

Immigrant versus Natives?

Displacement and Job Creation

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Development Research Group
Trade and International Integration Team
June 2014



Abstract

The impact of immigration on native workers is driven by two countervailing forces: the degree of substitutability between natives and immigrants, and the increased demand for native workers as immigrants reduce the cost of production and output expands. The literature so far has focused on the former substitution effect, while ignoring the latter scale effect. This paper estimates both of these effects using labor force survey data from Malaysia (1990–2010), a country uniquely suited for understanding the impact of low-skilled immigration. The instrumental variable estimates imply that the elasticity of labor demand (3.4) is greater than the elasticity of substitution between natives and immigrants (2.5). On average the scale effect outweighs the

substitution effect. For every ten additional immigrants, employment of native workers increases by 4.1 in a local labor market. These large reallocation effects are accompanied by negligible relative wage changes. At the national level, a 10 percent increase in immigrants, equivalent to 1 percent increase in labor force, has a small positive effect on native wages (0.14 percent). The impact of immigration is highly heterogeneous for natives with different levels of education, resulting in substantial changes in skill premiums and hence inequality. Immigrants net displace natives with at most primary education; while primarily benefiting those with a little more education, lower secondary or completed secondary education.

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Keywords: immigration, substitution, scale effect, displacement, output expansion

JEL Classification: J23, J61, O15

*The theory in this paper draws on material from Wagner's Ph.D. dissertation at the University of Chicago on "The Heterogeneous Labor Market Effects of Immigration" (Wagner, 2010). We thank Amir Omar and the Institute of Labor Market Information Analysis for their support, and the Department of Statistics of Malaysia for making the data available. Ximena Del Carpio lead the technical advisory project that forms the basis for this paper. Federico Mantovanelli and Mauro Testaverde provided research assistance. We thank Michel Beine, Simone Bertoli, George Borjas, Michael Clemens, Patricia Cortes, Gordon Hanson, Hubert Jayet, David McKenzie and seminar participants at Boston College, Boston University, Georgetown University, George Washington University, the World Bank, TEMPO Conference at Nottingham University, and the 6th International Conference on Migration and Development for comments and suggestions. Contact information: cozden@worldbank.org, mathis.wagner@bc.edu, Boston College, Department of Economics, 140 Commonwealth Avenue, Chestnut Hill MA 02467, USA.

1 Introduction

The central question of an extensive literature on immigration is whether it harms or improves the labor market outcomes (wages and employment) of native workers. However, as Card (2009) points out in his Ely lecture, “most of the existing research on immigration has focused on between-group inequality” (p. 3). Specifically, the debate has centered on the elasticity of substitution between different groups of workers, and the effect on relative wages as immigration changes the relative abundance of different types of labor. The impact of immigration on wage and employment levels and on inequality are related but distinct issues, a point elaborated on by Borjas (2013). While we have made significant progress on the latter issue, the former original research question has not been answered. This paper fills that gap with an empirical strategy for identifying the two economic forces that determine the net effect of immigration on the demand for native labor: the substitution and scale (output expansion) effects. Our estimates of the scale effect of immigration, to our knowledge the first in the literature, allow us to estimate the impact of immigration on the demand for native workers at both the local and national levels.¹

The economic mechanism at the heart of this paper is as follows. An outward shift of the immigrant labor supply curve causes a reduction in immigrant wages. This results in two countervailing economic forces. First, for a given level of output, firms will substitute immigrant for native labor, the standard substitution effect analyzed extensively in the literature. Second, for a given relative wage, firms will employ more native workers as output expands, the scale effect. Drawing on the seminal work by Katz and Murphy

¹For the enduring importance of these questions for policy see, for example, the recent controversy surrounding the Congressional Budget Office (2013) report, or *The Economist* (2006) and the Hamilton Project (2010) policy brief.

(1992) and Card and Lemieux (2001) the literature has used empirical specifications in which fixed effects absorb the scale effect.² In the local labor market approach Card (2001) uses city-fixed effects to control for the scale effect. In the nested-CES approach (e.g. Borjas, 2003; Borjas, Hanson and Grogger, 2011; Ottaviano and Peri, 2012) the scale effect operates at the level of a nest and is controlled for by the inclusion of nest-specific fixed effects. In either methodology, identification comes from the effect of changes in relative labor quantities on relative wages. Hence, the results are informative about the substitution effect which governs the impact of immigration on inequality across different labor groups.³ However, determining the net impact of immigration on native workers requires identifying both scale and substitution effects.⁴

Based on our analytical model we develop a parsimonious empirical strategy to identify scale and substitution effects arising from immigration. We estimate the impact of immigration on (i) native employment, (ii) native wages, and (iii) immigrant wages by using variation in instrumented immigration flows across local labor markets.⁵ We then

²The literature on inequality provides the basis for these specifications. In the Katz and Murphy (1992) the scale effect simply cancels out as they take wage and quantity ratios. Card and Lemieux (2001) illustrate how to extend the methodology to nested-CES production functions, and describe how fixed effects are used to control for nest-level effects.

³The work estimating the impact of immigration on between-group inequality includes work by skill groups (Altonji and Card, 1991), different occupations (Friedberg, 2001 and Card, 2001), and education/experience groups (Borjas, 2003, 2006, Ottaviano and Peri, 2012, Borjas, Grogger and Hanson, 2011, and Docquier, Ozden and Peri, forthcoming), and immigrant versus native (Grossman, 1982, Chiswick, Chiswick and Miller, 1985, LaLonde and Topel, 1991, and Cortes, 2008). See Card (2009) and Borjas (2013) for recent overviews. Dustmann, Frattini and Preston (2013) provide evidence of relative wage effects along the distribution of native wages.

⁴There is a growing literature on adjustment mechanisms that can ameliorate the substitution (displacement) effect of immigration, including induced technological change (Lewis, 2011, 2012), and changing native task specialization (Peri and Sparber, 2009, and Ottaviano, Peri and Wright, 2012). In contrast, the effects emphasized in this paper are present even in the absence of any such adjustment mechanisms. While we focus only on the production effects of immigration, scale effects also have an impact on consumption and real wages as the cost reductions due to immigration are passed onto consumers in the form of lower prices. See Lach (2007) and Cortes (2008) for work on the effect of immigration on prices.

⁵We define a local labor market by the region and industry (pooled over years) in which a worker is employed. For robustness we also provide evidence using variation across localities (regions), as in Card

use these estimates to identify three key parameters of the model: the elasticity of labor demand, the elasticity of substitution between native and immigrant workers, and the elasticity of native labor supply. The first two parameters determine the sign and magnitude of the immigration induced shock to native labor demand. The third, the elasticity of native labor supply, governs the degree to which this demand shock is reflected in wage or employment changes. Using these parameter estimates we are able to identify the effect of immigration on wage and employment levels at a local labor market and national level, as well as, on the returns to education and associated inequality. Finally, we are able to simulate the effect of changes in various immigration policies on these outcomes.

We implement our methodology using Malaysian data. The vast majority of papers in the literature use data from OECD countries, even though half of all immigrants reside in developing countries (Artuc et al., forthcoming). Malaysian data enable us to present rare evidence from a developing country that is also a prominent destination for migrants.⁶ A second key advantage is that the Malaysian experience is uniquely suited to understanding the labor market impact of low-skilled immigration. Immigrants to the United States, and numerous other OECD countries, are overrepresented at both the higher and lower end of the skills distribution (Docquier, Ozden and Peri, 2010). They also have the opportunity to assimilate, obtain permanent residency, and eventually become citizens. This assimilation process creates another potential source of heterogeneity as older immigrants may become more like natives.⁷ In contrast, immigration to Malaysia is

(2001), Card and DiNardo (2000), Cortes (2008), and Peri and Sparber (2009). Altonji and Card (1991) and Ottaviano, Peri and Wright (2012) use variation across industries. Our main specifications combine these approaches and use variation across both regions and industries.

⁶In terms of both income and immigration levels Malaysia is close to a median country.

⁷The high degree of heterogeneity among immigrants in the US likely explains why, as highlighted by Cortes (2008), it is difficult to identify the effect of immigration on immigrant wages for the US.

overwhelmingly low-skilled; and the vast majority of foreign workers are, legally, allowed to remain in Malaysia for at most five years without the ability to bring any dependents, limiting assimilation.⁸

The data for this paper come from the Malaysian Labor Force Survey (LFS), which provides detailed information on the sectoral, skill and geographic composition of the native and immigrant workers for the years 1990 to 2010.⁹ Over this period the fraction of immigrants in the labor force increased from 3.6 to 10.6 percent. In terms of our structural parameter estimates, we find an elasticity of labor demand of 3.4, which is significantly larger than the elasticity of substitution between immigrant and native labor of 2.5.¹⁰ Thus the scale effect outweighs the substitution effect in Malaysia. The IV estimates imply that, on average, an additional 10 immigrants in a given industry-region results in the employment of an additional 4.1 natives. Despite these very large reallocation effects across sectors or regions, immigration has a negligible effect on the relative native wages across local labor markets. This suggests that a large number of Malaysian workers are highly mobile. A 10 percent increase in immigration, roughly equivalent to a 1 percent increase in total the labor force, increases native wage levels by 0.14 percent, but decreases immigrant wages by 3.9 percent. As a result, the net effect on average wages (immigrants and natives combined) is also negative at 0.35 percent.¹¹

⁸In addition, in Malaysia the minimum wage was only introduced in 2012, making it much easier to identify wage effects at the lower-end of the wage distribution during our sample period than would be the case in most OECD countries.

⁹A wage module was added in 2007 and we have detailed wage data for 2007-10.

¹⁰Our estimate is similar to the elasticity of substitution between high and low-skilled labor in the US (Autor and Acemoglu, 2012, provide a recent overview).

¹¹Average wages (across immigrants and natives) fall due to immigration as a consequence of downward-sloping demand for output produced in Malaysia. If the scale effect were smaller than the substitution effect then immigration would result in both immigrant and native wages decreasing.

The impact of immigration is highly heterogeneous for natives with different levels of education and follows an inverted u-shape. The bulk of immigrants have at most primary education and, on net, they displace natives in that education category. The implication is that at the national level a 10 percent increase in the stock of immigrants decreases average wages of natives with at most primary education by a substantial 0.7 percent. Those natives with a little more education, lower secondary or completed secondary education, experience the greatest benefits, with wage gains of 0.38 and 0.26 percent, respectively. The gains for those Malaysians with a vocational diploma or university degree are small and not significant. Our results suggest that immigration to Malaysia resulted in substantial changes in skill premiums and hence inequality.

This paper makes two additional contributions. We construct a novel instrument, combining the insights of Hanson and McIntosh (2010) with the typical Altonji-Card instrument. The identifying variation of our instrument comes from changes in the population and age structure of migrant source countries, primarily Indonesia and the Philippines, and the differential historic propensity of these groups to migrate to particular industry-regions. The concern with the Altonji-Card instrument, as it is with ours, is that very persistent demand shocks would result in a correlation between the historic distribution of immigrants and current demand shocks. However, our instruments rely both on cross-sectional and time-series variation, allowing us to control for such correlated demand trends using industry-region specific linear trends. We show that our results are robust to the inclusion of local labor market-specific time trends, which we take as strong evidence in favor of the validity of our exclusion restriction.

We also contribute to the central methodological debate about the appropriate identi-

fyng variation. The local labor markets literature, following Altonji and Card (1991) and Card (2001), has used the historical distribution of immigrants across local labor markets as an instrument for the current distribution to deal with the endogeneity of immigrant location decisions. Borjas, Freeman and Katz (1996) and Borjas (2003, 2006) criticize this approach arguing that it fails to take into account the off-setting capital and native labor mobility.¹² Their solution is to use variation over time at the national level, where native labor supply can be thought of as perfectly inelastic. The disadvantage of this approach is that it maintains the assumption that the composition of immigrant flows is exogenous. Our analytical and empirical methodology aims to address these concerns and bridge the gap between these two approaches. We instrument for immigration flows and explicitly estimate the elasticity of native labor supply across our local labor markets. This allows us to draw inferences about the effects of immigration at the national level, while using local labor market variation.

The rest of this paper is organized as follows. Section 2 outlines the theoretical framework we use to understand the effects of immigration on natives. Section 3 describes the data. In Section 4 we present our identification strategy, the instrument, main results, and extensive robustness checks. Section 5 presents the identification strategy and results when allowing for heterogeneous effects for natives of different educational attainment. Section 6 presents policy counterfactuals of the impact of additional immigration quotas and levies. Section 7 concludes.

¹²Card and DiNardo (2000), Card (2001) and Card and Lewis (2007) find there is little offsetting native labor mobility across US cities in response to immigration shocks. Borjas (2006) and Cortes (2008) find substantial, but not perfectly, offsetting displacement effects.

2 Theoretical Framework

2.1 Basic Model

Consider an economy with S competitive industries in R regions producing final goods Y using a two-level nested aggregation of native labor N , immigrant labor M and capital K .

$$\begin{aligned} Y_{rs} &= F(L_{rs}, K_{rs}) \\ &= F(G(N_{rs}, M_{rs}), K_{rs}), \end{aligned} \tag{1}$$

with σ_{mn} as the elasticity of substitution between native and immigrant labor (as $\sigma_{mn} \rightarrow \infty$ native and immigrant labor become perfect substitutes). In this basic framework we allow for imperfect substitution between immigrant and native labor, but assume that individuals within groups are perfect substitutes. In an extension, we relax this restriction to allow different substitution patterns between immigrant labor and different types of native labor.

We can derive the elasticity of native wages, native employment, immigrant wages and output with respect to an exogenous change in immigrant labor, using the production function of firms. The impact of immigration will depend on three key parameters: the elasticity of substitution (σ_{mn}), the elasticity of labor demand (η), and the elasticity of native labor supply across industries and regions (ϕ_n). See Appendix A for a derivation of the results used in this section. We suppress industry and region subscripts for notational simplicity.

The elasticity of substitution describes how, for a fixed level of output, firms will change the ratio of native to immigrant employment as the relative wage changes: $\sigma_{mn} = \frac{d \ln(N/M)}{d \ln(w_m/w_n)}$, where w_n and w_m are the wages of native and immigrant workers, respectively. The elasticity of substitution depends on the degree to which the human capital embodied by immigrants and natives is substitutable. Language barriers, cultural norms, and differences in general and industry-specific human capital are reasons why even observationally identical immigrants and natives may nevertheless be imperfect substitutes.

The elasticity of labor demand determines the extent to which a fall in the cost of the labor input L will result in an increase in the employment of that input:

$$\eta = -\frac{d \ln L}{d \ln w_l} = \frac{\sigma_{lk}\psi + \phi_k(s_l\psi + s_k\sigma_{lk})}{\phi_k + s_k\psi + s_l\sigma_{lk}}, \quad (2)$$

This elasticity is always positive (or at least non-negative) and is increasing in the elasticity of demand for the final product ψ , the elasticity of substitution between labor and capital σ_{lk} and elasticity of supply of capital ϕ_k . The degree to which a reduction in labor costs is translated into a reduction in production costs depends on how easy it is to substitute between capital and labor, as well as the availability of capital. In turn, the degree to which a reduction in production costs results in an increase in output, and thus an increase in the demand for all inputs, depends on the elasticity of product demand. The scale effect will, all else equal, be greater in industries / local labor markets where output is more easily traded, and that have more potential substitutes. In those industries small reductions in costs lead to large increases in output, resulting in large scale effects.

The elasticity of native labor supply describes how a change in native wages will affect

the supply of native labor to that industry-region: $\phi_n = \frac{d \ln N}{d \ln w_n}$. It depends primarily on the willingness and ability of native workers to change their industry or region of employment, as well as flexibility to enter and exit the labor force.¹³

The effect of immigration on the wage and employment levels of native workers in an industry-region is given by:

$$\frac{d \ln w_n}{d \ln M} = \frac{s_m (\eta - \sigma_{mn})}{\sigma_{mn} \eta + \phi_n (s_m \eta + s_n \sigma_{mn})}, \quad (3)$$

$$\frac{d \ln N}{d \ln M} = \phi_n \frac{d \ln w_n}{d \ln M}, \quad (4)$$

where s_m and s_n is the shares of immigrant and native labor, respectively, in the total wage bill. Whether immigration increases or decreases the demand for labor depends on whether the elasticity of labor demand or the elasticity of substitution is greater. When $\eta > \sigma_{mn}$, then immigration will increase native wages and employment. The intuition for this result is that the inflow of immigrants reduces the cost of immigrant labor and hence results in two countervailing effects. First, the substitution effect: for a given level of output, firms will substitute immigrant workers for native labor. Second, the scale effect: the decline in the cost of production results in output expansion and hence, for a given relative wage, firms will employ more native workers. The difference in the magnitude of these effects determines whether immigration is a positive or negative shock to the demand for native labor, as seen in equations (3) and (4). The elasticity of native labor

¹³The elasticity of native labor supply across industry-regions can be thought of as deriving from a worker's discrete choice problem that takes the form of a two-level nested logit. Workers can be thought of as first choosing a region and then an industry, reflecting the fact it is likely easier to move across industries within a region than across regions. The elasticity of labor supply across industry-regions is the weighted sum of the elasticity across industries (within the same region) and across regions. With data on worker flows across industries and regions it could be decomposed into these two components.

supply has an important role since it determines the degree to which an immigration induced shock will result in native wage or employment changes in an industry-region. With higher elasticity of labor supply, immigration will result in more native workers relocating across industry-regions, $\frac{d}{d\phi_n} \left(\frac{d \ln N}{d \ln M} \right) > 0$, and less changes in the relative wages across industry-regions $\frac{d}{d\phi_n} \left(\frac{d \ln w_n}{d \ln M} \right) < 0$.

Finally, the effect on immigrant wages is always negative:

$$\frac{d \ln w_m}{d \ln M} = - \frac{\phi_n + s_n \eta + s_m \sigma_{mn}}{\sigma_{mn} \eta + \phi_n (s_m \eta + s_n \sigma_{mn})}, \quad (5)$$

This is simply due to downward sloping demand: an increase in the supply of immigrant labor decreases its price.

2.2 Country-Level Effects of Immigration

A central debate in the literature is the appropriate level of aggregation at which to estimate the impact of immigration on labor market outcomes. Following the local labor markets approach, following Altonji and Card (1991) and Card (2001), we identify the impact of immigration based on variation across industries and regions. In other words, our local labor market is an industry-region in a given year. Hence, the derived demand elasticities given by equations (3), (4) and (5) depend on the elasticity of labor supply of native workers across industries and regions. Borjas, Freeman and Katz (1996) and Borjas (2003, 2006) are critical of this approach arguing that it fails to take account for off-setting native labor mobility across local labor markets. While mobility of workers across industries and regions may be fairly high, at the national level the elasticity of

labor supply depends on the propensity of workers to exit and enter the labor force in response to changes in wages. Consequently, we would expect labor supply to be far less elastic for the country as a whole when compared to a given industry-region.

Though not essential for our analysis, we follow the typical assumption in the literature that native labor supply is perfectly inelastic at the national level (Borjas, Freeman and Katz, 1996; Borjas, 2003; Ottaviano and Peri, 2012). In that case, the country-level effect of immigration is given by the elasticity of native wages with respect to immigration when the elasticity of labor supply is zero:¹⁴

$$\frac{d \ln w_n}{d \ln M} \Big|_N = \frac{s_m (\eta - \sigma_{mn})}{\sigma_{mn} \eta}. \quad (6)$$

Correspondingly, again when the elasticity of native labor supply is zero, the effect of immigration on immigrant wages is given by equation (5):

$$\frac{d \ln w_m}{d \ln M} \Big|_N = -\frac{s_n \eta + s_m \sigma_{mn}}{\sigma_{mn} \eta}. \quad (7)$$

Hence, if we are able to identify the elasticity of substitution and the elasticity of labor demand from variation at the industry-region level, then we are in a position to calculate the effect on native and immigrant labor market outcomes at the national level.

One difficulty is that at the national level general equilibrium effects are likely important. In particular, immigrants not only produce goods and services but also consume them. That will result in a shift in the native labor demand curve due to immigration, not

¹⁴We also present results for a variety of alternative assumptions about the elasticity of labor supply at the national level.

just a movement along it. It is straightforward to adjust for this shift, it simply depends on the propensity of immigrants to consume goods produced in Malaysia. For reasonable propensities (below one) such an adjustment will not make that much difference to our estimates, but in the absence of good information on immigrant consumption we do not make such an adjustment to the estimates in this paper.

2.3 The Role of Scale and Substitution Effects

The distinct role of scale and substitution effects in determining the sign and magnitude of the immigration induced demand shock for native labor is particularly evident at a national level (where the elasticity of labor supply can be assumed to be equal to zero). The average wage effect of immigration, across both immigrants and natives, only depends on the elasticity of labor demand:

$$s_n \frac{d \ln w_n}{d \ln M} \Big|_N + s_m \frac{d \ln w_m}{d \ln M} \Big|_N = -s_m \frac{1}{\eta},$$

and the aggregate wage elasticity (scaled by the immigrant share in the wage bill) is equal to $-\frac{1}{\eta}$. An implication is that immigration will reduce average wages in an economy, and consequently lead to convergence of wage levels between source and destination countries.¹⁵

In contrast, the effect of immigration on inequality between groups depends solely on

¹⁵The long-run effect of immigration on average wages (native and immigrant) is equal to zero if the elastic of labor demand is perfectly elastic. That, in turn, requires the product demand and the supply of capital to be perfectly elastic. Of course, shifts in the demand curve due to immigration will also tend to make average wage effects closer to zero, though they very likely remain negative.

the elasticity of substitution:

$$\frac{d \ln w_n}{d \ln M} \Big|_N - \frac{d \ln w_m}{d \ln M} \Big|_N = -\frac{1}{\sigma_{mn}}.$$

The wage elasticity of native wages with respect to immigration, scaled by the share of immigrants in the labor force, is the sum of these two effects:

$$\frac{1}{s_m} \frac{d \ln w_n}{d \ln M} \Big|_N = \frac{1}{\sigma_{mn}} - \frac{1}{\eta}.$$

In short, the scale effect determines the impact of immigration on average wages in an economy, while the substitution effect determines the impact of immigration on relative wages. Hence, the literature has been able to consider the impact of immigration on inequality without reference to the scale effect.¹⁶

The simple dichotomy observed at the national level between scale and substitution effects no longer applies at the local labor market level, where the elasticity of native labor supply will be frequently different from zero. An interesting case is where the elasticity of labor supply to a local labor market is infinite, i.e. a sufficient number of natives are highly mobile such that wages across local labor markets do not vary. Then the impact of immigration on native wages in the local labor market is zero, and the effect on native employment is given by:

$$\frac{d \ln N}{d \ln M} \Big|_{w_n} = \frac{s_m (\eta - \sigma_{mn})}{s_m (\eta - \sigma_{mn}) + \sigma_{mn}}.$$

¹⁶Borjas (2013) has an extensive discussion of some of these and related results.

The empirical literature on the impact of immigration has used fixed effects to control for the scale effect, thereby allowing for identification of the substitution effect. See Appendix B for an extensive discussion. In the local labor market approach of, for example, Card (2001) production happens at the level of city, and therefore city-fixed effects are used to control for the scale effect. In the nested-CES approach of, for example, Borjas (2003) the inclusion of nest-specific fixed effects also controls for the scale effect. Specifically, in the structural model of Borjas (2003) the inclusion of year and education by year fixed effects absorbs all changes in the demand for native labor due to changes in the scale of production. The remaining correlation between wages and labor quantities (for a fixed level of output) can then be attributed to the substitution effect. Ottaviano and Peri (2012), using a nested-CES production function with potentially imperfect substitution of natives and immigrants within the same education-experience group, estimate the impact of immigration on native wages of a particular education-experience group. Their innovation is to also account for cross-effects: the indirect impacts of immigration on all other groups of workers, thereby providing a more complete estimate of the impact of immigration on native wages. However, these cross-effects are not the source of the scale effect estimated in this paper. The scale effect in this paper arises irrespective of the existence of the cross-effects - though potentially incorporates these as well - and is driven by the increase in output as immigration reduces firms' costs of production.

2.4 Model With Native Heterogeneity

Immigration is likely to have differential effects on natives with different levels or types of human capital, as captured in particular by their education. We can extend the production function given by equation (1) to incorporate such heterogeneity. We assume that the labor aggregate L is constructed using a three-level nested-aggregation of different types of labor inputs H_e , $e = 1, \dots, z$, which in turn are composed of native labor of that type N_e and immigrant labor M :

$$\begin{aligned} Y_{rs} &= F(L_{rs}, K_{rs}) \\ L_{rs} &= \Phi(H_{1,rs}, \dots, H_{z,rs}), \\ H_{e,rs} &= \Gamma(N_{e,rs}, M_{rs}) \quad \text{for } e = 1, \dots, z; \end{aligned}$$

We maintain the assumption that immigrants are perfect substitutes for each other, but allow elasticities of substitution between natives and immigrants, σ_{mn}^e , specific to group e . We do not distinguish between different types of immigrant labor, but rather assume that immigrants potentially work with all types of native labor. As recent work by Borjas, Grogger and Hanson (2011) and Ottaviano and Peri (2012) suggests it is hard to decide on the appropriate substitution patterns between different types of native and immigrant labor, and so we do not attempt to do so for Malaysia. The assumption that immigrants provide a single type of labor simplifies our analysis considerably. In principle, however, our methodology can be adapted to deal with heterogeneous immigrant types.

The derived demand elasticities for natives of a specific group mirror those in equations

(3) and (4), except that the key parameters are now specific to each group e :

$$\begin{aligned}\frac{d \ln w_n^e}{d \ln M} &= \frac{s_m^e (\eta_e - \sigma_{mn}^e)}{\sigma_{mn}^e \eta_e + \phi_n^e (s_m^e \eta_e + s_n^e \sigma_{mn}^e)}, \\ \frac{d \ln N^e}{d \ln M} &= \phi_n^e \frac{d \ln w_n^e}{d \ln M}.\end{aligned}$$

In these equations, w_n^e is the wage for native workers, ϕ_n^e is the elasticity of native labor supply, and s_m^e is the immigrant share of the wage bill for group e .

3 Data

3.1 Data

The Labour Force Survey (LFS) of Malaysia provides annual data on various characteristics of the labor force and the structure of employment. The main survey is conducted by the Department of Statistics of Malaysia. Data are available for the years 1990 to 2010, with the exceptions of 1991 and 1994 when the survey was not conducted and 2008 where the survey weights were not available. Wage and income data were not collected until 2007 when an additional module was included in the survey. As a consequence, our main analysis is conducted with data from 2007 to 2010, with the earlier data used to help construct our instrument and conduct a number of robustness checks. The main survey samples, on average, 1 percent of the Malaysian population, while the supplement surveys around 0.5 percent of the working population.

Table 1 presents summary statistics for three years of the survey: 1990, 2007 (the first year of the supplement) and 2010. This is a period of rapid economic growth for

Malaysia, despite the Asian Crisis during late 1990s and the recent financial crisis.¹⁷ The rapid transformation of the native labor force's educational attainment is particularly impressive. In 1990, 62 percent of the native labor force had primary school education or less, and only 29 percent had high school education or more. By 2010 the share of the labor force with at most primary school education declined to 20 percent while 66 percent had at least high school education. Among the new entrants to the labor force, age group 20-25, over 80 percent of this group have at least a high school degree.

Between 1990-2010, the share of immigrants in the labor force increased from 3.6 to 10.6 percent according to the LFS. Immigrant workers are disproportionately employed in agriculture and construction. Their share in manufacturing also increased during this period, while they are under-represented in relatively skill-intensive service sectors such as health, education and public administration. Immigrants are significantly less educated than Malaysians: 91 percent had (at most) primary school education in 1990. Even though this number had fallen to 66 percent by 2010, only 19 percent had completed high school. Around 55 percent of all immigrants are from Indonesia, 20 percent from the Philippines and the remainder from countries such as Bangladesh, Cambodia, India, Lao PDR, Myanmar, Sri Lanka, Thailand, and Vietnam.

The income supplement includes information on numerous forms of income. The wage measure we use is the total income derived from all labor related sources in the previous month divided by the number of days worked in that month. The income measure also includes all employment related forms of non-monetary compensation, such as housing

¹⁷Malaysia's GDP per capita in current US dollars went from \$2,418 in 1990 to \$8,691 in 2010 (World Bank national accounts data).

allowances which are common for agricultural workers and miners. We restrict our sample to workers to those who worked at least 30 hours per week during the past month. Our results are robust to using different wage measures: monthly, hourly, and with or without non-monetary compensation.

The LFS records the state people live in (we include Putrajaya in Selangor throughout) and their employment status (employed, unemployed or out of labor force). We aggregate the educational classification into five main categories: those with at most primary education (which includes those without any formal education), lower secondary, upper secondary (which also includes post-secondary, STPM), certificate / diploma (vocational training), and university degree and above. In addition, the LFS asks about an individual's age, gender, marital status, and the month in which the survey took place. Our main unit of analysis is a sector (out of 23 main sectors), in a region (one of the 15 states) in a particular year, for which we calculate total employment for various education and age categories of both natives and immigrants.

3.2 Background

There are two types of formally registered immigrants to Malaysia: expatriates and foreign workers.¹⁸ Expatriates are skilled managerial, professional, and technical workers who are able to obtain long-term visas and enjoy special privileges, such as the ability to bring their spouse. These make up only 2 percent of the total immigrant stock. The remaining 98 percent of immigrant workers only receive temporary work permits, which are valid

¹⁸The material in this section draws on Del Carpio et al. (2013) who provide an extensive discussion of the Malaysian immigration system.

for less than a year and renewable for at most five years. These workers are not allowed to bring any dependents, and there is no pathway to permanent residence or citizenship (as there is for the US and European countries).

Hiring of foreign workers is regulated by quotas assigned to specific sectors, which are adjusted annually (and in practice also occasionally retrospectively). Foreign workers are hired either directly by a company, or through a recruitment or outsourcing agency which, especially for smaller companies, shoulder the administrative burden of obtaining work permits. Hiring costs are comparatively low by international standards, but hiring and work permit procedures are arduous and include medical checks. In addition, annual levies (payable by the employer) are charged for the employment of foreign workers. These are adjusted annually, vary by sector, and may differ for Peninsula Malaysia and Sabah and Sarawak. Levies have increased substantially over time; they were RM 1,850 (around \$575) and RM 1,250 (\$390) in services and manufacturing, respectively, in 2011. They impose a substantial burden on employers, and may more than double the cost of employing a low-skilled foreign worker.

Foreign workers are by law required to receive workmen's compensation for injuries though it is more generous for Malaysians. On plantations and in mining employers are responsible for providing housing of (poorly enforced) minimum standards, and they are not part of Malaysia's Employment Provident Fund which finances retirement. A minimum wage was introduced in Malaysia only in 2012, and hence during our sample period there were no legal restrictions on how much firms pay workers (Malaysian or foreign).

There is a substantial number of irregular foreign workers who are employed illegally

though may have entered Malaysia legally and overstayed their permits. Good estimates are not available, but a 1996/97 regularization exercise resulted in almost one million unregistered migrants being legalized. This suggests that as many as half, if not more, of all immigrants are employed illegally. In principle, our data are a representative sample of all workers, employed legally or not. In practice, there is likely undercounting of foreign workers without work permits which we will have to account for in our empirical strategy.

4 Homogeneous Effects of Immigration

4.1 Regression Specifications and Parameter Identification

The approach outlined in Section 2 shows that we need to identify three key parameters in order to determine the effects of immigration on natives. These are (1) the elasticity of substitution between native and immigrant labor σ_{mn} , (2) the elasticity of demand for native labor η , and (3) the elasticity of supply for native labor ϕ_n . The remaining variables are the shares of native and immigrant labor in the wage bill, s_n and s_m , which can be directly calculated from the data. We begin by identifying the effect of immigration M on native employment N in an industry-region-year regression:

$$N_{rst} = \beta_1 M_{rst} + \delta_{rs} + \delta_{st} + \delta_{rt} + \varepsilon_{1,rst} \quad (8)$$

In this expression, δ_{rs} are region by industry, δ_{st} are industry by year, and δ_{rt} are region by year fixed effects, and $\varepsilon_{1,rst}$ are idiosyncratic unobservables. The fixed effects and the error term capture shocks to output prices, both factor-neutral and factor-enhancing differences

in technology, product quality, transportation costs and other factors that affect demand. In addition, any misspecification error, especially due to heterogeneity in the elasticity of substitution, labor demand, and factor shares, will be reflected in the fixed effects and error term.¹⁹ The inclusion of δ_{rs} means that the effect of immigration is identified from changes over time in the number of immigrants in each industry-region. The inclusion of δ_{st} and δ_{rt} implies that only deviations from the sector-specific and region-specific average in immigration flows to an industry-region are used for identification. The regression is estimated at the local labor market level (industry-region in a year).

Note that we are estimating the relationship between immigrant and native employment in levels,²⁰ as opposed to in natural logarithms or, similarly, these variables standardized by local labor market employment levels. The reason is that a log-log specification imposes the restriction that in percentage terms the effect of immigration on natives is always the same, independently of the fraction of immigrants.²¹ However, as is evident from our discussion of equations (3), (4) and (5) in Section 2, the elasticity of wage and employment levels with respect to immigration will depend on the share of immigrants. A log-log specification is likely to fit the data well when directly estimating the elasticity of substitution, as is typical in the literature, and when factor shares do not vary too much, such as in the seminal work of Katz and Murphy (1992). In our case we are estimating the full derived-demand elasticity and the immigrant share varies enormously across local

¹⁹These fixed effects also control for the annual levies employers have to pay for employing foreign workers.

²⁰Peri and Sparber (2010) describe this as the straightforward way of testing for displacement. We deal with their concern about differential sizes of local labor market through the inclusion of fixed effects.

²¹A very similar restriction is imposed when standardizing variables by the level of employment (or the population), such that the relationship between immigrant and native employment is constant in percent changes.

labor markets.²² We show results for a log-log specification in Section 4.4, confirming the suspicion that it performs poorly under these circumstances.

The degree to which the effect of immigration shows up on employment or wages (in an industry-region-year) depends on the mobility of native workers across sectors and regions. In order to estimate the elasticity of native labor supply we regress the log of native wages $\ln w^n$ on immigrant employment M :

$$\ln w_{it}^n = \beta_2 M_{rst} + n(X_{it}) + \delta_{rs} + \delta_{st} + \delta_{rt} + \varepsilon_{2,irst} \quad (9)$$

Wages are observed for an individual i in year t and $n(X_{it})$ is a flexible polynomial of the observed worker characteristics (gender, education, potential experience, marital status).

In addition, we include the same set of fixed effects as in equation (8).

Finally, we estimate the effect of immigration M on the log of immigrant wages $\ln w^m$:

$$\ln w_{it}^m = \beta_3 M_{rst} + m(X_{it}) + \delta_{rs} + \delta_{st} + \delta_{rt} + \varepsilon_{3,irst} \quad (10)$$

Similarly, wages are observed at the individual level and $m(X_{it})$ is a flexible polynomial of the observed immigrant worker characteristics. We again include the same set of fixed effects as in equations (8) and (9).

Using the estimates, and the labor shares calculated from the data, it is possible to identify the key parameters of the derived demand elasticities. Our estimate of the elasticity of labor supply across industry-regions is given by the relative effect of immigration

²²49 percent of local labor markets contain no immigrants (this is unsurprising since our data is only a 1/2 - 1 percent sample of the population); while for 24 percent of local labor markets the fraction is above 10 percent, and for 4 percent the fraction is above 50 percent.

on native employment versus native wages:

$$\hat{\phi}_n = \frac{d \ln N}{d \ln w^n} = \frac{\hat{\beta}_1}{\hat{\beta}_2 \bar{N}}.$$

where \bar{N} is the average number of natives in an industry-region-year. The elasticity of labor demand, η , and the elasticity of substitution, σ_{mn} , are identified from the parameter estimates β_1 and β_3 , and equations (4) and (5):

$$\begin{aligned} \hat{\sigma}_{mn} &= \frac{\hat{\beta}_1 \frac{\bar{M}}{\bar{N}} - 1}{\hat{\beta}_3 \bar{M} - \hat{\beta}_2 \bar{M}} \\ \hat{\eta} &= -\frac{s_m + s_n \hat{\beta}_1 \frac{\bar{M}}{\bar{N}}}{s_m \hat{\beta}_3 \bar{M} + s_n \hat{\beta}_2 \bar{M}} \end{aligned}$$

where s_m is the immigrant share of the total wage bill in an industry-region-year, $s_n = 1 - s_m$, and \bar{M} is the average number of immigrants in an industry-region-year.

The elasticity of substitution is, as always in the literature on inequality or immigration, identified from the immigration induced change in relative wages and employment for immigrants and natives. The nested CES-framework with constant returns to scale implies that relative wages are independent of the scale of production and, as in Katz and Murphy (1992), taking ratios differences out the scale effect. The scale effect is then identified by the difference in the estimated total effect of immigration, and the change in outcomes implied purely by the substitution effect. Identification is analogous to how substitution and income effects are identified in consumer theory.

It is also worth noting that identification of both scale and substitution effect depend on observing both outcomes of natives and immigrants. If native labor supply is perfectly

inelastic (as required for many identification strategies in the literature) estimates of the impact of immigration on native and immigrant wages are required to identify scale and substitution effects. If native labor supply is perfectly elastic the impact on native employment and immigrant wages needs to be estimated.²³ In the intermediate case where the elasticity of labor supply is neither zero nor infinite identification requires estimates of the impact on native wages and employment, as well as immigrant wages.

Having identified the parameters of the production function, we can calculate the implied wage effects at national level for natives and immigrants using equations (6) and (7) respectively:

$$\frac{d \widehat{\ln w_n}}{d \ln M} \Big|_N = \frac{s_m (\hat{\eta} - \hat{\sigma}_{mn})}{\hat{\sigma}_{mn} \hat{\eta}}, \quad \frac{d \widehat{\ln w_m}}{d \ln M} \Big|_N = -\frac{s_n \hat{\eta} + s_m \hat{\sigma}_{mn}}{\hat{\sigma}_{mn} \hat{\eta}}.$$

This allows us to use variation in immigration flows across local labor markets and nevertheless infer the economy-wide effects of immigration.

4.2 Instrument

The central challenge in estimating equations (8), (9) and (10) is the endogeneity of the inflow of immigrants, which is likely to be correlated with unobserved shocks to the demand for labor in an industry and/or region. Immigrants are more likely to locate in

²³In the case of perfectly elastic native labor supply the parameter estimates are given by

$$\hat{\sigma}_{mn} = \frac{\hat{\beta}_1 \frac{\bar{M}}{N} - 1}{\hat{\beta}_3 \bar{M}}, \quad \hat{\eta} = -\frac{s_m + s_n \hat{\beta}_1 \frac{\bar{M}}{N}}{s_m \hat{\beta}_3 \bar{M}};$$

when native labor supply is perfectly inelastic they are

$$\hat{\sigma}_{mn} = \frac{-1}{\hat{\beta}_3 \bar{M} - \hat{\beta}_2 \bar{M}}, \quad \hat{\eta} = -\frac{s_m}{s_m \hat{\beta}_3 \bar{M} + s_n \hat{\beta}_2 \bar{M}}.$$

industries and regions that are experiencing positive shocks to the demand for labor. In that case, the OLS estimate of the effect of immigration on native employment and wages will be upward biased. It is also possible that declining industries make a special effort to attract immigrant labor to lower their wage bill. For example, immigrants require a work permit to legally work in Malaysia; one way that declining industries may respond is by exerting political pressure that more work permits be issued for their industry. In that instance there is a negative correlation between the inflow of immigrants and shocks to the wages and employment of native labor, and the OLS estimates would be downward biased.²⁴ The likelihood of biased OLS estimates makes it important to instrument for the inflow of immigrants to an industry-region.

A valid instrument for immigration flows needs to be uncorrelated with any demand shocks, caused by changes in technology or output prices, that may affect the demand for native or immigrant labor. To construct such an instrument we use changes in the population and age structure of immigrant source countries over time. These source countries are Bangladesh, Cambodia, India, Lao PDR, Myanmar, Sri Lanka, Thailand, Vietnam, and most importantly Indonesia and Philippines. Using the data from the United Nations Population Division, we calculate the number of individuals in each of 7 age-groups in each of these source countries in every year during 1990-2010.²⁵ These population numbers form the potential pool of immigrants to Malaysia, where the likelihood of migration would vary by age group, country of origin and year. This is our measure of the supply of immigrants S_t^{ac} to Malaysia from source country c in age-group a and year t .²⁶ Since

²⁴This is what Friedberg (2001) finds when examining the distribution of Russian arrivals in Israel after the end of the Cold War.

²⁵The age groups are 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45 and above.

²⁶We multiply these population numbers by the average propensity of people from each country to

data on immigrants' nationality are grouped into Indonesians, Filipinos and the rest of the world, we add our measure of the supply of immigrants for all other countries into a single category, such that effectively we have three source countries: Indonesia, the Philippines and Other.

What remains to be determined is the industries and regions within Malaysia in which the immigrants choose to work. In order to construct this variable, we use the LFS for the period 1990 to 2002 to calculate the average probability of individuals from a source country and age group to be employed in a certain industry-region

$$\lambda_{rs}^{ac} = \frac{\frac{1}{T} \sum_{t=1990}^{2002} M_{rst}^{ac}}{\frac{1}{T} \sum_{t=1990}^{2002} M_t^{ac}},$$

where M_{rst}^{ac} is the number of immigrants from a source country in an age group, region, industry and year, and M_t^{ac} is the total number of immigrants in Malaysia from a source country and in an age group.

The source country and age-group specific instrument for the immigration flows in a certain, industry, region and year is given by:

$$IV_{rst}^{ac} = \lambda_{rs}^{ac} * S_t^{ac}. \quad (11)$$

We have three source countries (Indonesia, Philippines and Other) and seven age groups for a total of twenty-one instruments. The identifying variation comes from the interaction

migrate to Malaysia. This is so as to ensure that the magnitudes of the coefficients on each instrument are broadly comparable. These propensities are calculated from data provided by the Ministry of Home Affairs of Malaysia and are: Bangladesh 1.96%, Cambodia 1.03%, India 0.11%, Lao PDR 0.01%, Myanmar 2.18%, Sri Lanka 0.16%, Thailand 0.22%, Vietnam 0.78%, Indonesia 5.56% and Philippines 0.38%.

of λ_{rs}^{ac} and S_t^{ac} , conditional on the included fixed effects, and is due to changes in the size of cohorts in source countries (which are experiencing their demographic transition at different rates) and their differential propensity to be employed in certain industries and regions in Malaysia. The variation in the instrument generated by the differential propensity of immigrant groups (defined by nationality and age) to work in different local labor markets is similar to the commonly used Altonji-Card instrument (Altonji and Card, 1991; Card, 2001). The variation induced by the demographic changes in source countries is similar to Hanson and McIntosh (2010) who find that Latin American migration to the US is highly responsive to labor supply and demographic shocks, as predicted by earlier changes in birth cohort sizes.

Considering potential threats to the validity of this instrument, it is worth noting that the supply of potential migrants to Malaysia from different source countries (S_t^{ac}) is determined by the demographic patterns and transition in those countries, and hence clearly exogenous with respect to contemporaneous labor market shocks in Malaysia. However, it is also necessary that the only channel by which it affects outcomes in Malaysia is through changing the supply of potential immigrants. A reason this may not be the case is that demographic changes in source countries may affect the price of internationally traded goods produced in Malaysia (as a result of both changes in the demand for those goods and changes in the supply of competing products). The inclusion of year by industry fixed effects and region by year fixed effects, as in our main specification addresses these concerns.²⁷

²⁷The major immigrant source countries - Indonesia, Philippines and Thailand - accounted for only 7 percent of Malaysian exports in 2000 and 10 percent in 2010 (Department of Statistics, Malaysia) and hence the direct effect of their demographic transition on the consumption of Malaysian exports is likely modest.

The average propensity of an immigrant from a source country to be employed in a certain industry-region (λ_{rs}^{ac}) depends on permanent differences in the levels of demand across local labor markets, which is why we include industry-region specific fixed effects in all our regression specifications. It is of course independent of any transitory shocks that may affect demand for natives (and immigrants) in a particular year. However, the concern is that persistent demand shocks, i.e. long periods of decline or growth in certain regions and/or industries, would result in a correlation between the average distribution of immigrants and current demand shocks. Calculating this propensity for the period 1990 to 2002, while our main analysis begins in 2007, helps alleviate this concern. The inclusion of industry by year (and even region by year) fixed effects means that such long-term trends would have to be specific to an industry in a certain state and can not be the result of industry or region-specific factors. While we can not rule out such long-term trends, the advantage of our instrument, as compared to the Altonji-Card instrument, is that we can even include local labor market (industry-region) specific linear time trends and potentially have sufficient variation induced by the demographic transition in source countries for identification. We show that our results are robust to the inclusion of such local labor market-specific time trends, see Section 4.4 (though we only have sufficient variation to do so when we use data for 1990 - 2010, as opposed to in our main sample which uses 2007-10 data). We take these results as strong evidence in favor of the validity of our exclusion restriction.

In interpreting our results, it is worth noting that the variation captured by the instrument will account for the migration decisions of only a subsection of all immigrants. These migrants are ones for whose social networks at the industry-region level are impor-

tant for their location decisions (see Munshi, 2003; Patel and Vella, 2007; Beine, Docquier and Ozden, 2011; for recent work on immigration networks). Such immigrants may be systematically different from those whose locations decisions are determined primarily by demand shocks, and we would be estimating a local average treatment effect (which may or may not be the same as the average treatment effect for all immigrants).

4.3 Results

We present our OLS estimates in Table 2; our instrumental variable and parameter estimates, as well as the implied country-level wage effects, are in Table 3. Extensive robustness checks are presented in Section 4.4, below. In Panel A we have the estimates of the industry-region-year level effect of immigration on native employment (equation 8). Panel B presents the effect of an immigrant induced change in native employment on native wages (equation 10). Panel C shows the impact of immigration on immigrant wages (equation 9). Each column of the table presents estimates for different sets of fixed effects. In all specifications standard errors are clustered by industry-region-year (rst).²⁸

OLS estimates show that native outcomes, both employment and wages, are uncorrelated with immigration flows. Immigrant wages are negatively correlated with immigration flows; however, this correlation is not statistically significant when including our full set of fixed effects.

The instrumental variable estimates show that immigration, on average, increases the

²⁸Conditional on the included fixed effects the serial correlation within an industry-region is negative, hence we do not cluster on industry-region. In Section 4.4 we report standard errors clustered by industry-region.

The first-stage differs across specifications: in equation (8) an industry-region is left unweighted, while the observations are individual native workers and the immigrant workers in equations (9) and (10), respectively. As a result the F-statistics of the first-stages differ.

demand for native labor in a given sector-region pair where the effect on employment is large and statistically significant. The results are qualitatively robust to the inclusion of more or less fixed effects, though the inclusion of industry-year specific fixed effects attenuates the effect of immigration on both native employment and immigrant wages.

On average, an additional 10 immigrants employed in a given industry-region results in the employment of an additional 4.1 natives in our preferred specification with a full set of fixed effects.²⁹ These considerable reallocation effects in native employment in local labor markets are not associated with significant relative wage increases for the affected natives, except in the specification with the minimum set of fixed effects. Sufficient Malaysian workers seem to be highly mobile across industry-regions and, consequently, the positive demand shock induced by immigration results in relative changes in employment, but not relative wages, of natives. Consequently, immigration results in large-scale reallocation of native workers across industries and regions of Malaysia. Finally, immigration decreases the relative wages of immigrant workers significantly, with the estimates suggesting that a 10 percent increase in the number of immigrants decreases average immigrant wages by 3.9 percent in an industry-region. The fact that immigration lowers immigrant wages (demand is downward-sloping) gives rise to the scale effect: lower immigrant wages result in lower costs, leading to output expansion, and additional demand for native labor.

The structural parameters implied by the IV estimates are presented in Panel D of Table 3. The estimated elasticity of labor demand is consistently larger than the elasticity of substitution between immigrant and native labor, 3.4 and 2.5, respectively, in our main

²⁹The first-stage F-statistic in regression (8) is 8.9 in our main specification, somewhat lower than conventionally deemed desirable. Our robustness checks with a single instrument and a longer time period yield similar point estimates with far higher F-statistics. This suggests that any potential weak instruments problem are unlikely to qualitatively affect our results.

specification. The estimate of the elasticity of substitution between (primarily very low-skilled) immigrant labor and (primarily medium skilled) native labor are similar to those for the elasticity of substitution between high and low-skilled labor in the US which tend to be around 2 (Acemoglu and Autor, 2012). The predominantly very low-skilled immigrants to Malaysia are net substitutes for natives, and, for a given level of output, displace these. However, immigration also reduces the cost of production for Malaysian firms, resulting in increases in output. Our estimate of the elasticity of labor demand implies an elasticity of product demand for the output of an average industry-region of 4.7,³⁰ which seems reasonable given that around half our industry-regions are for traded manufacturing and agricultural goods and the other half are for service industries.³¹

Our next set of results, presented in Panels E and F of Table 3, show the implied employment effects at the local level and wage effects at the national level. At the local level increased demand for native labor results in a large inflow of native workers, but has modest positive effects on the average wage of Malaysians. A 10 percent increase in immigration, equivalent to a 1 percent increase in the labor force, will increase native employment in a local labor market by 4.4 percent, but average native wages by only 0.14 percent. Immigration has a very large negative impact on immigrant wages, with an elasticity of -0.39. The fact that the scale effect is larger than the substitution effect does not imply that average wages in Malaysia will increase due to immigration. Our estimates imply that a 10 percent increase in immigrants would decrease average wages

³⁰The calculation assumes that capital and labor are combined using a Cobb-Douglas production function, and that the supply of capital to an industry-region is perfectly elastic. Our estimates use annual variation, to the extent that capital is more easily adjusted over longer periods this would lead to more positive long-run effects of immigration than are presented here.

³¹See Broda, Greenfield and Weinstein (2006) for comparison.

in Malaysia (across natives and immigrants) by 0.35 percent, which is simply a consequence of downward-sloping demand for output produced in Malaysia. If the scale effect were actually smaller than the substitution effect then immigration would result in both declining immigrant and native wages.

The differences between the OLS and IV estimates provide evidence on the factors that influence the location decisions of immigrants. The IV estimates of the impact on immigration on native employment in an industry-region are considerably larger than the OLS estimates. This suggests that immigrants are not systematically hired by industries experiencing positive demand shocks, but rather in particular by industries in difficulties, likely in an attempt to cut costs and survive. The OLS estimates of the relationship between immigration and immigrant wages are smaller than the IV estimates, and frequently insignificant. The IV estimates tell us that immigration does decrease immigrant wages, but the OLS estimates suggest that immigrants tend to go to industry-regions where their wages are increasing; and those two effects partially cancel each other out.

An advantage of the instrumental variable approach is that it addresses certain measurement problems. For example, there are a substantial number of immigrants who are undocumented and illegally employed in Malaysia. These are likely undercounted by the LFS, resulting in attenuation bias (if illegal and legal immigration flows are uncorrelated) and other more complicated biases (if they are correlated) in the OLS estimates. But for the instrumental variable estimates to be consistent, it is only necessary that the flows of illegally employed immigrants are uncorrelated with the instrument (conditional on the included fixed effects). This is likely to explain why the IV estimates are larger than the OLS.

There are, however, a number of other confounding factors that may bias the estimates of the employment and wage effects of immigration. If immigration has heterogeneous effects on individuals with different characteristics it may change the composition of natives, with implications both for the wage and labor supply (if different individuals vary in how many hours they work per year). Our extensive controls ameliorate these concerns, but changes in unobserved characteristics of individuals may nevertheless affect the estimates. Further, we assume that immigration causes native workers to change employers solely on account of changes in the wage. However, there may be non-pecuniary reasons why natives may or may not wish to work with immigrants not captured by the model. In that case, immigration changes both the demand and supply for native labor at a given wage, with unaccounted for biases in our parameter estimates.

It is conceivable that immigration to an industry-region may significantly increase the demand for the output of that industry-region, which would result in an upward bias of the estimates. Specifically, the estimated elasticity of product demand will be upward biased, since we would be confusing shifts in demand with the elasticity of demand. However, even if workers spend all of their income in the same region, only a very small fraction would be ultimately spent on the output of the industry they are actually employed in, so this bias is likely to be negligible. Nevertheless, such general equilibrium effects are to a large extent accounted for with the inclusion of industry by year and region by year fixed effects.³²

Finally, there may be spillover effects of immigration across local labor markets (as

³²Immigration may affect the technological choices of firms, see Lewis (2011), in which case there is not a stable production function we are estimating.

opposed to labor movements, which we explicitly account for). In particular, this may be a concern if the output of one industry-region is used as an input in another industry-region, and these also experience correlated immigration flows. In our full specification any spillovers that occur across industries are accounted for by the inclusion of industry by year fixed effects; those at the regional level are accounted for by the inclusion of region by year fixed effects. However, we can not rule out more subtle input-output linkages specific to both an industry and region. This would be a problem if instrumented immigration flows are correlated with linked industries in the input-output tables. It is unclear whether conditional on our fixed effects these are likely positive or negative. In order to properly estimate these, we would need region-specific input-output tables which are not available for Malaysia.

4.4 Robustness Checks

4.4.1 Alternative Specifications

Table 4 presents a number of alternative specifications of our main regressions: weighting observations, clustering standard errors on the local labor market, using only a single instrument, and a log-log specification. All specifications including a full set of fixed effects: industry by region, industry by year, and region by year. Column (1) reports the impact on immigration native employment when industry-region observations are weighted by the average employment in that industry-region (as in Card, 2001, for example). This increases the point estimates slightly, suggesting that larger industry-regions tend to experience more positive effects of immigration. Column (2) reports standard er-

rors clustered at the industry-region, thereby accounting for potentially serially correlated standard errors. These are very similar to the ones in our main specification. To address potential weak instrument concerns Column (3) reports results when we aggregate our 21 instruments into a single instrument. The point estimate of the effect of immigration on native employment in an industry-region increases to 0.71 with a single instrument (however, the instrument is not significant in the wage regressions). Column (4) reports a log-log specification where dependent, independent and instruments are all in natural logarithms.³³ As anticipated, this specification fits the data very poorly: the instruments are not significant in the first-stage, and the employment effect of immigration is not significant.

4.4.2 Using Labor Force Survey Data for 1990 - 2010

We have employment data for Malaysia for the period 1990 - 2010, and can therefore run our employment regression, equation (8), for that time period. Uniquely in this literature this allows us to test the robustness of our results to the inclusion of local labor market (industry-region) specific linear time trends, so as to deal with potential bias arising from long-term correlated demand shocks. We also provide results using regions, as opposed to industry-regions, as our local labor markets. We report our results in Table 5.

Panel A.1 replicates our main IV regressions including the full set of fixed effects of our main specifications (Table 3) using the data for 1990 - 2010. The point estimate of the impact of immigration on native employment in an industry-region are somewhat higher: 0.60 instead of 0.41 (standard errors are smaller and the first-stage F-statistic is 14.6).

³³We add one to each variable to avoid the problem of taking natural logarithms of zero.

The estimates are practically unaffected by weighting each observation by the average employment in that local labor market (column 2). Clustering at the local labor market level reduces standard errors, since conditional on all the fixed effects immigration flows are negatively serially correlated (column 3).

The main concern with our instrument, as with a conventional Altonji-Card style shift-share instrument, is that there may be local labor market-specific long-term demand trends which affect both the historic and current distribution of immigrants (see also the discussion in Section 4.2, above). Our instrument, however, has the considerable advantage that the identifying variation comes from the interaction between a variable that varies over time (the size of an age group in a source country) and a variable that varies across local labor markets (the average propensity of workers of a specific age group and source country to be employed in that local labor market). Hence, unlike the Altonji-Card instrument which relies exclusively on cross-sectional variation, we can control for such correlated demand trends using industry-region specific linear trends. This is particularly important when using data for 1990 - 2010 since the instrument is no longer constructed using data for an earlier period, but within sample. Our point estimate of the causal effect of immigration on native employment in an industry-region remains positive and highly significant when including linear trends, see Panel A.2. We would argue that this provides very strong evidence that our main qualitative result (the scale effect is larger than the substitution effect) is not a result of an invalid instrument. Moreover, our point estimate is very similar to that obtained in our main specification using 2007-10 data, 0.37 compared to 0.41. This is consistent with the idea that having constructed part of the identifying variation of the instrument within sample when using

all 18 years of data biases the estimates upward somewhat, but when including industry-region linear trends we plausibly recover the true causal effect.

Panel B presents these same regressions using regions (instead of industry-regions) as units of observations. Using this much broader definition of a local labor market results in far larger estimates of the positive impact of immigration on native employment (including region and year fixed effects), see Panel B.1. Once we also control for region-specific linear trends, see Panel B.2, the estimated impact of immigration on employment in the region is in line with our main results, a point estimate of 0.56. Our interpretation of these findings is that at the region-level (unlike the industry-region) there are very pronounced long-term trends in employment. Hence, in the baseline specification our instrument, in particular since it is constructed in-sample but likely even if were based on a pre-period, is not valid and our estimate upward biased. However, once we include region-specific trends (which would not be possible with the typical shift-share instrument) we are able to recover a plausibly unbiased IV estimate.

4.4.3 Varying Assumptions About Labor Supply Elasticities

A concern for our identification strategy is that we do not obtain precise or significant estimates of the effect of immigration on native wages in a local labor market (relative to other industry-regions). We have argued that this suggests native labor is highly mobile across industry-regions and consequently immigration results in changes in employment not wages. However, we can not exclude the possibility, and indeed it is likely, that labor supply across industry-regions (ϕ_n) is less than perfectly elastic.³⁴

³⁴We will continue to assume that native labor supply to an industry-region is non-negative. Unlike aggregate labor supply, which may be backward bending, it is hard to imagine that less people are willing

Table 6, Panel A, shows the sensitivity of our parameter estimates, and the implied national wage effects, to varying assumptions about the elasticity of labor supply across industry-regions. Assuming perfectly elastic labor supply yields estimates very similar to those in our main specification in Table 3. Assuming a lower elasticity of labor supply results in somewhat higher estimates of the elasticity of product demand. Once the elasticity is assumed to be around 2 the parameter estimates become insignificant and the implied elasticity becomes unrealistically high; the results are incompatible with such low elasticities. Our estimates of the elasticity of substitution are barely affected (though they trend down slightly) as we assume lower elasticities of labor supply. The estimate of the effect of immigration on native wages increases as we assume native labor is less than perfectly elastically supplied to an industry-region. For example, the elasticity of native wages with respect to immigration in our main specification is 0.13, when assuming $\phi_n = 5$ it is 0.020.

In short, our parameter estimates do not crucially depend on a precisely estimated elasticity of native wages with respect to immigration. They are broadly robust to a wide-range of labor supply elasticities, while ruling out particularly low elasticities. Moreover, we are likely recovering a lower-bound on the magnitude of the scale effect and hence the true (positive) effect of immigration on average native wages.³⁵

to work in industry-regions which pay higher wages (especially once controlling for industry and region fixed effects).

³⁵It is also straightforward to show the sensitivity of our national wage estimates to assumptions about the extensive margin labor supply elasticity at the national level (due to entry and exit from the labor force or emigration and immigration of natives). The results are qualitatively robust to a wide array of such assumptions.

5 Heterogeneous Effects of Immigration

5.1 Regression Specifications and Parameter Identification

Identifying effects of immigration on native workers of different educational attainment, as outlined in the model in Section 2.2, requires estimating versions of equations (8) and (9) for natives with different educational attainment (e):

$$N_{rst}^e = \beta_1 M_{rst} + \delta_{rs} + \delta_{st} + \delta_{rt} + \varepsilon_{1,rst}^e, \quad (12)$$

$$\ln w_{it}^e = \beta_2 M_{rst} + n^e(X_{it}) + \delta_{rs} + \delta_{st} + \delta_{rt} + \varepsilon_{2,irst}^e \quad \text{for all } i \in e, \quad (13)$$

where native employment N^e is measured in an industry-region-year (rst) for natives of educational attainment (e), log native wages $\ln w^e$ are for individual i of group e , $n(X_{it})$ are flexible polynomials of the observed native worker characteristics; δ_{rs} are region by industry, δ_{st} are industry by year, and δ_{rt} are region by year fixed effects. The explanatory variable M (the number of immigrants) is the same in all regressions. Since we continue to assume that immigrants are homogeneous, and potentially work with natives of different characteristics, we simply use the estimates reported in Table 3 for equation (10) as the effect of immigrant on immigrant wages.³⁶ We use these estimates to identify the key parameters of the derived demand elasticities in a manner identical to that described in Section 4.1, above. We calculate the immigrant share in each nest as $s_m^e = \frac{w_m M}{w^e N^e + w_m M}$.

Note that our identification procedure differs from the main identification strategy in Card and Lemieux (2001) and subsequent work, notably Ottaviano and Peri (2012), since

³⁶While this assumption is restrictive it is consistent with the fact that immigrants in Malaysia are comparatively homogeneous low-skilled workers.

we do not need to assume that the elasticity of substitution in the lower nest, between immigrant and native labor, is identical across education groups.

5.2 Results

We present our OLS and IV estimates of the impact of immigration on natives of different educational attainment in Tables 7 and 8, respectively. Each column represents results for natives of one of five levels of educational attainment. All regressions include region by industry, industry by year, and region by year fixed effects. Panel A reports the impact on native employment, since our estimates lack precision we extend the years used for our analysis to 2003-10.³⁷ Panel B reports the effect of immigration on the log of native wages (using 2007-10 data). Panel C of Table 8 reports the implied structural parameters, and Panel D the native wage elasticity with respect to immigration. We also report the share of natives and immigrants in each educational category for the period 2003-10. 76 percent of the immigrant stock in Malaysia over this period had at most completed primary school education, as compared to 26 percent of Malaysians. Particularly few, 1.2 percent, had some type of vocational training (certificate / diploma), compared to 10 percent of Malaysians. They were also much less likely to have a university degree, 3.2 percent compared to 8.7 percent among Malaysian workers.

The results show highly heterogeneous impacts on immigration on natives with different educational attainment. Focusing on the IV results (Table 8) we find that natives with the same educational attainment as the bulk of immigrants (at most primary educa-

³⁷Recall that the instrument is based on the average distribution of immigrants over the period 1990-2002.

tion) are displaced by immigration. Every 10 immigrants displace 3 natives with at most primary education (an elasticity of -0.21) in a given industry-region. All other groups of natives experience a positive demand shock due to immigration. An additional 10 immigrants results in the employment of 1.6 natives with lower secondary education (an elasticity of 0.12), 3.1 natives for who have completed secondary education (an elasticity of 0.07), 0.4 with some form of vocational training (an elasticity of 0.03), and the impact on natives with a university degree is even smaller and not statistically significant.

OLS and IV estimates exhibit the same inverse u-shaped pattern. Interpreting the difference in sign and magnitude of OLS and IV estimates as suggestive about the location decisions of immigrants, we find that (primarily very low-skilled) immigrants are less likely to locate in industry-regions that experience negative shocks to the demand for very low-skilled native labor (OLS is upward biased). They are, however, more likely to locate in industry-regions that experience negative demand shocks for medium skilled native labor (OLS is downward biased). Finally, their location decisions are only very weakly correlated with demand shocks for high-skilled native labor (OLS unbiased).

An advantage of being agnostic about how immigrants and natives of different education levels interact is that our estimates can simply be interpreted as local average treatment effects. Moreover, we can unambiguously conclude that immigrants, given their composition, decrease the demand for native workers with at most primary education, and increase the demand for all other types of workers. However, to use our estimates to calculate wage effects at the national level requires estimating the underlying structural parameters. These are presented in Panel C of Table 8. For those with at most primary education the elasticity of substitution is greater than the elasticity of la-

bor demand. The estimated elasticity of substitution, 3.7, is much lower than is typically assumed in papers using US data, see Ottaviano and Peri (2012). All that is required for immigration to result in a negative demand shock is that the elasticity of labor demand be smaller. For workers with lower and upper secondary education the scale effect outweighs the substitution effect, while the magnitude of these parameters is near identical for those with education beyond secondary school.³⁸ The implied wage elasticities (at the country-level) are such that a 10 percent increase in immigrants - equivalent to an around 1 percent increase in the labor force - will decrease wages for natives with at most primary education by 0.71 percent, increase the wage of those with lower secondary education by 0.38 percent, and those with completed secondary school education by 0.26 percent. The impact of immigration on wages of highly educated workers is negligible. Whether immigration affects inequality in the U.S. is a topic of continued debate. For Malaysia we find strong evidence that it does. It is worth emphasizing that it is not the natives with the highest education levels who benefit most from low-skilled immigration, but rather those just a little more educated than the immigrants. This is consistent with the idea that immigrants are engaged in tasks complementary to the skills of natives with a little more education, but that are less related to those performed by highly educated natives (see Ottaviano, Peri and Wright, 2012; and Peri and Sparber, 2009).

³⁸The parameter estimates vary less across education groups than we might have expected. In part this is a result of assuming immigrants are homogeneous, thereby constraining our estimates of the elasticity of substitution. It also reflects the fact that even small variations in these parameters results in significant variation in the implied wage and employment effects.

6 Policy Counterfactuals

National governments throughout the world invest considerable resources into controlling immigration flows. Large number of countries use quota-based systems, where a certain number of immigrants with certain personal and human capital characteristics receive work permits every year (Borjas, 1999). An alternative mechanism is to introduce levies on immigrant workers, i.e. a fee to receive an employment permit in specific sectors. Malaysia has pursued both policies simultaneously over the past twenty years.³⁹ We use the estimates in this paper to assess the implications of such quotas and levies.

One potential counterfactual exercise is to assess the impact of the total immigration flow to Malaysia since 1990 on labor market outcomes for natives.⁴⁰ In the absence of these immigration flows, we estimate that native wages in Malaysia would have been around 1.5 percent lower than the present levels. The wage effects for Malaysians of different education levels vary widely, and the implied impact of immigration on the skill premium (as compared to those with at most primary school education) is substantial. Figure 1 shows actual and counterfactual skill premiums.⁴¹ The effect is most pronounced at the lower end of the skill distribution. In 2007-10 a worker with lower secondary education (3 years of education past primary) had 18 percent higher wages than those with at most primary education. In the absence of the additional immigration, this skill premium

³⁹Del Carpio et al. (2013) discusses in detail the various migration related policies implemented by the Malaysian government.

⁴⁰We conduct our analysis in log points, a reduction of the fraction of immigrants from 10.6 to 3.6 percent is equivalent to 1.08 log points.

⁴¹Skill premiums are measured in log points and estimated for the years 2007-10 from a Mincer regression on education levels, a fourth-order polynomial in potential experience, controls for marital status and the month in which the survey was conducted, as well as industry by region, industry by year, and region by year fixed effects.

would only be 6 percent. For those with completed secondary school education the skill premium would be 38 percent instead of the current 49 percent. In contrast, the effect on skill premiums for those with a university degree is small and not significant. The immigration induced increase in skill premiums will likely have encouraged additional Malaysians to attend secondary school, though it will have made obtaining a university degree slightly less attractive (as compared to completing secondary school).

We also consider what would have happened if the government were able to enforce quotas in a particular industry and set these at 1990 immigration levels. Native employment in agriculture would, *ceteris paribus*, be 9 percent lower than the current levels. Similarly, employment in manufacturing would be 5 percent lower, in services 3 percent lower, and in construction 7 percent lower. Clearly, the cost advantages provided by immigrant labor has substantial consequences for the relative growth of different sectors and Malaysia's industrial composition.

Malaysia also imposes differential levies on sectors. A 25 percent levy on immigrant wages in a specific industry would, based on the assumption that immigrants are perfectly mobile across industries and hence the burden of the levy would fall on firms, reduce immigrant employment in that industry by 10 percent. As costs increase, there would be significant reductions in the number of natives employed: 1 percent in agriculture, 0.4 percent in manufacturing, 0.8 percent in services and 0.4 percent in construction.

7 Conclusions

The impact of immigration on native workers is driven by two countervailing forces: the degree of substitutability between natives and immigrants (which has been the focus of the existing literature), and the increased demand for native workers as immigrants reduce the cost of production and output expands. Using data for Malaysia and a novel instrument we find that the scale effect on average outweighs the substitution effect, such that immigration results in a positive demand shock for native labor. The cost advantages provided by immigration allow industries to expand sufficiently so as to outweigh the displacement of natives due to substitution. Hence, immigration results in a substantial reallocation of native workers across industries (and regions), but has only very modest effects on average native wages (immigrant wages fall substantially). The impact of immigration is highly heterogeneous for natives with different levels of education and follows an inverted u-shape. The bulk of immigrants have at most primary education and, on net, displace natives in that education category, with a significant negative impact on wages. Those natives with a little more education, lower secondary or completed secondary education, experience the greatest benefits; while the gains for those Malaysians with a vocational diploma or university degree are smaller.

Two lines of inquiry follow naturally from the work in this paper. First, having established the importance of scale effects a next step is to identify their magnitude in different sectors of the economy. This is especially important for immigration policy, since issuing work permits in industries with large scale effects is likely to have a positive effect on native workers, while in those with small scale effects displacement is likely. In

theory we have a good sense of what determines these (the elasticity of product demand, the elasticity of supply of capital and the labor share), but empirical evidence is lacking. Second, we provide evidence that immigration has a significant impact on skill premiums, and hence inequality, which in turn is likely to affect the education decisions of young Malaysians. Whether this mechanism is important and to what extent it has contributed to the extraordinarily rapid increase in the educational attainment of Malaysia's workforce is an open question.

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Appendix

A. Elasticities of Derived Demand

Firms maximize profits subject given the production function described by (1). Taking the derivative of the first-order conditions with respect to a change in the number of immigrants:

$$\frac{d \ln w_m}{d \ln M} = \frac{d \ln L}{d \ln M} \left(\frac{1}{\sigma_{mn}} - \frac{1}{\eta} \right) - \frac{1}{\sigma_{mn}} \quad (14)$$

$$\frac{d \ln w_n}{d \ln M} - \frac{d \ln w_m}{d \ln M} = \frac{1}{\sigma_{mn}} \left(1 - \frac{d \ln N}{d \ln w_n} \frac{d \ln w_n}{d \ln M} \right) \quad (15)$$

Eliminating $\frac{d \ln w_m}{d \ln M}$ using (14) and (15)

$$\frac{d \ln L}{d \ln M} = \frac{d \ln w_n \eta (\sigma_{mn} + \phi_n)}{d \ln M (\eta - \sigma_{mn})} \quad (16)$$

Then differentiate the production function and use the fact that with constant returns to scale $s_m = \frac{w_m M}{w_l L} = \frac{w_m}{w_l} \frac{M}{L} = \frac{F_M M}{L}$ and $s_n = \frac{w_n N}{w_l L} = \frac{F_N N}{w_l L}$

$$\begin{aligned} \frac{dL}{dM} &= F_M + F_N \frac{dN}{dw_n} \frac{dw_n}{dM} \\ \frac{d \ln L}{d \ln M} &= s_m + s_n \phi_n \frac{d \ln w_n}{d \ln M} \end{aligned} \quad (17)$$

Eliminate $\frac{d \ln L}{d \ln M}$ using (16) and (17) to find the expression for $\frac{d \ln w_n}{d \ln M}$, see equation (3). Then substitute into (16) to find the expression for $\frac{d \ln L}{d \ln M}$. Finally, substituting this expression into (14) to obtain $\frac{d \ln w_m}{d \ln M}$ as a function of the exogenous parameters.

B. Controlling for the Scale Effect in the Literature

We illustrate the manner in which the literature controls for scale effects, in order to estimate the substitution effect, using simplified versions of the identification strategies in Card (2001) and Borjas (2003). We the conclude this section with a discussion of Ottaviano and Peri (2012).

Consider first the Card (2001) model where output in a city c is produced using a two-level nested CES production function combining labor and capital

$$Y_c = F(K_c, L_c).$$

The labor aggregate L_c is a CES-aggregate of quantities of labor N_{jc} of occupation categories $j = 1, \dots, N$:

$$L_c = \left[\sum_j (e_{jc} N_{jc})^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)},$$

where σ is the elasticity of substitution between workers of different types. Workers are paid their marginal product:

$$w_{jc} = \frac{\partial Y_c}{\partial N_{jc}} = e_{jc}^{(\sigma-1)/\sigma} N_{jc}^{-1/\sigma} L_c^{1/\sigma} q_c F_L,$$

where q_c is the price of output in a city and $q_c F_L$ is the marginal product of the labor aggregate.

The relationship between factor prices (the wage) and quantities

$$\ln w_{jc} = -\frac{1}{\sigma} \ln N_{jc} + \frac{\sigma-1}{\sigma} \ln e_{jc} + \ln (L_c^{1/\sigma} q_c F_L),$$

depends on the elasticity of substitution, a city and occupation productivity shock $\ln e_{jc}$, and a common city-specific component shared by all groups $j \ln (L_c^{1/\sigma} q_c F_L)$. Immigration will affect the wage of a worker of occupation j via two channels: a change in N_{jc} , and a change in the city-specific component due to, in particular, a change in the scale of production (it may of course also affect the productivity parameters). Card does not estimate both of these effects, but rather runs a regression of the type

$$\ln w_{jc} = u_j + u_c + \beta N_{jc} + \varepsilon_{jc},$$

where city fixed effects absorb the impact of immigration on the scale of production, and the parameter of interest $\beta = -1/\sigma$ identifies the substitution effect (provided that the

elasticity of labor supply is equal to zero).

Borjas (2003) extends this model to allow for imperfect substitution between workers of the same education level i but different experience j , and instead of variation across cities he uses variation across years t . The three-level nested CES has an aggregate production function for the economy with output Q_t produced by capital K_t and labor L_t in year t :

$$Q_t = (\lambda_{Kt}K_t^v + \lambda_{Lt}L_t^v)^{1/v}.$$

The labor aggregate nests workers of different levels of education L_{it} and different levels of experience with a certain level of education L_{ijt} :

$$\begin{aligned} L_t &= \left(\sum_i \theta_{it} L_{it}^\rho \right)^{1/\rho}, \\ L_{it} &= \left(\sum_j \alpha_{ij} L_{ijt}^\eta \right)^{1/\eta}. \end{aligned}$$

The wage for skill group (i, j, t) is

$$\ln w_{ijt} = \ln \lambda_{Lt} + (1 - v) \ln Q_t + (v - \rho) \ln L_t + \ln \theta_{it} + (\rho - \eta) \ln L_{it} + \ln \alpha_{ij} + (\eta - 1) \ln L_{ijt}$$

There are now three channels, apart from the productivity parameters, by which immigration make affects wages: L_{ijt} , changes in the scale of the education specific component $(\rho - \eta) \ln L_{it}$, and the scalar of the aggregate year specific component $(1 - v) \ln Q_t + (v - \rho) \ln L_t$. To estimate the impact of immigration on wages Borjas follows Card and Lemieux (2001) by rewriting wage for skill group (i, j, t) as

$$\ln w_{ijt} = \delta_t + \delta_{it} + \delta_{ij} - (1/\sigma_x) \ln L_{ijt},$$

In this specification the year fixed effects δ_t absorb the impact of immigration on wages through changes in the aggregate scale of production, and the education by year fixed effects δ_{it} absorb the impact of immigration on wages via changes in the scale of the education aggregates. This then allows for the estimation of the elasticity of substitution across experience groups $\sigma_x = \frac{1}{1-\eta}$ (and subsequently the elasticity of substitution in

higher level nests). Borjas' reduced-form estimating equation earlier in that paper is very similar but simplifies matters by assuming that the elasticity of substitution across education groups is the same as across experience groups.

Ottaviano and Peri (2012), using a nested-CES production function with potentially imperfect substitution of natives and immigrants within the same education-experience group, distinguish between partial and total wage effects. The partial wage effect is that identified in Card (2001) or Borjas (2003) and is the wage impact on native workers of a change in the supply of immigrants with the same characteristics, while keeping constant the labor supplies of all other workers. The total wage effect also accounts for the indirect impacts of immigration on all other groups of workers, which in Borjas' specification, for example, is absorbed by the education by year fixed effects δ_{it} . Allowing for these more complicated cross-effects across groups provides a more complete estimate of the impact of immigration on native wages. However, it is not the source of the scale effect estimated in this paper. The scale effect in this paper arises irrespectively of the existence of the cross-effects of Ottaviano and Peri (2012) - though potentially incorporates these as well - and is driven by the increase in output as immigration reduces firms' costs of production.

Figure 1: Actual and Counterfactual Skill Premiums in 2010

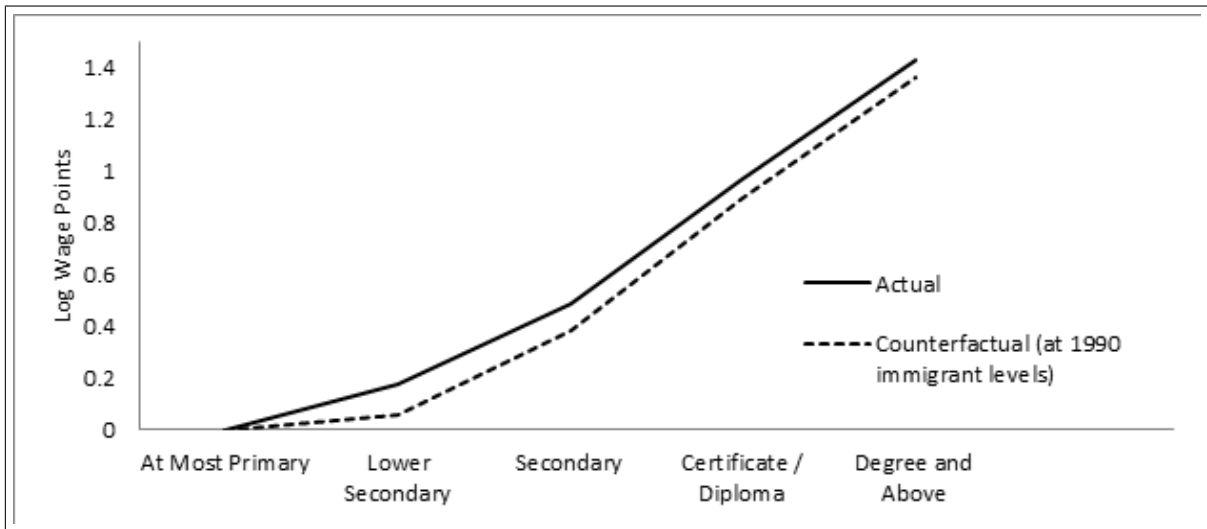


Table 1: Descriptive Statistics: (for working-age population, ages 15-64)

	Natives			Immigrants		
	1990	2007	2010	1990	2007	2010
Labor Force Participation Rate (%)	66.4	61.7	61.5	72.0	81.6	78.9
Unemployment Rate (%)	4.6	3.4	3.5	2.9	1.3	1.8
	Among Employed (in %)					
Fraction Female	35.9	36.4	36.6	26.1	32.8	31.7
At most primary	62.4	26.4	20.5	90.6	78.6	66.0
Lower secondary	8.7	14.2	13.8	2.5	9.9	15.1
Upper secondary	23.1	41.1	43.3	2.8	7.9	14.6
Diploma/Certificate	3.3	10.3	11.6	0.8	0.9	1.2
Degree	2.5	8.0	10.7	3.3	2.7	3.1
Ages 15 - 19	9.4	3.6	3.2	9.1	5.2	5.1
Ages 20 - 29	34.6	30.9	30.7	39.3	25.5	19.3
Ages 30 - 39	26.4	26.8	27.0	29.4	38.9	39.5
Ages 40+	29.6	38.6	39.1	22.2	30.3	36.0
Agriculture and Mining	25.7	13.1	11.9	48.4	34.4	32.5
Manufacturing	20.3	18.8	17.1	9.8	17.1	17.9
Construction	6.2	8.2	8.6	10.4	13.6	14.0
Services	31.9	41.8	42.5	29.3	32.5	33.6
Public Admin, Health, Education	15.8	18.1	19.8	2.1	2.4	2.0
Number of Observations	77,511	227,226	242,276	3,018	13,704	16,224
Total	10,484,606	15,919,461	16,980,672	351,512	1,300,187	1,394,177

Table 2: Labor Market Impact of Immigration, OLS Estimates

	(1)	(2)	(3)
A: Dependent Variable = Native Employment			
Immigrant Employment	0.104 (0.105)	0.100 (0.096)	0.095 (0.097)
Elasticity	0.009	0.009	0.008
Observations	1,320	1,320	1,320
B: Dependent Variable = Log Wage for Natives			
Immigrant Employment (in 10,000s)	-0.001 (0.007)	-0.003 (0.007)	0.002 (0.006)
Elasticity	-0.005	-0.015	0.013
Observations	91,150	91,150	91,150
C: Dependent Variable = Log Wage for Immigrants			
Immigrant Employment (in 10,000s)	-0.064** (0.025)	-0.041** (0.028)	-0.033 (0.028)
Elasticity	-0.032	-0.020	-0.016
Observations	9,523	9,523	9,523
Fixed Effects:			
Industry by Region	Yes	Yes	Yes
Year	Yes	Yes	Yes
Industry by Year	No	Yes	Yes
Region by Year	No	No	Yes

Note: All wage regressions include gender-specific individual-level controls for education, potential experience, part-time employment, marital status and month of survey. Native and immigrant employment is measured in an industry-region-year. Standard errors are clustered by industry-region-year and robust to heteroscedasticity. Individual observations are weighted using sampling weights. *, **, *** denote significance at the 10, 5 and 1 percent significance level.

Table 3: Labor Market Impact of Immigration, Instrumental Variable Estimates

	(1)	(2)	(3)
A: Dependent Variable = Native Employment			
Immigrant Employment	0.623*** (0.203)	0.361** (0.179)	0.410** (0.177)
Elasticity	0.066	0.038	0.043
First-stage F-statistic	5.3	5.3	8.9
Observations	1,320	1,320	1,320
B: Dependent Variable = Log Wage for Natives			
Immigrant Employment (in 10,000s)	0.009 (0.021)	0.005 (0.021)	0.001 (0.019)
Elasticity	0.002	0.001	0.000
First-stage F-statistic	6.4	6.0	8.1
Observations	91,150	91,150	91,150
C: Dependent Variable = Log Wage for Immigrants			
Immigrant Employment (in 10,000s)	-0.137*** (0.023)	-0.119*** (0.042)	-0.094*** (0.034)
Elasticity	-0.570	-0.494	-0.390
First-stage F-statistic	27.7	14.2	16.4
Observations	9,523	9,523	9,523
D: Structural Parameter Estimates			
η (elasticity of labor demand)	2.68*** (0.564)	2.64*** (1.005)	3.41*** (1.315)
σ (elasticity of substitution)	1.63*** (0.276)	1.94*** (0.686)	2.45*** (0.889)
ϕ (elasticity of labor supply)	36.57 (85.77)	37.19 (152.9)	202.9 (359.7)
E: Immigration at Local Labor Market Level			
Native Employment Elasticity	0.070	0.041	0.044
F: Immigration at National Level			
Native Wage Elasticity	0.028	0.016	0.014
Immigrant Wage Elasticity	-0.584	-0.499	-0.394
Average Wage Elasticity	-0.044	-0.045	-0.035
Fixed Effects:			
Industry by Region	Yes	Yes	Yes
Year	Yes	Yes	Yes
Industry by Year	No	Yes	Yes
Region by Year	No	No	Yes

Note: All wage regressions include gender-specific individual-level controls for education, potential experience, part-time employment, marital status and month of survey. Native and immigrant employment is measured in an industry-region-year. Standard errors are clustered by industry-region-year and robust to heteroscedasticity. Individual observations are weighted using sampling weights. *, **, *** denote significance at the 10, 5 and 1 percent significance level.

Table 4: Robustness Checks I, Instrumental Variable Estimates

	(1) Weighted	(2) S.E. Clustered	(3) Single Instrument	(4) Log-Log
Panel A: Dependent Variable: Native Employment				
Immigrant Employment	0.510** (0.247)	0.410** (0.207)	0.710*** (0.262)	-0.009 (0.035)
First-stage F-statistic	6.8	8.9	17.9	1.5
Panel B: Dependent Variable: Log Native Wages				
Immigrant Employment (in 10,000s)	0.001 (0.002)	0.001 (0.002)	-0.034 (0.240)	0.001 0.004
First-stage F-statistic	8.1	8.1	5.7	1.5
Panel C: Dependent Variable: Log Immigrant Wages				
Immigrant Employment (in 10,000s)	-0.094*** (0.034)	-0.093** (0.041)	-0.319 (0.290)	-0.191*** 0.073
First-stage F-statistic	45.4	16.4	1.2	2.2

Note: In column (1) observations are weighted by the average employment in an industry-region. In column (2) standard errors are clustered by industry-region. In column (3) we use a single instrument. In column (4) all variables are in natural logs. All specifications include industry-region, industry-year and region-year fixed effects. All wage regressions include gender-specific individual-level controls for education, potential experience, part-time employment, marital status and month of survey. Native and immigrant employment is measured in an industry-region-year. Standard errors are clustered by industry-region-year unless otherwise specified and robust to heteroscedasticity. Individual observations are weighted using sampling weights. *, **, *** denote significance at the 10, 5 and 1 percent significance level.

Table 5: Robustness Checks II, 1990 - 2010, Variation by Industry-Region and Region
Instrumental Variable Estimates

	(1)	(2)	(3)
	Main Specification	Weighted	Clustered
Dependent Variable: Native Employment in Industry-Region			
Panel A.1: Baseline Specification			
Immigrant Employment	0.602*** (0.105)	0.591*** (0.081)	0.603*** (0.050)
First-stage F-statistic	14.6	40.5	14.6
Panel A.2: Specification Including Industry-Region Linear Trends			
Immigrant Employment	0.374*** (0.134)	0.350*** (0.085)	0.374*** (0.101)
First-stage F-statistic	17.7	52.1	17.7
Observations	5,940	5,940	5,940
Dependent Variable: Native Employment in Region			
Panel B.1: Baseline Specification			
Immigrant Employment	1.816*** (0.338)	2.082*** (0.46)	1.816*** (0.784)
First-stage F-statistic	105	97.0	105
Panel B.2: Specification Including Region Linear Trends			
Immigrant Employment	0.560*** (0.158)	0.567*** (0.170)	0.560*** (0.097)
First-stage F-statistic	13.9	14.9	13.9
Observations	270	270	270

Note: In Panel A all specifications include industry-region, industry-year and region-year fixed effects. Native and immigrant employment is measured in an industry-region-year. In columns (1) and (2) standard errors are clustered by industry-region-year and robust to heteroscedasticity; in column (3) by industry-region. In Panel B all specifications include region and year fixed effects. Native and immigrant employment is measured in a region-year. In columns (1) and (2) standard errors are clustered by region-year and robust to heteroscedasticity; in column (3) by region. *, **, *** denote significance at the 10, 5 and 1 percent significance level.

Table 6: Sensitivity of Results to Different Elasticities of Labor Supply Across Industry-Regions

Local Labor Supply Elasticity	Perfectly Elastic	20	10	5	2	1
A. Structural Parameter Estimates						
η (elasticity of labor demand)	3.39*** (1.28)	3.54** (1.41)	3.70** (1.56)	4.07** (1.93)	5.80 (4.32)	20.0 (61.5)
σ (elasticity of substitution)	2.45*** (0.89)	2.44*** (0.88)	2.43*** (0.87)	2.40*** (0.85)	2.32*** (0.80)	2.21*** (0.73)
B. Wage Elasticity of Immigration at National Level						
Native Wage Elasticity	0.013	0.015	0.017	0.020	0.030	0.048
Immigrant Wage Elasticity	-0.394	-0.395	-0.396	-0.397	-0.400	-0.406
Average Wage Elasticity	-0.035	-0.033	-0.032	-0.029	-0.020	-0.006

Note: Standard errors for the parameter estimates are calculated using the delta method, and are based on the estimates presented in column (3) of Table 3. *, **, *** denote significance at the 10, 5 and 1 percent significance level.

Table 7: Impact of Immigration by Native Educational Attainment, OLS Estimates

	(1) No Formal / Primary	(2) Lower Secondary	(3) Secondary	(4) Certificate / Diploma	(5) Degree +
A: Dependent Variable = Native Employment					
Immigrant Employment	-0.137 (0.102)	0.090*** (0.024)	0.149*** (0.040)	0.036** (0.014)	0.041*** (0.015)
Elasticity	-0.094	0.070	0.034	0.028	0.039
Observations	2,310	2,310	2,310	2,310	2,310
B: Dependent Variable = Log Wage for Natives					
Immigrant Employment (in 10,000s)	-0.023** (0.012)	-0.030* (0.018)	0.009 (0.011)	0.040* (0.021)	0.055 (0.034)
Elasticity	-0.007	-0.008	0.008	0.010	0.012
Observations	15,234	13,091	40,818	12,451	9,556
Share of Natives (in %)	26.4	14.2	40.8	10.0	8.7
Share of Immigrants (in %)	75.8	10.5	9.4	1.2	3.2

Note: All wage regressions include gender-specific individual-level controls for education, potential experience, part-time employment, marital status and month of survey. Native and immigrant employment is measured in an industry-region-year. Standard errors are clustered by industry-region-year and robust to heteroscedasticity. Individual observations are weighted using sampling weights. *, **, *** denote significance at the 10, 5 and 1 percent significance level.

Table 8: Impact of Immigration by Native Educational Attainment, IV Estimates

	(1)	(2)	(3)	(4)	(5)
	No Formal / Primary	Lower Secondary	Secondary	Certificate / Diploma	Degree +
A: Dependent Variable = Native Employment					
Immigrant Employment	-0.304*	0.157***	0.306***	0.045***	0.022
	(0.156)	(0.044)	(0.093)	(0.015)	(0.014)
Elasticity	-0.213	0.123	0.070	0.034	0.021
First-stage F-statistic	7.2	7.2	7.2	7.2	7.2
Observations	2,310	2,310	2,310	2,310	2,310
B: Dependent Variable = Log Wage for Natives					
Immigrant Employment (in 10,000s)	0.0004	-0.015	-0.033	-0.064	-0.079
	(0.033)	(0.039)	(0.030)	(0.045)	(0.082)
First-stage F-statistic	7.9	5.2	5.4	6.8	4.7
Observations	15,234	13,091	40,818	12,451	9,556
C: Dependent Variable = Log Wage for Immigrants					
Immigrant Employment (in 10,000s)	-0.094***	-0.094***	-0.094***	-0.094***	-0.094***
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
D: Structural Parameter Estimates					
η (elasticity of labor demand)	2.46***	3.42***	4.06***	3.07***	3.00***
	(0.95)	(1.24)	(1.61)	(1.07)	(1.04)
σ (elasticity of substitution)	3.74***	2.73***	2.82***	3.11***	3.18***
	(1.40)	(1.01)	(1.00)	(1.18)	(1.22)
ϕ (elasticity of labor supply)	-2442	-41.5	10.7	-2.68	-1.35
	(184002)	(109)	(10.3)	(2.07)	(1.65)
E: Wage Elasticity of Immigration at National Level					
Native Wage Elasticity	-0.071	0.038	0.026	-0.002	-0.009
Share of Natives (in %)	26.4	14.2	40.8	10.0	8.7
Share of Immigrants (in %)	75.8	10.5	9.4	1.2	3.2

Note: All wage regressions include gender-specific individual-level controls for education, potential experience, part-time employment, marital status and month of survey. Native and immigrant employment is measured in an industry-region-year. Standard errors are clustered by industry-region-year and robust to heteroscedasticity. Standard errors for the parameter estimates are calculated using the delta method. Individual observations are weighted using sampling weights. *, **, *** denote significance at the 10, 5 and 1 percent significance level.