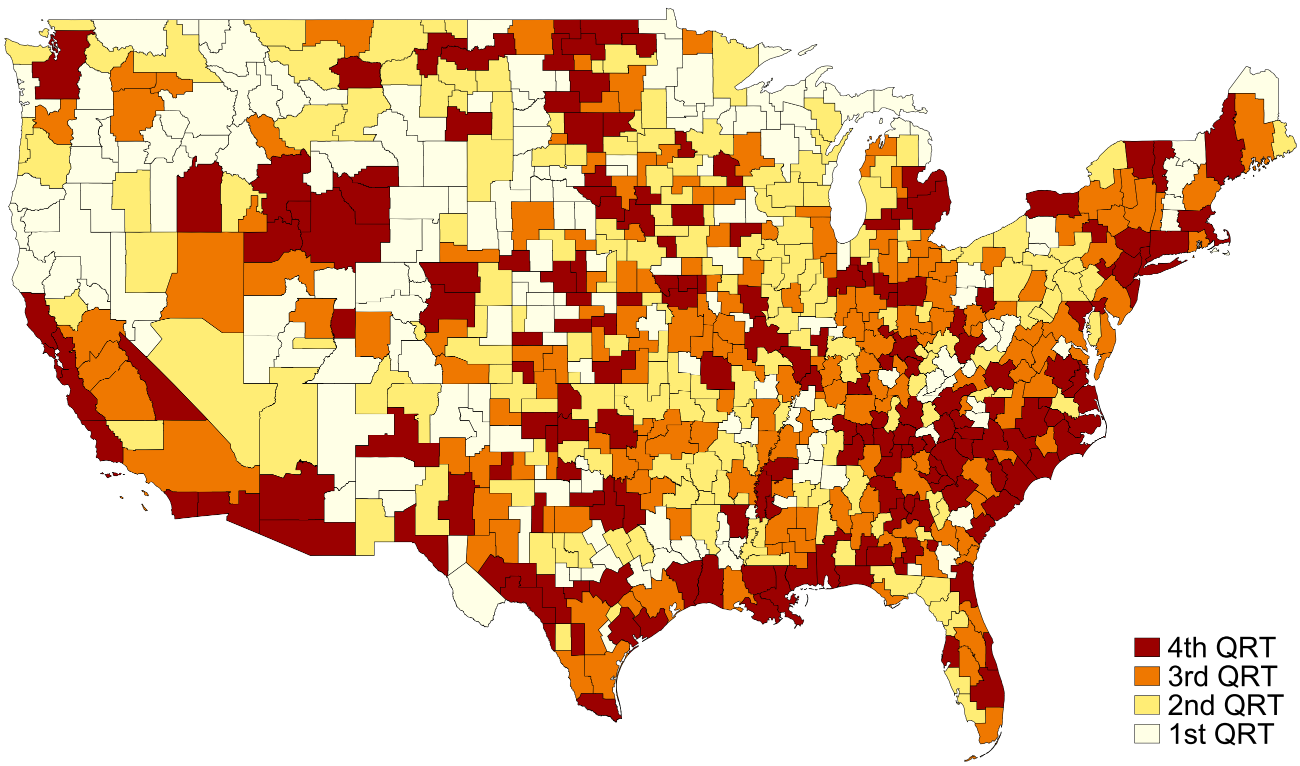

Figure 8: Offshoring Exposure (2000)

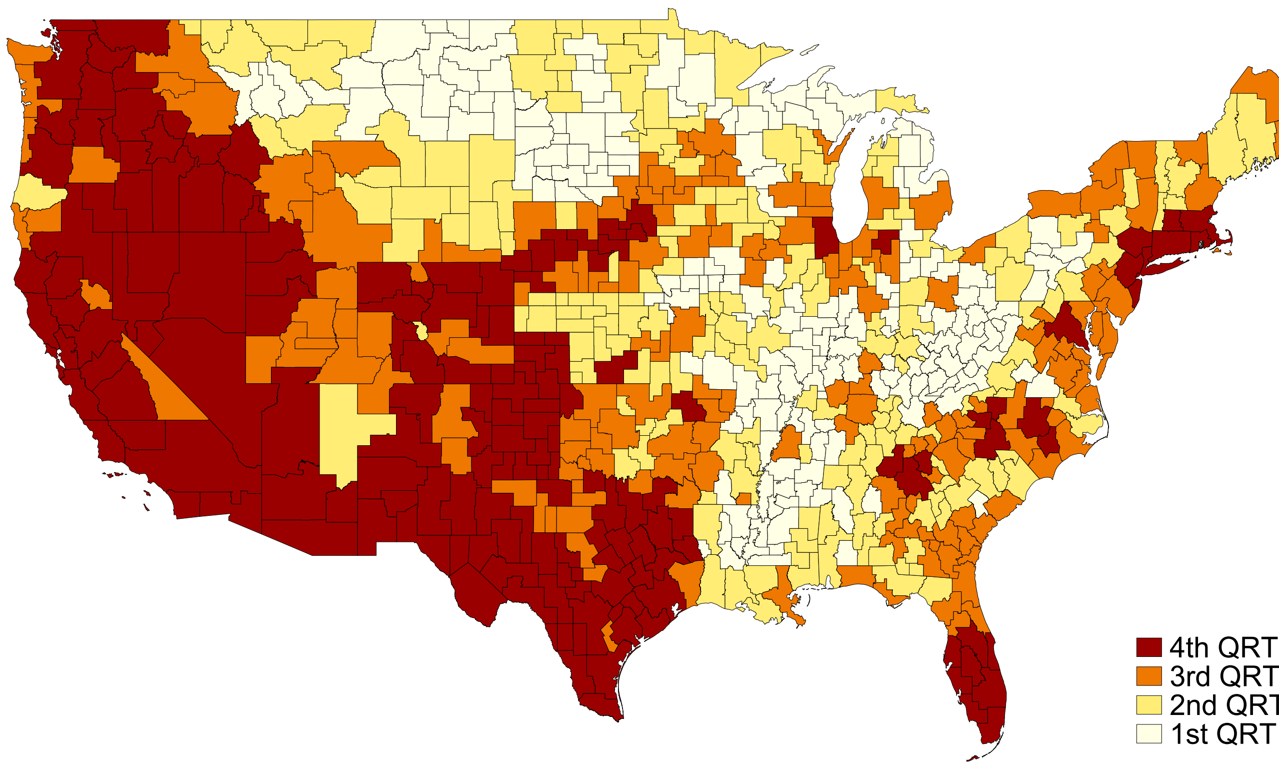

Figure 9: Low-Skilled Immigration Exposure (2000)

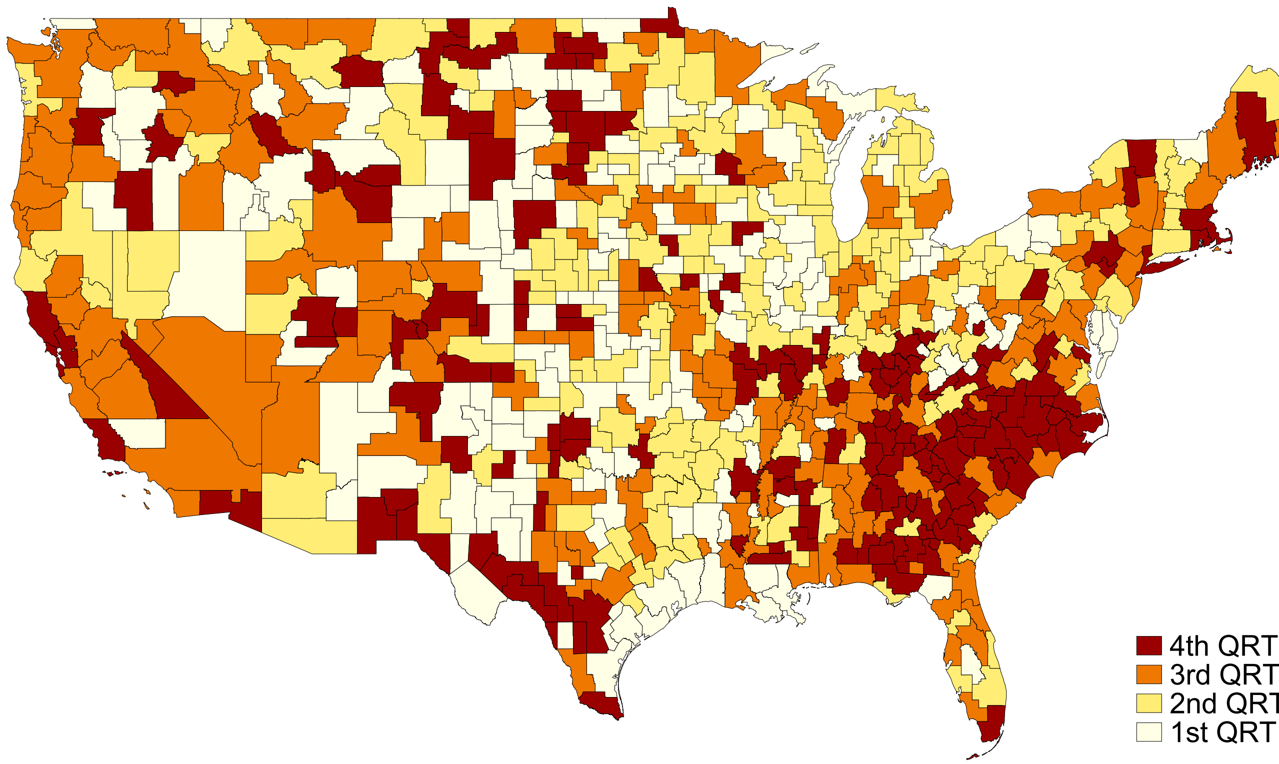

Figure 10: Offshoring Exposure Change (1990-2000)

(Correlation with immigration change = -0.007.)

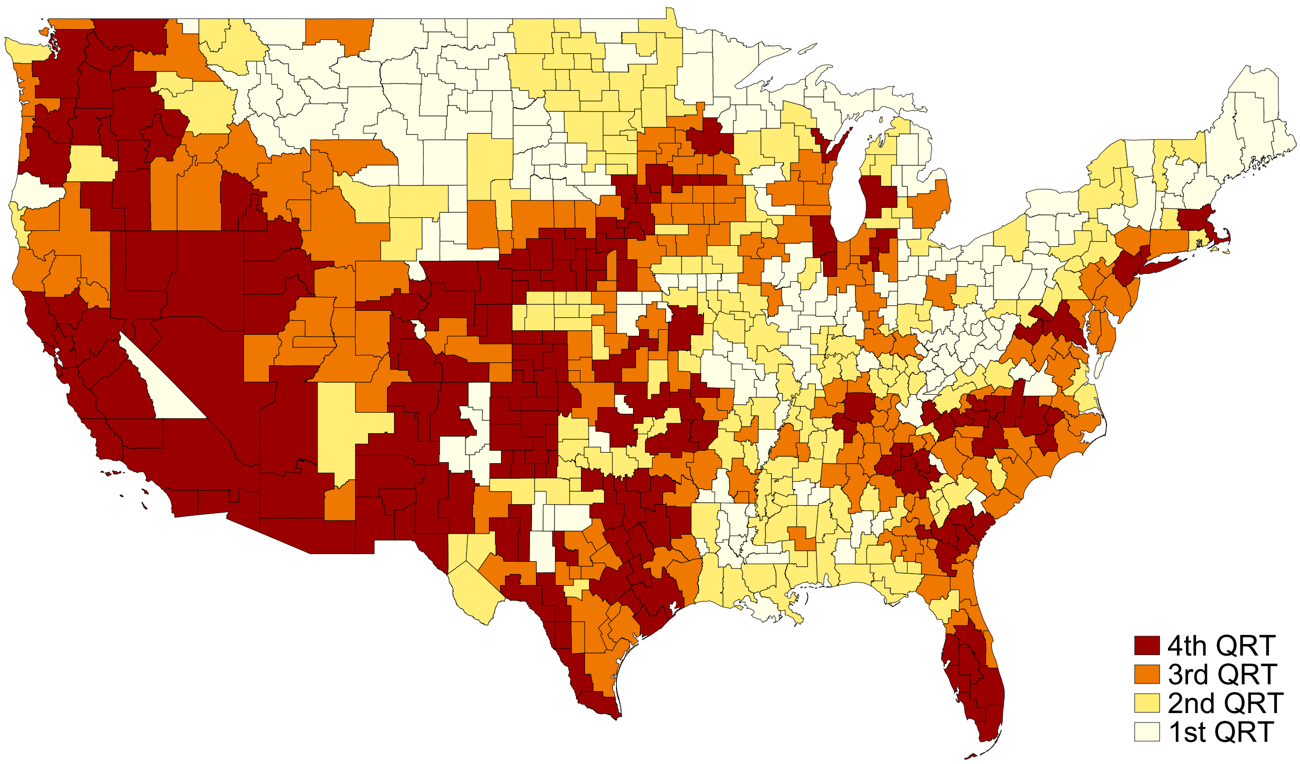

Figure 11: Low-Skilled Immigration Exposure Change (1990-2000)

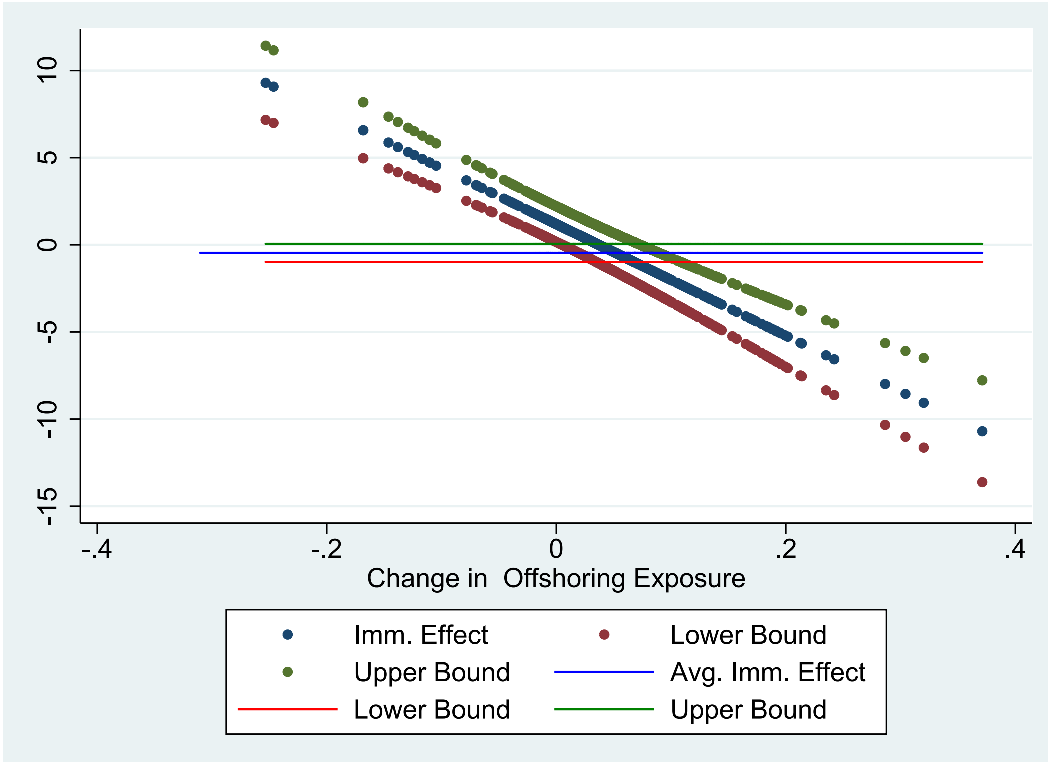

Figure 12: Immigration Effect on those with less than BA by Off. Exp

Table 1: Offshoring Exposure: Affiliate Industry-Based (Emp. in '000)

Indname	SIC	Domestic Employment		Offshoring Exposure	
		1990	2000	1990	2000
Food	200	1453	1546	0.24	0.32
Tobacco	210	40	29	0.59	0.68
Textiles and Apparel	220.5	1682	1114	0.05	0.12
Wood & Furniture	240.5	1217	1336	0.04	0.05
Paper and Allied	260	631	603	0.21	0.22
Printing and Publishing	270	1552	1521	0.02	0.07
Chemicals	280	864	830	0.4	0.43
Petroleum	290	113	108	0.68	0.35
Rubber and Plastics	300	883	1060	0.15	0.14
Glass and Stone	320	523	525	0.16	0.14
Primary Metals	330	723	689	0.09	0.13
Fabricated Metals	340	1483	1568	0.1	0.09
Industrial Machinery	350	1922	1893	0.23	0.23
Electrical Equipment	360	1557	1508	0.31	0.36
Transportation Equipment	370	1798	1568	0.33	0.39
Instruments and Related	380	966	792	0.17	0.18
Other Manuf.	390	512	448	0.11	0.14

Table 2: Employment Number and Share by Education and Origin

		All Industries					Manufacturing				
		1980	1990	2000	2010	2014	1980	1990	2000	2010	2014
						Share					
All	Native	0.935	0.908	0.867	0.835	0.831	0.921	0.893	0.841	0.812	0.813
	Foreign	0.065	0.092	0.133	0.165	0.169	0.079	0.107	0.159	0.188	0.187
HS	Native	0.932	0.891	0.826	0.765	0.760	0.918	0.878	0.809	0.763	0.763
	Foreign	0.068	0.109	0.174	0.235	0.240	0.082	0.122	0.191	0.237	0.237
Lcol	Native	0.761	0.693	0.629	0.558	0.541	0.816	0.749	0.69	0.613	0.607
	Foreign	0.052	0.07	0.098	0.116	0.114	0.069	0.089	0.128	0.139	0.137
Scol	Native	0.946	0.935	0.916	0.895	0.894	0.937	0.928	0.908	0.894	0.894
	Foreign	0.054	0.065	0.084	0.105	0.106	0.063	0.072	0.092	0.106	0.106
Col	Native	0.174	0.215	0.238	0.276	0.29	0.104	0.144	0.152	0.198	0.207
	Foreign	0.013	0.021	0.035	0.05	0.054	0.011	0.018	0.031	0.049	0.05
MA	Native	0.871	0.888	0.842	0.821	0.810	0.818	0.825	0.745	0.689	0.701
	Foreign	0.129	0.113	0.158	0.179	0.190	0.182	0.175	0.255	0.311	0.299
						Employment (millions)					
All	All	84.7	101.2	116.3	117.7	122.9	22.0	20.6	19.2	14.4	14.9
	Native	79.2	91.9	100.8	98.3	102.1	20.3	18.4	16.2	11.7	12.1
	Foreign	5.5	9.3	15.5	19.4	20.8	1.7	2.2	3.1	2.7	2.8
Lcol	Native	64.4	70.2	73.2	65.7	66.5	18.0	15.4	13.3	8.8	9.1
	Foreign	4.4	7.1	11.4	13.7	14.0	1.5	1.8	2.5	2.0	2.0
Col	Native	14.7	21.8	27.7	32.5	35.6	2.3	3.0	2.9	2.8	3.1
	Foreign	1.1	2.1	4.1	5.9	6.6	0.2	0.4	0.6	0.7	0.7

Table 3: Regression Tables Descriptive Statistics (1990-2000 Change)

Variable	N	Mean	SD	Min	Max
Wages (HS or Less)	741	0.01	0.07	-0.5	0.24
Wages (Some College)	741	0.04	0.06	-0.66	0.59
Wages (Less than College)	741	0.03	0.06	-0.55	0.35
Wages (College)	741	0.09	0.09	-0.47	1.04
Wages (Masters)	710	0.08	0.2	-1.95	2.38
Wages (10th percentile)	741	0.05	0.09	-0.47	0.73
Wages (25th percentile)	741	0.04	0.07	-0.63	0.51
Wages (50th percentile)	741	0.03	0.07	-0.63	0.35
Wages (75th percentile)	741	0.05	0.07	-0.64	0.46
Wages (90th percentile)	741	0.09	0.08	-0.54	0.56
Wage Polarization (90th/10th)	741	0	0.08	-0.68	0.53
Wage Polarization (75th/25th)	741	0	0.04	-0.3	0.15
Wage Polarization (90th/50th)	741	0.02	0.03	-0.14	0.18
Wage Polarization (50th/10th)	741	-0.02	0.05	-0.41	0.38
Wages (College/No College)	741	0.02	0.04	-0.25	0.37
Wages (Least Manual)	741	0.09	0.07	-0.45	0.69
Wages (Most Manual)	741	0.04	0.08	-0.84	0.42
Wages (Least Routine)	741	0.07	0.08	-0.52	0.57
Wages (Most Routine)	741	0.07	0.08	-0.61	0.84
Wages (Least Abstract)	741	0.04	0.07	-0.68	0.44
Wages (Most Abstract)	741	0.05	0.07	-0.39	0.47
Wages (Least Cognitive)	741	0.01	0.08	-0.75	0.32
Wages (Most Cognitive)	741	0.03	0.08	-0.54	0.69
Wages (Least Communication)	741	0.04	0.08	-0.68	0.45
Wages (Most Communication)	741	0.05	0.1	-0.55	1.16
Immigrant Share (Below College)	741	0.03	0.02	-0.02	0.11
Immigration Instrument	741	0.04	0.05	-0.01	0.21
Offshoring Exposure	734	0.05	0.03	-0.25	0.37
Offshoring Instrument	737	0.03	0.02	-0.24	0.23
Offshoring (Majority Owned)	734	0.06	0.03	-0.23	0.32
Offshoring (Parent-Based)	734	0.04	0.03	-0.29	0.40
Import Competion	722	0.43	0.38	-0.02	7.62
Import Competition Isntrument	722	0.33	0.28	-0.47	4.28
Stardardized Immigration	722	0.07	0.06	-0.02	0.30
Bartik Labor Demand Shocks	722	0.06	0.01	0.04	0.08
Average Age	741	1.69	0.47	-0.56	4.47
Share Male	741	-0.01	0.01	-0.08	0.04
Share Black	741	0.01	0.01	-0.08	0.15
Share Single	741	0.01	0.02	-0.07	0.16
Share College Educated	741	0.04	0.02	-0.10	0.15
Manufacturing Empl. Share	741	-0.04	0.02	-0.24	0.09
Share Asian	741	0.02	0.01	-0.07	0.09
Share Hispanic	741	0.03	0.03	-0.20	0.31

Note: all wages are for native workers.

Table 4: First Stage

	Dimmshare	Doffexp	Dimmshare	Doffexp	Dinteraction
Immigration Instrument	0.661***	0.0191	0.898***	-0.0470	0.00658
	(0.0556)	(0.0480)	(0.109)	(0.0965)	(0.0188)
Offshoring Instrument	0.331*	1.300***	0.598***	1.226***	0.0548**
	(0.130)	(0.127)	(0.156)	(0.140)	(0.0195)
Immigration Inst. # Offshoring Inst.			-6.418*	1.786	0.771
			(3.192)	(3.357)	(0.691)
N	737	734	737	734	734
R-sq	0.65	0.31	0.66	0.31	0.46
F-Stat, Inst.	71.6	58.5	74.0	44.8	15.7

Standard errors in parentheses

Weighted by lagged CZ employment.

+ p<0.10, * p<0.05, ** p<0.010, *** p<0.001

Table 5: Immigration and Offshoring Effects of Native Wages (< BA)

	OLS	2SLS	OLS	2SLS
Immigration Change	-0.0509	-0.462+	0.388	1.189*
	(0.191)	(0.250)	(0.256)	(0.521)
Offshoring Change	0.319*	0.576*	0.873***	2.295***
	(0.160)	(0.265)	(0.131)	(0.691)
Immigration Ch.#Offshoring Ch.			-8.894***	-32.03*
			(2.651)	(14.16)
N	734	734	734	734
R-sq	0.03		0.10	
Wald F-stat of 1st Stage		152.5		52.7

Standard errors in parentheses

Weighted by lagged CZ employment.

The dependent variable is change in wages of natives with less than Bachelor's

+ p<0.10, * p<0.05, ** p<0.010, *** p<0.001

Table 6: Offshoring and Immigration Effects on Native Wages

	Panel A. By Education					
	High School or Below	Below College	Some Col.	College		
Immigration Change	-0.663*	-0.462+	-0.185	0.384		
	(0.288)	(0.251)	(0.186)	(0.241)		
Offshoring Change	0.698*	0.576*	0.164	-0.0412		
	(0.290)	(0.265)	(0.215)	(0.234)		
	Panel B. By Wage Percentile					
	p10	p25	p50	p75	p90	
Immigration Change	-1.172**	-0.579+	-0.0314	0.398+	0.504+	
	(0.430)	(0.321)	(0.280)	(0.232)	(0.287)	
Offshoring Change	0.481	0.686*	0.602*	0.258	-0.0552	
	(0.385)	(0.299)	(0.288)	(0.250)	(0.200)	
	Panel C. By Task Intensity					
	Manual		Routine		Abstract	
	Least	Most	Least	Most	Least	Most
Immigration Change	-0.0427	-0.632*	0.0376	-0.715*	-0.639*	0.266
	(0.272)	(0.271)	(0.268)	(0.333)	(0.275)	(0.222)
Offshoring Change	0.215	0.814**	-0.120	0.950*	0.622*	-0.0868
	(0.281)	(0.300)	(0.191)	(0.369)	(0.313)	(0.177)
	Panel D. By Task Intensity (Least/Most Intensive Third)					
	Communication			Cognitive		
	Least	Middle	Most	Least	Middle	Most
Immigration Change	-0.709*	0.238	0.187	-0.676*	-0.127	0.146
	(0.311)	(0.255)	(0.246)	(0.293)	(0.252)	(0.214)
Offshoring Change	0.785**	-0.161	-0.195	0.804**	0.302	0.114
	(0.300)	(0.272)	(0.159)	(0.298)	(0.236)	(0.182)

Standard errors in parenthesis

Weighed by lagged CZ employment. The number of observations is 734 in each regression.

+ p<0.10 * p<0.05 ** p<0.010 *** p<0.001

Table 7: Offshoring and Immigration Effects on Native Wages

Panel A. By Education

	High School or Below	Below College	Some Col.	College
Immigration Change	1.136+	1.189*	0.968**	1.119**
	(0.626)	(0.521)	(0.354)	(0.418)
Offshoring Change	2.573**	2.295***	1.365**	0.725
	(0.815)	(0.691)	(0.475)	(0.524)
Immigration Ch.#Offshoring Ch.	-34.92*	-32.03*	-22.38*	-14.28
	(17.16)	(14.16)	(9.163)	(9.971)

Panel B. By Wage Percentile

	p10	p25	p50	p75	p90
Immigration Ch.#Offshoring Ch.	-40.12+	-35.96*	-35.72*	-29.93**	-24.44*
	(22.18)	(17.73)	(15.38)	(11.48)	(10.87)
Immigration Change	0.896	1.274*	1.809**	1.940***	1.764***
	(0.787)	(0.646)	(0.579)	(0.518)	(0.437)
Offshoring Change	2.634*	2.616**	2.519***	1.865***	1.257*
	(1.054)	(0.845)	(0.736)	(0.561)	(0.524)

Panel C. By Task Intensity (Least/Most Intensive Third)

	Manual		Routine		Abstract	
	Least	Most	Least	Most	Least	Most
Immigration Ch.#Offshoring Ch.	-23.23*	-41.96*	-29.57+	-39.80*	-31.34+	-20.68+
	(11.06)	(19.69)	(15.88)	(16.39)	(16.66)	(11.01)
Immigration Change	1.234**	1.447*	1.481*	1.419*	0.975	1.331**
	(0.427)	(0.724)	(0.617)	(0.634)	(0.611)	(0.435)
Offshoring Change	1.126*	3.202***	1.803*	2.950***	2.304**	1.023*
	(0.535)	(0.933)	(0.768)	(0.795)	(0.803)	(0.515)

Panel D. By Task Intensity (Least/Most Intensive Third)

	Communication			Cognitive		
	Least	Middle	Most	Least	Middle	Most
Immigration Ch.#Offshoring Ch.	-26.99	-29.55**	-18.11	-28.72+	-30.47*	-21.24+
	(18.36)	(9.281)	(11.36)	(16.91)	(12.32)	(10.97)
Immigration Change	0.682	1.761***	1.120**	0.804	1.443**	1.240**
	(0.676)	(0.411)	(0.429)	(0.620)	(0.509)	(0.429)
Offshoring Change	2.234**	1.425**	0.777	2.346**	1.937**	1.254*
	(0.852)	(0.496)	(0.526)	(0.804)	(0.612)	(0.521)

Standard errors in parenthesis

Weighed by lagged CZ employment. The number of observations is 734 in each regression.

+ $p<0.10$ * $p<0.05$ ** $p<0.010$ *** $p<0.001$

Table 8: Offshoring/Immigration Effects on Wage Polarization

	9010	7525	9050	5010	Col/Lcol
Immigration Change	1.264***	0.490***	0.194***	0.795***	0.354***
	(0.242)	(0.100)	(0.0397)	(0.171)	(0.0617)
Offshoring Change	-0.530+	-0.311*	-0.320***	-0.0615	-0.309**
	(0.288)	(0.121)	(0.0910)	(0.157)	(0.109)

With Interaction

	9010	7525	9050	5010	Col/Lcol
Immigration Ch.#Offshoring Ch.	24.46+	7.890	7.655*	10.54	9.778*
	(14.55)	(5.757)	(3.620)	(8.079)	(3.845)
Immigration Change	0.00315	0.0833	-0.200	0.252	-0.150
	(0.540)	(0.234)	(0.148)	(0.304)	(0.161)
Offshoring Change	-1.843**	-0.735**	-0.731***	-0.627	-0.834***
	(0.711)	(0.280)	(0.190)	(0.391)	(0.209)

Standard errors in parenthesis

Weighed by lagged CZ employment. The number of observations is 734 in each regression.

+ p<0.10 * p<0.05 ** p<0.010 *** p<0.001

Table 9: Offshoring Effect on Migrant Wage Share

		OLS			2SLS	
	HS	SCOL	LCOL	HS	SCOL	LCOL
			Overall Across CZone			
Offshoring Change	0.265+	0.208*	0.227*	0.342	0.252*	0.293+
	(0.146)	(0.0854)	(0.112)	(0.235)	(0.107)	(0.167)
N	734	734	734	734	734	734
R-sq	0.03	0.10	0.05	0.03	0.09	0.05
			Manufacturing Sector Only			
Offshoring Change	0.230	0.187+	0.234	0.485	0.301*	0.485+
	(0.180)	(0.0983)	(0.151)	(0.307)	(0.152)	(0.248)
N	734	734	734	734	734	734
R-sq	0.02	0.03	0.03	.	0.02	.

Standard errors in parenthesis

Weighed by lagged CZ employment.

+ p<0.10 * p<0.05 ** p<0.010 *** p<0.001

Table 10: Robustness Check: Import Competition, Labor Demand Shocks

	High School or Below	Below College	Some Col.	College	Col/LCol
With Imp. Competition					
Immigration Change	1.115+	1.144*	0.892**	1.042**	-0.160
	(0.604)	(0.487)	(0.308)	(0.380)	(0.155)
Offshoring Change	2.543**	2.255**	1.316**	0.772	-0.793***
	(0.852)	(0.710)	(0.471)	(0.534)	(0.223)
Immigration Ch.#Offshoring Ch.	-34.33*	-31.01*	-20.86*	-13.67	9.503*
	(16.97)	(13.61)	(8.185)	(9.128)	(3.868)
Import Competition	0.00226	-0.00136	-0.00805	-0.0363+	-0.0149+
	(0.0269)	(0.0236)	(0.0183)	(0.0206)	(0.00892)
With Bartik Labor Demand Shocks					
	High School or Below	Below College	Some Col.	College	Col/LCol
Immigration Change	0.813	0.886+	0.705*	0.884*	-0.104
	(0.583)	(0.462)	(0.280)	(0.346)	(0.159)
Offshoring Change	2.200**	1.962**	1.103**	0.593	-0.729***
	(0.772)	(0.641)	(0.426)	(0.509)	(0.221)
Immigration Ch.#Offshoring Ch.	-31.80*	-28.85*	-19.29**	-12.35	9.035*
	(15.76)	(12.52)	(7.314)	(8.302)	(3.744)
Bartik LD Shocks	3.615***	3.084***	2.244***	1.889+	-0.669
	(0.949)	(0.815)	(0.655)	(1.072)	(0.430)
Import Competition	-0.00440	-0.00705	-0.0122	-0.0398+	-0.0137+
	(0.0250)	(0.0223)	(0.0175)	(0.0213)	(0.00794)

Standard errors in parenthesis

Weighed by lagged CZ employment. The number of observations is 734 in each regression.

+ p<0.10 * p<0.05 ** p<0.010 *** p<0.001

Table 11: Robustness Check: Demographic Controls

	With Imp. Competition				
	High School or Below	Below College	Some Col.	College	Col/LCol
Immigration Change	0.731*	0.627*	0.285	0.447	-0.156
	(0.318)	(0.257)	(0.235)	(0.396)	(0.156)
Offshoring Change	1.310*	1.117*	0.430	0.149	-0.499*
	(0.546)	(0.457)	(0.371)	(0.460)	(0.232)
Immigration Ch.#Offshoring Ch.	-19.95**	-16.46**	-8.243+	-2.485	7.030*
	(7.746)	(5.989)	(4.399)	(6.603)	(3.165)
Change in Avg. Age	0.0100+	0.0157**	0.0226***	0.0162*	-0.000776
	(0.00568)	(0.00501)	(0.00557)	(0.00683)	(0.00327)
Change in Share Male	0.795***	0.695***	0.535***	0.117	-0.282**
	(0.174)	(0.152)	(0.145)	(0.181)	(0.0937)
Change in Share Black	0.298+	0.154	-0.0285	0.301	0.0414
	(0.165)	(0.131)	(0.121)	(0.184)	(0.0864)
Change in Share Single	-0.301	-0.123	-0.0164	-0.365	-0.0993
	(0.257)	(0.212)	(0.184)	(0.252)	(0.120)
Change in Share College Grad.	0.269	0.398*	0.449**	0.626**	0.0625
	(0.215)	(0.168)	(0.140)	(0.209)	(0.111)
Change in Share Asian	0.677	1.054*	1.260**	2.116***	0.325
	(0.551)	(0.469)	(0.480)	(0.606)	(0.230)
Change in Share Hispanic	-1.120***	-0.882***	-0.439**	-0.558*	0.213+
	(0.273)	(0.211)	(0.169)	(0.264)	(0.113)

Standard errors in parenthesis

Weighed by lagged CZ employment. The number of observations is 734 in each regression.

+ p<0.10 * p<0.05 ** p<0.010 *** p<0.001

Table 12: Robustness Checks

	Majority-Owned	Parent-Based	Standard. Imm.
Immigration Ch.#Offshoring Ch.	-27.27+	-24.69+	-45.52
	(15.12)	(12.95)	(41.27)
Immigration Change	1.344+	0.573	0.512
	(0.741)	(0.520)	(1.089)
Offshoring Change	1.685*	1.663*	1.816
	(0.772)	(0.821)	(1.504)

	CZ Immig. Share	CZ-Wide Wages	W/ Services Offshoring
Immigration Ch.#Offshoring Ch.	-38.38**	-24.98**	-45.77
	(13.12)	(9.600)	(49.51)
Immigration Change	1.241*	0.525	-0.132
	(0.483)	(0.354)	(0.693)
Offshoring Change	1.894***	1.498***	2.650
	(0.529)	(0.384)	(1.721)
Change in Share in Manuf.		0.511**	0.361*
		(0.170)	(0.150)

Standard errors in parenthesis

Weighed by lagged CZ employment. The number of observations is 734 in each regression.

+ p<0.10 * p<0.05 ** p<0.010 *** p<0.001

7 Appendix 2: Theoretical Model Special Case

Whereas the model in the main part of the paper is more flexible and generalizable, we can also obtain analogous insights from modeling offshoring in a more standard way–where an offshored task is offshored completely. To see this in the most transparent way, consider the offshoring of a range of tasks performed originally by native workers $[0, \Delta_n]$, and a range of tasks originally performed by immigrants $[1 - \Delta_m, 1]$, where $\Delta_m > 0$, and $\Delta_n > 0$. We show that whether native or immigrant tasks are offshored directly determines whether native workers adjust to offshoring by shifting to tasks that have relative comparative advantage in. In particular, the analogue of (A2) with offshoring is:

$$\frac{\sigma}{1-\sigma} = \frac{\int_I^{1-\Delta_m} a_m(i)di}{a_n(I - \Delta_n)}, \;\; \theta = \frac{w_m \int_I^{1-\Delta_m} a_m(i)di}{w_m \int_I^{1-\Delta_m} a_m(i)di + w_n a_n(i)(I - \Delta_n)}. \tag{C1}$$

By inspection, the offshoring of native tasks shifts the threshold task to the right, allowing immigrants to specialize more in tasks where they have comparative advantage, while the opposite applies to native workers. The offshoring of immigrant tasks is analogous. Furthermore, offshoring allows more native workers and immigrants to be devoted to the remaining tasks. The result is an increase in the employment of the composite labor input, as can be seen below:

$$Y = N/(a_n(I - \Delta_n)), \;\; Y = M/\int_I^{1-\Delta_m} a_m(i)di. \tag{C2}$$

Finally, let $w_o(i)$ denote the wage cost of a unit of task i selected to be offshored. To account for the cost savings of offshoring, assume henceforth that

$$w_o(i) = (1 - \gamma_i) \min\{w_n a_n, w_m a_m(i)\}, \;\; \gamma_i \in (0, 1),$$

where γ_i denotes proportional cost savings.[26] Introducing these changes into the model, the native wage can be express as

$$w_n = P/\phi(I, \Delta_n, \Delta_m), \tag{C3}$$

where

$$\phi(I, \Delta_n, \Delta_m) \equiv \left(a_n I + B(I) \int_0^1 a_m(i) di - \int_0^{\Delta_n} \gamma_i a_n di - B(I) \int_{1-\Delta_m}^1 \gamma_i a_m(i) di \right), \tag{C4}$$

where, once again, the native wage depends on a price effect and a productivity effect. The price effect depends directly on the employment of the composite labor input Y in (C2). The productivity effect $\phi(I, \Delta_n, \Delta_m)$ depends on the range of tasks natives specialize in, I, as well as the cost savings of offshoring Δ_n and Δ_m that spill over to benefit native workers (Grossman and Rossi-Hansberg (2008)). Using the results above and following the steps from the offshoring model in the main part of the paper, it can be shown that

$$\frac{\hat{w_n}}{\hat{\sigma}} = \left(\alpha - 1 + \varepsilon\tilde{\theta}\right) \frac{\theta}{1-\sigma} \tag{C5}$$

$$\frac{\hat{w_n}}{\hat{\Delta}_n} = (\alpha - 1)(1-\theta)\frac{\Delta_n}{I - \Delta_n} - \varepsilon\tilde{\theta}\frac{\Delta_n}{I - \Delta_n}\theta + \Omega_n \Delta_n \tag{C6}$$

$$\frac{\hat{w_n}}{\hat{\Delta}_m} = [(\alpha - 1 + \varepsilon\tilde{\theta})\theta\zeta_m \Delta_m + \Omega_m \Delta_m] \tag{C7}$$

where, $\varepsilon = \frac{dB(I)/B(I)}{dI/(I-\Delta_n)}$, $\tilde{\theta} = \frac{\int_I^1 a_m(i)di - \int_{1-\Delta_m}^1 \gamma_i a_m(i)di}{\phi(I,\Delta_n,\Delta_m)}$, $\Omega_n = \frac{\gamma(\Delta_n)a_n}{\phi(I,\Delta_n,\Delta_m)}$,$\Omega_m = \frac{B(I)\gamma(1-\Delta_m)a_m(1-\Delta_m)}{\phi(I,\Delta_n,\Delta_m)}$, and $\zeta_m = \frac{a_m(1-\Delta_m)}{\int_I^{1-\Delta_m} a_m(i)di}$]

From (C5), we can observe that the expression for the native wage impact of immigration is very similar to (B12), except for the absence of ζ in the productivity term and slightly different expressions for $\tilde{\theta}$ and ε. Proposition 1 can be expressed as before:

Proposition A1. *The native wage impact of low-skilled immigration is negative (positive) if (and only if) the productivity effect is small (large) relative to the price effect. In both cases, if the difference between productivity parameter ε and price effect $\alpha - 1$ is* ***sufficiently*** *large, a higher*

[26]Note, cost savings are allowed to differ by taks, but the main results are the same if they are constant across tasks.

immigrant wage share magnifies the native wage impact of low-skilled immigration, all else equal.

With regards to the effect of offshoring, as long as offshoring gives rise to wages savings, $\gamma_i > 0$, the possibility of a native wage gain subsequent to either type of offshoring exists. For native task offshoring, the price effect $(\alpha-1)(1-\theta)\frac{\Delta_n}{I-\Delta_n}$ and comparative advantage effect $\varepsilon\tilde{\theta}\frac{\Delta_n}{I-\Delta_n}\theta$ are negative (for the latter–because natives are pushed to perform tasks in which they have less comparative advantage), while the productivity effect is positive. On the other hand, for offshoring of immigrant tasks, price effect $(\alpha-1)\theta\zeta_m\Delta_m$ is negative, and comparative advantage effect $\varepsilon\tilde{\theta}\theta\zeta_m\Delta_m$ (because natives now perform tasks in which they have greater comparative advantage) and productivity effect $\Omega_m\Delta_m$ are positive. Naturally, the overall effect depends on the balance of the three effects.

Proposition A2. *Offshoring of native tasks increases native wages if the productivity effect dominates the price/labor supply and comparative advantage effects, and decreases them otherwise. Analogously, offshoring of immigrant tasks increases native wages if the productivity effect and comparative advantage effect dominate the price/labor supply effect, and decreases them otherwise.*

In summary, the overall native wage effects of offshoring are ambiguous, depending on the relative magnitudes of the price, comparative advantage and productivity effects. Furthermore, since offshoring impacts the immigrant wage share, the precise nature of offshoring has very nuanced implications on the native wage impact of *immigration*:

Proposition A3. *Offshoring of native tasks increases the immigrant wage share, and reinforces the negative (positive) wage impact of immigration if the productivity parameter ϵ is sufficiently small (large) relative to the price effect $(1-\alpha)$.*

Offshoring of immigrant tasks decreases the immigrant wage share, and mitigates against the negative (positive) wage impact of immigration if the productivity parameter ϵ is sufficiently small (large) relative to the price effect $1-\alpha$.

Proposition 3A is more direct and less ambiguous than Proposition 3, as it is certain that native task offshoring increases immigrant wage share and offshoring of immigrant tasks–decreases it. On the other hand, the environment producing the above result is more stylized than that in the general model in the main part of the paper. This more stylized environment, by modeling offshored tasks as offshored completely and exploiting assumptions about their location, is more similar to what is commonly featured in the literature (Ottaviano, Peri and Wright (2013)). This simpler environment produces insights very similar to those in the main theory section, with the same mechanisms at work, and also helps understand factors likely behind the empirical results.