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ABSTRACT

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We review research on the impact of immigration on income distribution. We discuss routes through which immigration can affect income distribution in the host and source countries, including compositional effects and effects on native incomes. Immigration may affect the composition of skills among the residents of a country. Moreover, immigrants can, by changing relative factor supplies, affect native wage and employment rates and the return to capital. We then provide evidence on the level and recent increases in immigration to OECD countries and on the distribution of native and immigrant educational attainment. We next provide a decomposition of 1979-2009 changes in US wage inequality, highlighting the effects of immigration on workforce composition. We then consider the economic theory of the impact of immigration on income distribution, emphasizing labor market substitution and complementarity between natives and immigrants. Further, by changing job opportunities or child care availability, immigrants can affect family, as well as individual, income distribution. We review research methodologies used to estimate the impact of immigration on the native income distribution. These include the structural approach (estimating substitution and complementarity among factors of production, including capital and labor force groups) as well as the natural experiment approach (seeking exogenous sources of variation in immigration) to studying the labor market. We then discuss evidence on these questions for Austria, Britain, France, Germany, Hong Kong, Israel, Portugal, Spain and the United States, as well as the impact of emigration on source country income distribution.

JEL Classification: D33, J61

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1. Introduction

Immigration has become a contentious issue in Western industrialized countries. In Europe, Australia and the United States, anti-immigrant political parties have made electoral gains in recent years, reflecting in many cases voter hostility to immigrants (Van der Brug, Fennema and Tillie 2000; Jacobson 2011; Mughan and Paxton 2006). While some of the growth in anti-immigrant sentiment is related to ethnic or religious hostility, there is also evidence that such attitudes are affected by the perceived economic effects of immigrants on natives. For example, survey respondents in OECD countries were more pro-immigrant if they were in skill groups less likely to compete with the immigrants in their country (Mayda 2006); and individuals were more likely to vote for a far right anti-immigrant party in Australia if they perceived that immigrants reduce job opportunities for natives (Mughan and Paxton 2006).

In light of the perhaps growing public perception that immigration reduces native fortunes, it is important to find out what the impact of immigration on native incomes and the overall income distribution actually is. In this Chapter, we review research on these questions, surveying studies from a variety of immigrant-receiving countries. We first discuss at a conceptual level the differing routes through which immigration can affect the distribution of income in both the host and source countries. These can be broken down into compositional effects and actual effects on native incomes. The compositional effects reflect the possibility that immigrants may have different characteristics from natives such as schooling levels. Increases in immigration may then affect the distribution of skills among the residents of a country, where immigrants are included in our definition of residents. In addition to composition effects, immigrants can, by changing relative factor supplies, affect native wage and employment outcomes and the return to capital investment.

We then provide some evidence on the level of and recent increases in immigration to OECD countries and the distribution of native and immigrant educational attainment. And we also present data from the United States Census of Population and the American Community Survey (ACS) which allow us to assess the compositional effects of immigration on the distribution of

income. We follow this with a detailed discussion of the theoretical effects immigration can have on the native distribution of income. Much of the discussion here will involve theories about substitution and complementarity between natives and immigrants in the labor market. In addition, by expanding the availability of child care services for natives and facilitating the employment of higher-earning women, immigrants can affect the distribution of income across families as well as individuals. Next, we consider research methodologies used to estimate the impact of immigration on the native income distribution. These research designs illustrate both the structural approach as well as the natural experiment approach to studying the labor market. The former approach attempts to estimate fundamental production function parameters from which one can simulate the impact of immigration on prices and quantities. The latter seeks exogenous sources of variation of immigration, since immigrants likely respond in part to factor prices when they decide to migrate. This response can complicate attempts to directly estimate the impact of immigration, and as discussed in detail below, researchers in some cases have been able to exploit the exogenous variation in immigration caused by political events. We will discuss evidence on these questions for several countries including Austria, Britain, France, Germany, Hong Kong, Israel, Portugal, Spain and the United States. While almost all research on immigration and the income distribution studies its effect on the host country, economists also recognize that the distribution of income in the source country can also be affected. Several studies examine this question in the context of specific countries which have experienced large-scale emigration in recent years, including Honduras, Lithuania, and Mexico.

Consideration of the impact of immigration and emigration together suggests an additional concept of income distribution that international population movements can affect. Specifically, since immigrants' incomes in the host country usually are much higher than in their source country, population movements have the potential to affect the distribution of income in the world, and we will also review the small literature on this question.

2. The Impact of Immigration on the Distribution of Income: Conceptual Issues

Immigration (or emigration) can affect a country's distribution of income through composition effects as well as directly affecting the incomes of natives. To understand these two types of impacts, consider the following decomposition of the variance of incomes, which can be defined at the individual or family level:

$$(1)\quad Var(y)=\alpha_n Var(y_n) + \alpha_i Var(y_i) + \alpha_n(E(y_n)-E(y))^2 + \alpha_i(E(y_i)-E(y)))^2$$

where y refers to income in the population, y_n refers to native incomes, y_i refers to immigrant income, α_n is the population share composed of natives, and α_i is the population share composed of immigrants, which of course equals $(1-\alpha_n)$. Equation (1) states that the variance of income among residents in a country is comprised of two weighted sums (with the weights reflecting the native or immigrant population share): i) first is the weighted sum of the within native and within immigrant population variances, and ii) second is the weighted sum of the squared differences between the mean native and overall mean income and the immigrant mean and overall mean income.[1]

In an accounting sense, immigration can change the level of income inequality if immigrants have a different level of wage dispersion from natives, a different average level of incomes from natives or if they indirectly affect the level and dispersion of native incomes. Intuitively, if immigrants are only a tiny fraction of the population and if their skills and the rewards to those skills are very similar to those of natives, then there is little scope for immigrants to have a large effect on the overall or native income distribution. In addition, while equation (1) shows the impact of immigration on income inequality at a point in time, it is also possible to write down such an equation for different points in time, where each quantity has a time subscript. Thus, one can also decompose changes in a country's level of income inequality into components accounted for by changes in the share of immigrants in the population, changes

[1] For further details on this method of variance decomposition, see Freeman (1980) who used it to assess the effect of unionism on U.S. wage inequality; Blau and Kahn (1996) who used it to compare wage inequality in the US with that in several other countries; or Juhn, Murphy and Pierce (1993) who employed it to measure the impact of industry on wage inequality in the United States.

in native income inequality, changes in immigrant income inequality, and changes in the immigrant-native income differential. In Section 3 below, we will provide analyses of equation (1) to study changes in the overall level of income inequality for the United States. Earnings inequality in the United States has risen sharply since 1979 and researchers have been concerned with the extent to which immigration has contributed to this increase (Borjas 2003; Card 2009).

Analysis of equation (1) studies the compositional effects of immigration on one measure of income inequality, the variance. This measure is very convenient in that, as equation (1) shows, it can be decomposed into its between and within components which have ready interpretations. However, the variance is only one summary statistic, and immigration may affect different parts of the distribution differently. For example, low skilled immigration may affect the bottom of the wage distribution more than the top in countries where wages are flexible; alternatively, in highly unionized countries, there may be rigid wage floors which limit the impact the impact of immigration on low wage workers' earnings (Blau and Kahn 1996). Thus, the variance decomposition, while useful, also has limitations. In addition, the decomposition assumes that immigration does not affect the within components of the variance, which are likely the most interesting parts from the policy point of view. As the research on attitudes toward immigration suggests, individuals are particularly concerned with the impact of immigration on their own incomes. Perhaps not surprisingly, most research on the impact of immigration on the host country economy studies its impact on native income levels, jobs and income inequality. This research conceptualizes the impact of immigration as primarily adding to the supply of labor corresponding to immigrant skill levels. Emigration is treated symmetrically. In Section 4 below, we will present some detailed models of the impact of immigration, but, before doing so, it is important to consider some of the conceptual issues involved in modeling such effects.

While immigration may change the skill mix of the labor force, one must take into consideration the international context in which such population movements take place. As we shall discuss in detail below, if a country produces multiple goods that are each internationally-traded, then increases in the supply of labor of a particular skill level may have no effect on

relative wages or wages relative to the price of capital, at least if the country is small relative to the rest of the world (Samuelson 1948). In the simplest case, suppose a country produces two internationally-traded goods. Then immigration of less-skilled immigrants will cause the country's output mix to shift toward goods that intensively require less-skilled labor; however, as long as the country continues to produce both internationally-traded goods, free trade will be sufficient to equalize factor rewards across countries and immigration will have no additional effect (Samuelson 1948). On the other hand, immigration may affect relative wages if there is a significant nontraded sector or if a country specializes in one traded good (Kuhn and Wooton 1991; Dustmann, Fabbri and Preston 2005; Samuelson 1948). A key feature of these analyses of trade and immigration is that immigration may change the product mix, and we will consider evidence on this question.

Even in the circumstances under which increases in the relative supply of labor of different skill levels can affect factor payments, immigration may have conceptually different effects on labor markets from those of domestically-based increases in labor supply such as changes in the size of birth cohorts, increases in women's labor force participation, or the changing propensity to acquire a college degree. For example, immigrants may send earnings back to relatives in their source country, reducing the demand for output and thus labor, compared to comparable natives. To the extent that remittances are common, then the simple model of increased labor supply may not adequately describe the effect of immigrants on native workers. On the other hand, immigrants may bring capital with them in order to start businesses in the host country, particularly where immigration by entrepreneurs is favored by a country's immigration policy. If so, then immigrants may add to the overall demand for output and labor beyond what they spend from the income generated in the host country.

An additional factor suggesting that immigration-caused increases in labor supply may have different effects from native-caused increases is that immigrants may have fewer rights in the labor market than natives do. For instance, in the United States, a large share of immigration is undocumented and in Europe, immigrants may not receive the same level of employment protection as natives. Specifically, the United States Department of Homeland Security

estimated that, as of January 2006, 39.6% of the US foreign-born population was unauthorized (Hoefer, Rytina and Campbell 2007, p. 3). And in countries such as Austria, labor mobility of immigrants is strictly limited (Winter-Ebmer and Zweimüller 1996). Thus, undocumented immigrants in the United States or immigrants in Austria with limited mobility rights may be at a bargaining disadvantage vis-à-vis employers in comparison to native workers. In countries with strong employment protection of native workers on permanent jobs, immigrants may displace natives because, since they are more likely to be on temporary employment contracts, they cost less to fire (Angrist and Kugler 2003; Kahn 2007). Conversely, immigrant labor may produce an economic surplus and native workers may be able to appropriate some it due to their superior bargaining position (Winter-Ebmer and Zweimüller 1996). Again, the impact of a given amount of immigration of a particular skill level on native incomes and income distribution may be more complicated than what would be implied by a similar increase in native labor supply.

The basic model of substitution and complementarity between immigrants and natives, as described more fully below, yields considerable insight into our understanding of the impact of immigration on income distribution. However, the considerations in this Section suggest that attention must also be paid to the differences between the processes whereby native and immigrant labor supply increase. We will discuss such differences in several instances when we evaluate empirical evidence on the impact of immigrants on native incomes and income distribution.

3. Evidence on the Compositional Effects of Immigration on Income Distribution

As just mentioned, two important factors that influence the scope for immigration to affect a country's income distribution are the size and the skill composition of the immigrant population relative to natives. Tables 1 and 2 provide some information on how these characteristics of immigrants vary across OECD countries. First, Table 1 shows the level and recent growth of the immigrant population in OECD countries for the 1988-91 and 2000-1 periods. The Table indicates that the relative size of the immigrant population varies widely across industrialized

countries. For example, during the earlier period, fully 27% of Luxembourg's and 23% of Australia's population was foreign-born. In contrast, less than one percent of those living in Spain, Finland, Japan or Korea were immigrants, although immigration grew rapidly in Spain during the 2000s (Farré, González, and Ortega 2010). While the immigrant share varies a lot across countries, it grew between 1988-91 and 2000-1 in every country for which data were available, with increases in the share as large as eight percentage points in Austria and Ireland. Moreover, the immigrant share more than doubled in 12 of the 21 countries for which data were available, and the median relative increase was 140%. As of 2000-1, the population-weighted immigrant share of the population averaged 7.5%, a seemingly small number but was at least 10% in 14 of the 29 countries shown and above 15% in several countries, including Australia, Canada, Switzerland, Luxembourg, and New Zealand. Thus, there are several countries where immigration already is quantitatively important, and its widespread increase across countries suggests that it will become even more important in the future.

Table 2 presents data on the educational attainment of immigrants and natives as of 2000-1 across OECD countries. Although there are some dramatic contrasts across countries, on average (on a population-weighted basis), immigrants have a higher incidence of both primary and tertiary schooling levels than natives do. The gap is larger for tertiary schooling, as 24% of immigrants have attained this level in comparison to 20% of natives; in contrast, the immigrant-native gap for primary schooling is only two percentage points, with 42% of immigrants and 40% of natives having attained primary schooling levels. Thus, immigration has on average added to the relative supply of both the least and the most educated individuals, suggesting that, on average, immigration has raised the within-country dispersion of skills as measured by formal schooling. Immigrants of a given skill level can affect earnings of other workers with the same skill through substitution effects but also that of workers with other skill levels, through substitution and complementarities. We shall discuss these issues in detail below.

Looking at the individual countries in Table 2, in several cases, immigrants are much more likely to have primary schooling levels than natives, including Austria, Switzerland, the Czech Republic, Germany, Poland and the United States. In others, such as the UK, Ireland, Mexico,

Portugal and Turkey, immigrants are much less likely to have low educational attainment than natives. The immigrant-native contrasts in the incidence of high education levels are largely the reverse of those for the low end, except for the United States, where the incidence of high schooling levels is about the same for immigrants and natives.

As suggested above, even if immigrants are very different from natives in their skill levels, if immigration is a small portion of the total population, then these differing skill levels will likely have little effect on native and total labor market outcomes. Comparing the Total and Natives columns in Table 2 provides some evidence on the possible impact of immigrants on a country's supplies of skills. For example, in the United States, 23.1% of all individuals have low levels schooling, in contrast to 20.3% of natives. On the assumption that native schooling levels are not affected by immigration, then one could infer that immigration raised the supply of less educated individuals by 15% (i.e., .231/.203≈1.15), a potentially important effect. Similarly, Table 2 suggests that immigration has raised the supply of less educated individuals in Germany by 12%, in Switzerland by 15%, and in Luxembourg by 10%. (Of course, if immigration has lowered the relative wages of workers with low schooling levels, it could have induced some natives and some immigrants to acquire more schooling.) At the high end of the education distribution, the effects seem less dramatic: immigrants have raised the supply of those with tertiary schooling by 7% in the UK and Australia, 9% in Ireland, but 25% in Luxembourg.[2]

Tables 1 and 2 suggest that immigrants can in some cases comprise a large part of the population and have a substantially different skill distribution from that of natives. These two facts together suggest that immigration can potentially have compositional effects on the distribution of incomes among those living in a country as well as indirectly affecting the native distribution of income. We now provide some descriptive evidence on such composition effects for the United States for the 1980-2010 period, an era of rising income inequality and immigration. Returning to the decomposition of income inequality shown in equation (1), we

[2] The relative supply effects of immigration shown in Table 2 for the less educated are more dramatic than for the highly educated, despite the fact that the overall weighted average effect across OECD countries is slightly larger for the highly educated. This is the case because among the less educated, there are some large absolute immigrant-native differences in incidence, but some show a larger share of immigrants and some show a larger share of natives. In contrast, for the highly educated, the absolute differences are much smaller.

can use this identity to derive the following decomposition of the change in the variance of any income measure between two periods (year 0 and year 1):

$$(2)\ \mathrm{Var}(y_1)-\mathrm{Var}(y_0)=\alpha_{n0}(\mathrm{Var}(y_{n1})-\mathrm{Var}(y_{n0}))+\alpha_{i0}(\mathrm{Var}(y_{i1})-\mathrm{Var}(y_{i0})) +$$
$$(\alpha_{n1}-\alpha_{n0})\mathrm{Var}(y_{n1}) + (\alpha_{i1}-\alpha_{i0})\mathrm{Var}(y_{i1}) +$$
$$\alpha_{n0}((E(y_{n1})-E(_{y1}))^2)- (E(y_{n0})-E(_{y0}))^2)+ \alpha_{i0}((E(y_{i1})-E(y_1))^2)- (E(y_{i0})-E(y_0))^2) +$$
$$(\alpha_{n1}-\alpha_{n0})\ (E(y_{n1})-E(y_1))^2 + (\alpha_{i1}-\alpha_{i0})\ (E(y_{i1})-E(y_1))^2,$$

where n and i subscripts refer to natives and immigrants, respectively.

According to equation (2), the change in the overall variance of an income measure (y) is made up of four components, with each of the four being the sum of an effect for natives and one for immigrants. First, $[\alpha_{n0}(\mathrm{Var}(y_{n1})-\mathrm{Var}(y_{n0}))+\alpha_{i0}(\mathrm{Var}(y_{i1})-\mathrm{Var}(y_{i0}))]$ is the contribution of changing variances for natives and immigrants, weighted by their respective population shares.[3] That is, the overall variance of income could have increased because the native variance and/or immigrant variance increased. We call this component the Within Group Variance Effect. Second, $[(\alpha_{n1}-\alpha_{n0})\mathrm{Var}(y_{n1}) + (\alpha_{i1}-\alpha_{i0})\mathrm{Var}(y_{i1})]$ is the contribution to the change in the overall variance in income caused by changing weights attached to the within group variances. Suppose, for example, that immigrants have a higher income variance than natives. Then, all else equal, if the immigrant population share rises, a higher share of people will be in the high variance group, thus raising the overall income variance. We call this component the Within Group Composition Effect. Third, $[\alpha_{n0}((E(y_{n1})-E(_{y1}))^2)- (E(y_{n0})-E(_{y0}))^2)+ \alpha_{i0}((E(y_{i1})-E(y_1))^2)- (E(y_{i0})-E(y_0))^2)]$ is the contribution caused by changing differences between native and population mean income and immigrant and population mean income. For example, if the immigrant-native gap in income rises, then this will increase the overall variance of income. We term this component the Between Group Income Differential Effect. Finally, $[(\alpha_{n1}-\alpha_{n0})\ (E(y_{n1})-E(y_1))^2 + (\alpha_{i1}-\alpha_{i0})\ (E(y_{i1})-E(y_1))^2]$ is the contribution of changing weights on the income gaps between natives and the

[3] Note that equation (2) uses period 0 shares and period 1 variances and means to weight the immigrant and native changes. One could also have used period 1 shares and period 0 variances and means as weights, and in Table 3, we present decompositions using both of these alternatives.

population and immigrants and the population. For example, if immigrant income is further away from the population mean than native income, then a rise in the immigrant population share will raise the overall wage variance by increasing the share of people who are relatively far from the mean. We call this fourth component the Between Group Composition Effect.

We have implemented decompositions such as that in equation (2) for the United States for the period 1980-2010, which, as noted earlier, was an era of both rising income inequality and rising immigration. Table 3 shows the results of our analysis of changes in the male and the female variances in the log of real hourly earnings. We have also implemented decompositions of personal income, family income, and per capita family income with similar results to those shown in Table 3 with respect to the contribution of immigration to the trends. We use the 1980 Census of Population and the 2010 ACS microdata in the analysis. The data refer to individuals age 18-65 who were wage and salary workers and had no self-employment income. Earnings data refer to the previous year in each case (1979 and 2009 respectively) and have been converted into 2009 dollars using the Personal Consumption Expenditures deflator (available at www.bea.gov). Hourly earnings are computed by dividing annual wage and salary income by (weeks worked x hours worked per week). Additionally, we have limited the analysis to those with computed hourly earnings of at least $2 and no more than $250 per hour in 2009 dollars, a relatively wide band.[4] Immigrants were defined as those born abroad unless they were born in US territories, in which case they were defined as natives.

Table 3 shows a remarkable increase in the share of workers who are immigrants and a growing immigrant-native wage gap. However, the accounting effects of such changes are relatively small compared to the overall increases in male and female wage inequality. Specifically, looking at the summary statistics in Table 3, Panel A, one sees that immigrants increased from about 6% of workers in 1980 to 15-19% in 2010. The overall variance of log wages grew substantially for both men and women, with a larger rise for men (.18 log points vs. .15). Moreover, variances rose for both immigrants and natives, native wages increased relative

[4] 1979 earnings data were topcoded at $75,000 which we inflated by a factor of 1.5 as in much of the literature on wage inequality (see, for example, Katz and Murphy 1992). The 2009 data at topcoded values were reported as the state average among topcoded values and were left unaltered.

to those of immigrants, and within each group, women's wages rose relative to men's. Real wages in fact fell about 6% for immigrant men, likely reflecting both the changing composition of immigration and the decrease in real wages among less educated men during this period. Nonetheless, the table shows that the variance of wages for natives in each year and for each sex group is nearly the same as the overall variance for all workers and that, moreover, the variance of wages increased by similar amounts for natives and for all workers. This suggests that immigration can have had only a very limited effect on the increase in inequality, in an accounting sense.[5]

This conclusion is reinforced by the results in Table 3, Panel B which show the decomposition of the changes in the variance of the log of hourly earnings. We present results for two alternative bases: a) 1980 population shares and 2010 means and variances; and b) 2010 population shares and 1980 means and variances. The two approaches yield similar results. Specifically, in each case, almost all of the increase in the variance of wages is due to the Within Group Variance Effect: this component accounts for 94-97 % of the total increase in wage variance for men, and 97-99% for women. Moreover, for both men and women, the increase in native variance (Panel A) is virtually the same as the overall Within Group Variance Effect shown in Panel B, implying that immigrants are not contributing much to this component. Thus, in terms of its impact on the composition of the population, increasing immigration can explain at most only 3% of the increase in female wage inequality and 6% of the increase in male wage inequality over the 1979-2009 period.[6]

While Table 3 shows results analyzing wages for those with wage and salary jobs, it is well-known that immigrants and natives do not have the same employment propensities as natives, particularly among women (Blau, Kahn and Papps 2011). Thus, inequality of individual or family income may have changed differently for immigrants and natives from the changes in wage rates. However, as noted above, when we performed decomposition analyses similar to those in Table 3 for family income, per capita family income, and personal income, we obtained

[5] Card (2009) presents a similar table to Table 3, Panel A, for data from 1980 and 2005/6 with similar findings. He does not, however, perform the variance decomposition shown in Table 3, Panel B.
[6] As explained previously, wage estimates are based on earnings in the previous calendar year.

very similar results. Specifically, while there is rising inequality along all of these dimensions, immigration can only account for a very small portion of the increase. Therefore, if immigration has had a large effect on the overall distribution of income or earnings, it must have been through its effects on the native income distribution, and we now turn to a discussion of the economic theory behind such effects.

4. The Impact of Immigration on the Native Income Distribution: Theory

We begin with a simple demonstration of the result, initially obtained by Samuelson (1948), that when the economy produces multiple goods that are internationally-traded, immigration may have no effect on the native income distribution. The exposition follows Dustmann, Fabbri and Preston (2005). Suppose that we have three factors of production-skilled labor, unskilled labor, and capital--and two goods, with the goods sold at prices determined by world markets. Assume further that immigrants have a different distribution of skills from natives, that capital is mobile, and that production of each good is characterized by constant returns to scale. We assume that immigrants of a given skill level are perfect substitutes for natives of the same skill level, an assumption that as discussed below some of the literature on immigration relaxes and tests.

Let N_i and M_i be the number of natives and immigrants of skill level i, respectively, and let N and M be the total number of natives and immigrants in the population, respectively. Then the total population x_i of each skill level is:

(3) $x_i = N_i + M_i$, where i=S(skilled) or U(unskilled).

If B_i is the relative skill share of immigrants for skill group i (i.e., M_iN/N_iM) and if m=M/N is relatively small, then

(4) $d \ln x_i = d \ln(N_i + mB_iN_i) \approx d \ln N_i + B_i dm$

is the approximate effect of immigration on the relative supply of the i^{th} skill group. Equation (4) illustrates the notion that immigration will have larger effects on the relative supply of different skills groups the larger the immigrant share of the population and the more the skill distribution of immigrants differs from that of natives.

Even though equation (4) shows that immigration can affect the composition of the labor force, in a global market for the two goods 0 and 1, prices p_0 and p_1 are unchanged by immigration to the country in country in question. Moreover, free entry implies that in equilibrium, unit costs equal output price, so unit costs for each good are also unchanged. Writing these unit costs as functions of the three factor prices w_s (skilled labor), w_u (unskilled labor), and r (rental price of capital), we have:

(5) $\ln c^j\ (w_s, w_u, r) = \ln p_j, j = 0,1,$

where c^j is unit output costs for good j.

We wish to analyze the effect of immigration on these equilibrium conditions. Using Shepard's Lemma, we have:

(6) $\theta_S^0 d\ln w_s + \theta_U^0 d\ln w_u = 0$

(7) $\theta_S^1 d\ln w_s + \theta_U^1 d\ln w_u = 0$,

where $\theta_i^j = \partial \ln c^j / \partial \ln w_i$ is a cost share parameter (mobile capital implies that dr=0).
As long as the cost shares of the two factors differ across goods, then the only solution to (6) and (7) is one where the wages of skilled and unskilled labor do not change. Instead, production adjusts to the new supply of immigrant labor. For example, if immigrants are less skilled than natives, then output of the good that is more intensive in unskilled labor will increase. However, as shown by Dustmann, Fabbri and Preston (2005), if unskilled immigration lowered unskilled wages, profits would disproportionately rise in the unskilled labor-intensive sector, which would

increase its demand for factors of production until the original wages and return to capital were restored.

In the case where the country specializes in one good or where the cost shares are the same for the two goods (essentially reducing the economy to one good), then immigration will in general affect relative wages of skilled and unskilled labor in the expected way. If immigrants are less skilled than natives, then unskilled workers' wages will fall, skilled workers' wages will rise, and mobile capital will keep r the same. The extent to which skilled and unskilled workers' wages change depends on the degree of substitutability between the two groups in production. Intuitively, the closer substitutes skilled and unskilled labor are, the smaller the effect immigration will have on relative wages. In the specialization case with only two skill groups, immigration of less skilled workers will increase the wage differential between skilled and unskilled workers. The distribution of actual labor incomes will of course also depend on labor supply elasticities.

The foregoing analysis contrasts two polar situations with respect to international trade and the impact of immigration. An intermediate case is considered by Kuhn and Wooton (1991) in which there are three goods: two traded with internationally-determined prices and one non-traded (e.g. services). In this case, the authors show that immigration can affect relative incomes by changing the price of the non-traded good. The model implies that immigration of labor of a given skill level always lowers the wages of workers with that skill level, but the effects on the other two factors depend on relative factor intensities in the production functions of the three sectors.

An implication of these theories about immigration in an international trade context is that the potential for immigration to affect the native income distribution is greater the more closed the economy is to international trade. Such isolation can come about either due to high transport costs, protectionist trade policies, or, as suggested by Kuhn and Wooton (1991), a large non-traded sector. Most research on the impact of immigration on native income levels and income distribution takes the closed economy as its starting point—that is, it assumes one aggregate commodity and an aggregate production function. Immigration is then seen to change

the relative supplies of various types of labor, which in such an economy will affect relative wages through substitution and complementarity relationships among these types. In addition, the return to capital can also be affected if it is supplied less than perfectly elastically.

Modeling issues in such efforts include the definition of skill types, the manner in which skill groups are assumed to substitute for or complement each other, and the degree of substitutability between immigrants and natives of the same skill group. For example, college graduates may be closer substitutes for workers with some college than for workers who dropped out of high school. Moreover, young college graduates may not be perfect substitutes for more experienced college graduates. And immigrants with a college degree may be imperfect substitutes for similarly-educated natives due, possibly, to language problems or to customer discrimination against immigrants in service sectors. Thus, in writing down theoretical models of the impact of immigration on native incomes, one must make some assumptions about these issues.

To illustrate the closed economy predictions about the impact of immigration on the native income distribution, consider the following multilevel aggregate production function, originally used by Card and Lemieux (2001) to study changes in the return to schooling, as adapted by Borjas (2003) to examine the impact of immigration on native wage outcomes:

(8) $Q_t = [\lambda_{Kt} K_t^v + \lambda_{Lt} L_t^v]^{\frac{1}{v}}$,

where for time period t, Q is aggregate output, K and L are aggregate capital and labor inputs, λ_K and λ_L are share parameters, and $v=(1-1/\sigma_{KL})$, where σ_{KL} is the elasticity of substitution between labor and capital. In equation (8) the output price is normalized to one, and one can think of output as a composite commodity, since this model assumes a closed economy. As discussed further by Acemoglu (2002), the substitution elasticity in (8) encompasses not only technical substitution but also substitution in consumers' budgets across goods that make up the composite commodity. For example, a rise in the supply of labor will lower the relative cost of labor-intensive goods, and the change in the production levels of such goods (and therefore the demand for labor relative to capital in the overall economy) will depend in part on consumer demand

elasticity. Changes in the share parameters λ_K and λ_L represent capital- or labor-biased technological change, and without loss of generality, they can be assumed to sum to 1.[7]

Immigration is assumed to increase the supply of labor and also to affect the skill composition of the work force. To construct hypotheses about these effects, Borjas (2003) assumes that the labor aggregate in equation (8) is made up of workers from different education groups that substitute imperfectly for each other:

(9) $L_t = [\sum_i \theta_{it} L_{it}^p]^{1/p}$,

where i refers to education group, θ is a technology parameter, and $p=(1-1/\sigma_E)$, where σ_E is the elasticity of substitution across education groups. In equation (9), the relative productivity of different education groups is allowed to change over time through the θ_{it} parameters. For example, changes in the composition of college students or the performance of high schools may affect these parameters. Equation (9) captures the intuitive idea that, in addition to affecting the earnings of workers with similar skills to their own, immigrants may affect the earnings of workers with different skill levels, as long as education groups are imperfect substitutes. As with the aggregate production function, we assume that the share parameters sum to one.

While workers with different education levels are likely to be imperfect substitutes, it is also unrealistic to suppose that, within an education group (e.g., college graduates), workers of all ages are perfect substitutes for each other. For example, older college graduates are also likely to have accumulated more on-the-job training than younger workers, while recent college training may impart different skills from those learned twenty or thirty years ago. The two age groups may therefore not be perfect substitutes. To allow for this possibility, Borjas (2003) decomposes the aggregate education groups into education-age groups, following the multilevel production function analysis of Card and Lemieux (2001), who studied changes in wage inequality by education-age group:

[7] If their sum were different from one (say, s>0), we could define new share parameters λ_K/s and λ_L/s and multiply the expression in equation (8) in brackets by $s^{1/v}$.

(10) $L_{it} = [\sum_j \alpha_{ij} L_{ijt}^n]^{\frac{1}{n}}$,

where for education group i and age group j, α is a share parameter reflecting relative efficiency, and n=(1-1/σ_A), where σ_A is the substitution elasticity across age groups within each education group, and, as above, the α_{ij} share parameters sum to one.

By substituting (9) and (10) into equation (8) and assuming competition in the labor market, one can obtain predictions about the impact of immigration on the wage rates of workers in each age-education group. Labor earnings are of course equal to price times quantity of labor supply; therefore one can in principle move from wage rates to the distribution of labor earnings by using information on labor supply elasticities. With additional assumptions about the response of capital investment to the increased labor supply brought about by immigration, one can also make predictions about the functional distribution of income.

Letting w_{ijt} be the wage rate of workers in education group i, age group j at time t and taking logs, we have the following first order condition assuming that wages equal the marginal revenue product of labor:

(11) $ln\, w_{ijt} = ln\, \lambda_{Lt} + (1-v)lnQ_t + (v-p)lnL_t + ln\theta_{it} + (p-n)lnL_{it} + ln\alpha_{ij} + (n-1)lnL_{ijt}$

As discussed below, much of the empirical research studying the effect of immigration on natives' economic outcomes attempts to estimate the substitution parameters v, p and n which are shown in the first order condition (11). Our discussion in Section 5 below will focus on the difficult research design issues involved in estimating these parameters. Nonetheless, if one had good estimates of these and if immigrants were perfect substitutes for natives with the same observable characteristics, then we could infer the impact of immigrants on overall wages and profits. For example, equation (11) shows that immigrants of a given age-education group affect their own group's wages directly through the coefficient on ln L_{ijt} as well as through their effects on the aggregate supply of their education group (L_{it}), on the overall labor aggregate L_t, and even

through changes in the quantity of capital. Moreover, immigrants from a given age-education group can also affect the wages of members of other skill groups through their effect on L_t, L_{it}, and capital.

The simplified model shown in equations (8)-(11) makes some assumptions that recent literature on immigration has relaxed. First, Ottaviano and Peri (2012) posit a similar model but one where the elasticity of substitution between education groups is allowed to differ across differing subgroups. Specifically, high school dropouts may be closer substitutes for high school graduates than workers with some college attendance are for college graduates. Ottaviano and Peri (2012) implement such a model by assuming two broader groups of workers: (i) with low education (high school dropouts and high school graduates) or (ii) high education (those with some college and college graduates). There is an elasticity of substitution between these two groups overall, and within each group, a separate elasticity between the two skill groups included. To anticipate some of the empirical work discussed below, some researchers (e.g. Card 2009; Ottaviano and Peri 2012) have found that high school graduates and high school dropouts are virtually perfect substitutes. If so, then immigration of high school dropouts will affect the relative wages of high school dropouts only by affecting the aggregate of high school dropouts and high school graduates.

A second refinement of the simple model in equations (8)-(11) is to allow immigrants and natives within an age-education group to be imperfect substitutes. For example, language differences between immigrants and natives of a given education and age group may make them imperfect substitutes (Lewis 2011a). This modification of the basic model requires an additional step aggregating immigrant and native labor:

$$(12)\ L_{ijt} = [b_{Dijt}L_{Dijt}^{r} + b_{Fijt}L_{Fijt}^{r}]^{\frac{1}{r}},$$

where the additional D and F subscripts refer to domestic and foreign workers respectively and $r=1-1/\sigma_I$, where σ_I is the within-age-education group elasticity of substitution between immigrants and natives. Adding equation (12) to the model yields a first order condition for

immigrants and one for natives for each age-education group. Moreover, equation (12) implies that the within age-education group substitution elasticity between immigrants and natives is the same for each age-education group. This assumption can be relaxed by allowing the elasticities to differ depending, for example, on whether language difficulties are more or less likely to be present (Lewis 2011a).

Third, in the production function shown in equation (8), workers of different skill levels had the same substitution relationship with capital. Yet, going back to Griliches (1969), economic analysis suggests that capital is more complementary with skilled than with unskilled labor. Lewis (2011b) uses this insight in his study of immigration and relative wages to devise an aggregate production function in which skilled labor and capital are complements but unskilled labor and capital are substitutes. We illustrate such a function in a simplified form that captures the basic idea of capital-skill complementarity:

(13) $Q = (K^{\delta} + U^{\delta})^{\gamma/\delta} H^{1-\gamma}$,

where U is the quantity of unskilled labor and H is the quantity of skilled labor. As we discuss further below, Lewis (2011b) uses the framework in (13) to study the impact of immigration of less skilled labor on relative wages. Because unskilled labor and capital are substitutes, the response of the price of capital to profits will affect relative wages. This is in contrast to models where the relationships between skilled labor and capital and unskilled labor and capital are symmetric.

Fourth, the aggregate production function parameters in the model outlined above are assumed to be exogenous. However, as discussed by Acemoglu (1998 and 2002), technical change is likely to be affected by profit opportunities. Specifically, he argues that the increase in the supply of highly educated workers made skill biased technical change more profitable than otherwise, assuming that each technology carries with it a cost of implementation. The endogenous increase in skill bias helped explain, in his view, why the rising share of college educated workers in the 1980s and 1990s was accompanied by a rising skill premium. As

suggested by Lewis (2001b), immigration of less-skilled workers may have similar effects, in this case inducing the use of less-skilled intensive production techniques. If the endogenous technology effect is large enough, it may counteract or even reverse the negative effect immigrants are usually expected to have on native wages of similarly-skilled workers.

Finally, all of the discussion so far assumes competitive labor markets. This framework is extremely useful and leads to testable predictions about the impact of immigration on income distribution through the first order conditions relating factor prices and factor quantities, such as equation (11). However, we would point out that, in much of Europe, wages are heavily influenced by collective bargaining and employment decisions are often constrained by regulations and that these labor market institutions may significantly affect labor market outcomes. So, for example, in countries such as Austria, Belgium, Finland, France, and Sweden, collective bargaining covers over 90% of workers, and collective bargaining coverage in virtually all countries is considerably higher than in the United States, where coverage is less than 15% (OECD 2004, p. 145). Similarly, in some European countries such as Italy, Sweden, and Belgium, it is often very expensive or administratively cumbersome for firms to downsize their work forces, again in contrast to the United States, where such restrictions are much less extensive (OECD 2004, p. 117). These wage-setting institutions produce wage floors that equalize the wage distribution but may also lead to some loss of employment for low wage groups, particularly women, youth and immigrants (Blau and Kahn 1996; Bertola, Blau and Kahn 2007; Kahn 2004; and Kahn 2007). In addition to these constraints on firms with respect to wage setting and adjusting factor quantities in Continental Europe compared to the United States, in many European countries, including Austria, Belgium, Denmark, France, Germany, the Netherlands and Sweden, immigrants enter on temporary work visas which tie them to a particular firm (European Union 2010). In such countries immigrants may have fewer rights, for example to change jobs, than natives do.

The higher level of regulation of labor markets in Europe compared to the United States has several potential implications for the impact of immigration on the native income distribution. For example, if collective bargaining renders wages relatively unresponsive to changes in supply

and demand, then immigrants may reduce native employment but not the wages of employed natives with whom they compete. The native income distribution will be affected but not the wage distribution. Moreover, to the extent that immigrants have fewer rights than natives and where employment protection and collective bargaining for native workers are strong, immigrants may help produce a surplus that can be appropriated by unionized native workers and firm owners (Winter-Ebmer and Zweimüller 1996).

5. Empirical Issues in Estimating the Impact of Immigration on the Income Distribution

Empirical analyses of the impact of immigration on the distribution of income currently take one of two fundamentally different approaches to their research design. On the one hand, some authors attempt to estimate the parameters of the first order condition in models such as equation (11) and then implement simulations based on assumptions about the impact of immigration on the relative supply of skill groups. Estimating equations such as (11) for a closed economy or an economy with only one good will yield aggregate production function parameter estimates. However, as discussed above, in a small open economy in which all goods are traded on world markets, immigration or other changes in the relative supply of labor of various skill levels will not affect relative wages; and, with mobile capital, profit rates will also not be affected. In such a world, estimating equation (11) will yield wage coefficients of zero on the quantity variables. Alternatively, in an intermediate case such as that discussed by Kuhn and Wooton (1991), where there is a significant nontraded sector or a country specializes in one traded good, changes in skill quantities will affect relative wages. Under any of these three scenarios, the effect of immigration on the income distribution can be inferred from estimating such models, although the interpretation of the parameters as coming from a production function is less clear with an open economy. In this regard, as mentioned, Acemoglu (2002) points out, in the context of analyzing overall wage inequality, that one can view changes in product mix as part of the process of aggregate substitution between factors of production. In this framework, one can

view the pure open economy model as one where the goods are perfect substitutes in consumption, implying constant relative goods prices and therefore constant relative factor prices.

On the other hand, some authors take a less structural approach by comparing income distribution in areas or markets with high levels of immigration penetration with those in low immigration markets, controlling for other factors. The impact of immigration on income distribution is then estimated by the regression coefficients on the immigration measure. Unlike the structural approach outlined above, this research design is not based on a production function model. However, this approach does directly tie immigration to native outcomes, unlike some production function models. Before presenting the results of studies using either of these approaches, we provide some discussion of the advantages and disadvantages of each of these types of research design.

The major advantage of estimating the parameters of the underlying aggregate production function is that the estimates can be used to simulate the effects of any number of exogenous events potentially affecting the income distribution. These can include, for example, changes in immigration policy to allow more highly skilled immigrants to enter or increases in foreign investment. However, like any structural approach, estimating these parameters comes at a cost: one must specify the form of the production function. Specifically, one must decide how to disaggregate labor into skill groups and also what types of substitution/complementarity relationships to allow. As examples of the latter, recall Lewis's (2011b) model allowing skilled and unskilled labor to have asymmetric relationships with capital or Ottaviano and Peri's (2012) models allowing differing substitution relationships between different pairs of education groups. Moreover, researchers must also decide whether to allow immigrants and natives within a skill group to be imperfect substitutes, and if so, whether the immigrant/native substitution parameter should be the same for all skill groups (Lewis 2011a).

Having decided on the form of the production function, to implement this approach, one must also devise an identification strategy in light of the appearance of factor quantities on the right hand side of first order conditions such as equation (11). As in any supply and demand model,

simply regressing price on quantity will not necessarily identify a demand relationship. For example, the relative supply of skill groups is likely to respond positively in the long run to relative wages, imparting a likely positive Ordinary Least Squares (OLS) bias on the coefficient on ln L_{ijt} in equation (11). Failure to account for such a bias will likely lead to an underestimate of the magnitude of the negative impact of immigration on native wages of similarly-skilled workers. Solving such a problem requires credible instruments for the key labor quantities, and much research using this approach employs instrumental variables (IV) methods (Borjas 2003; Ottaviano and Peri 2012). The validity of such an approach depends of course on the validity of the instruments, and we will discuss this issue in more detail when we evaluate evidence using this research design.

The major advantage of the nonstructural, area approach to studying the effect of immigration on the native income distribution is that the empirical work directly ties the key explanatory variable, immigration, to the outcomes of interest. No assumptions about production functions need be made. In particular, one need not assume or try to estimate the degree to which immigrants and natives of equal observed skills substitute for each other, although such a relationship will influence the parameter estimates. In addition, using the area approach will provide more potential observations than using national aggregates, producing more efficient estimates.

There are several drawbacks, however, to the area approach. First, the kind of endogeneity problem that is likely to affect OLS analyses of structural equations such as (11) is also probably present in research that compares the area income distribution in high- vs. low-immigration areas. Specifically, immigrants are likely to choose where to locate in part based on the presence of jobs. We may therefore observe a spurious, positive correlation between the relative presence of immigrants of a given skill group and that group's relative earnings. Like some research using the structural approach, some economists have used IV analyses here as well (Altonji and Card 1991). In addition, in some cases, researchers have studied seemingly exogenous events such as the Mariel Boatlift from Cuba, the repatriation of French-Algerians after the uprising there in 1962, Portuguese repatriates from former African colonies in the 1970s, the immigration

to Israel of Jews from the former Soviet Union, and the repatriation of ethnic Germans from Eastern Europe and the former Soviet Union following German reunification (Card 1990; Hunt 1992; Carrington and de Lima 1996; Friedberg 2001; Cohen-Goldner and Paserman 2011; and Glitz 2012). In such cases, the original influx of immigrants may be exogenous, helping to reduce the positive bias that cross-area OLS regressions may yield on the impact of immigrants on native incomes.

Second, even if the original influx of immigration to an area is truly exogenous, there may be equilibrating adjustments of future immigration or deterred domestic migration due to the initially added supply of immigrants. For example, an initial influx of low skill immigrants into an area may eventually become dispersed across the country, and there may therefore be no effect of the initial immigration on the area's income distribution relative to other areas. Such an outcome of course depends on the level of internal mobility (see, for example, Chiswick 1991). Regressing, for example, the relative earnings on low skill natives in a metropolitan area on the relative presence of low skill immigrants in the area may, with sufficient mobility, yield a zero coefficient even if immigration does affect the national labor market for the less skilled. But if the labor market is truly national, then the long run relative supply effect of, say one million low skill immigrants moving to a metropolitan area with five million low skill workers is not really 20%; instead, the million immigrants should be compared to the national supply of low skill workers, which is likely to be much higher than five million. As we discuss below, several researchers have studied the degree to which such offsetting internal migration affects the area approach to estimating the impact of immigration on the native earnings distribution (Filer 1992; Card and DiNardo 2000; Card 2005; Borjas, Freeman and Katz 1997; White and Liang 1998; Wright, Ellis and Reibel 1997; Glitz 2012).

Third, spatial correlation studies often include area fixed effects in an attempt to account for omitted variables that could affect immigration and native outcomes within an area. As pointed out by Aydemir and Borjas (2011), such fixed effects designs are particularly susceptible to measurement errors, since the key effects of immigration are identified from changes. Measurement errors can be a much larger component of changes in a variable than in its levels

(Freeman 1984). Of course, to the extent that one can find instruments for the change in the presence of immigrants in an area, then the measurement error may be less severe than in OLS studies.

6. Evidence on the Impact of Immigration on Relative Wages

Tables 4-6 illustrate the findings from selected studies of the impact of immigration on relative wages, the subject of most of the research on the impact of immigration on income distribution. We have organized our discussion and the tables by research methodology. Table 4 shows results from studies using the aggregate production function approach; Table 5 presents research based on inter-area comparisons; while Table 6 summarizes studies exploiting exogenous sources of new immigration.

6.1 Aggregate Production Function Approaches

We begin with studies using the aggregate approach, as shown in Table 4. The Table shows several studies of the United States and Germany, as well as one from the United Kingdom. Looking at the United States, an early study by Borjas, Freeman and Katz (1997) employed previously-estimated CES production relationships using aggregate annual data for 1963-1987 to study the impact of immigration over the 1980-95 period on the relative wages of a) high school dropouts vs. those with at least a high school degree, and, b) college graduates vs. high school graduates, where in this latter comparison, all workers have been aggregated into high school equivalents and college equivalents.[8] For each of a) and b), the authors used the substitution parameter from the following type of regression, which had been estimated using OLS:

$$(14)\ (\text{Relative Earnings})_t = a_0 + a_1(\text{Relative Supply})_t + a_2(\text{Time Trend})_t\ ,$$

where t is year, and relative earnings and relative supply are in logs. The a_1 parameter from (14) is the negative of the inverse elasticity of substitution between the two groups in question. For

[8] For details on this aggregation, see Katz and Murphy (1992).

the college-high school comparison the estimate of a_1 was taken from Katz and Murphy (1992), while for the high school dropout-high school and beyond comparison, it came from Borjas, Freeman and Katz (1992). The time trend in equation (14) is intended to proxy skill biased technical change, which is predicted to raise the relative earnings of more skilled workers controlling for relative supplies. Having obtained an estimate of the a_1 parameter for the two comparisons, the authors then computed the contribution of immigration to changes in the relative supplies of high school dropouts or college graduates during the 1980-95 period Multiplying these changes by a_1 provides an estimate of the impact of immigration on relative wage changes over the period. As Table 4 indicates, this computation yields a predicted effect of -0.048 on high school dropouts' relative wages, which is about 44% of the 0.109 log point decline in this group's relative wages that occurred during this time. Thus, the authors find a very important negative effect of immigration on the wages of high school dropouts. In contrast, immigration did not greatly affect the supply of college equivalents vs. high school equivalents and therefore, in the authors' estimation, had little effect on college graduates' relative earnings. While the authors did not study the return to capital, their production function analysis implicitly assumes that skilled and unskilled labor have the same substitution relationship with capital. While we will examine research on this question below, if this assumption held true, then the rising labor supply caused by immigration would raise the demand for capital by increasing firm profitability. If capital fully adjusted, then its price would stay the same; if not, the return to capital would rise. As a result, the authors' findings imply that immigration to the United States has lowered the relative price of unskilled labor, left the relative price of skilled labor roughly unchanged and either raised or left unchanged the price of capital. Absent a backward bending relative labor supply curve for less skilled workers, these findings imply that immigration widened the income distribution.

While Borjas, Freeman and Katz's (1997) findings suggested that immigration had a large negative effect on less skilled workers' wages, the results were based on models aggregating the labor force into two skill groups and estimated using OLS methods. As noted earlier, such a design may be overly restrictive if there are important differences across

disaggregated skill groups and endogeneities of relative employment levels. Borjas (2003) addresses these issues in a study of the impact of immigration on relative wages in the United States over the 1980-2000 period. He uses the nested production function approach outlined above with four education groups (less than high school, high school, some college, college graduate) and eight potential experience groups (five year increments up to a potential experience level of 40). His production function assumes that immigrants and natives are perfect substitutes within age-education groups, a perhaps restrictive assumption; however, he does compare the occupational distributions of natives and immigrants within these groups and concludes that they are similar enough to warrant the perfect substitutability assumption. To address the endogeneity of relative quantities of age-education groups, he uses IV analysis where the supply of immigrants in an age-education group is the instrument for the total supply in the group. While recognizing that even this instrument could be affected by the group's relative wage, Borjas (2003) suggests that the likely bias on the quantity coefficient in an equation such as (11) would be positive: immigrant quantity in a skill group is likely to be positively affected by its relative wage. Therefore, Borjas (2003) suggests that his estimates of substitution elasticities are likely to be downward biased in absolute value.

The results of Borjas's (2003) analysis are striking. Over the 1980-2000 period, immigration raised the relative supply of both high school dropouts and college graduates. Borjas's (2003) estimated substitution parameters imply, assuming a constant capital stock, that these supply increases lowered average wages by 3.2%, wages of high school dropouts by 8.9% and wages of college graduates by 4.9%.[9] Even allowing for a full adjustment of capital, so that average wages would have stayed the same, Borjas's (2003) results imply that immigration lowered the *relative* wages of high school dropouts and college graduates, with a larger impact on the former. The relative wages of high school graduates and those with some college but not a college degree were, according to this analysis, raised. Thus, the impact of immigration on the overall wage distribution is estimated to be non-monotonic, reflecting the pattern of differences in the distribution of education between immigrants and natives.

[9] Wages of high school graduates were lowered by 2.6 percent and barely changed for workers with some college.

The findings of both the Borjas, Freeman and Katz (1997) and Borjas (2003) studies imply a strong negative effect of immigration on less skilled workers' wages. The latter study, by disaggregating education groups was able to also uncover a negative effect on college graduates' wages, and these impacts held up to IV analyses taking into account the endogeneity of skill group quantities. But even the more disaggregated approach used by Borjas (2003) made some simplifying assumptions that have been challenged in recent research by Ottaviano and Peri (2012) examing the impact of immigration over the 1990-2006 period. Specifically, these authors challenged the assumptions that each pair of education groups had the same substitution elasticity and that, within age-education groups, immigrants and natives were perfect substitutes. First, regarding the education groups, the authors let the labor aggregate be made of two skill groups: skilled (S) and unskilled (U):

(9′) $L_t = [\theta_{Ut} L_{Ut}^{\lambda} + \theta_{St} L_{St}^{\lambda}]^{1/\lambda}$,

where $\lambda=(1-1/\sigma_{US})$ and σ_{US} is the elasticity of substitution between the unskilled and skilled groups, which the authors define as i) unskilled: high school dropouts and those with exactly a high school degree; and ii) skilled: those with some college but less than a degree and those with at least a college degree. Equation (9′) is an aggregated version of equation (9), and the innovation in Ottaviano and Peri's (2012) treatment of skill is their further disaggregation of these two categories into separate sub-aggregates adding up to L_{Ut} and L_{St} respectively. Each sub-aggregate then carries its own elasticity of substitution between its components, allowing the substitutability between high school dropouts and high school graduates to differ from the substitutability between those with some college and college graduates. The relevance of this further disaggregation of skilled and unskilled workers to the question of immigration will soon become clear.

Second, Ottaviano and Peri (2012) allow immigrants and natives within an age-education group to be imperfect substitutes, with the substitution elasticity between them becoming a parameter to be estimated. The less closely immigrants substitute for natives, the smaller the

effect immigrants will have on natives with the same observable skills. While allowing for less than infinite substitutability between immigrants and natives is clearly an advance over models that assume they are perfect substitutes, a lack of instruments leads the authors to estimate this stage of their model using OLS.

These two conceptual modifications of the basic Borjas (2003) approach have important consequences. First, the substitutability within a skill designation (high or low) is much greater than that between the high and low skill groups. The former is at least 10 and is infinite in some estimates within each subgroup, while the latter is roughly 2. An implication of this pattern is that to the extent that high school dropouts and high school graduates are close substitutes, an increase in low skill immigration will lower less skilled workers' wages only to the extent that the aggregate of high school dropouts and high school graduates increases. Immigrants are a much smaller proportion of this aggregate than they are of high school dropouts and thus the impact of low skilled immigration on native wages is simulated to be much smaller than if one had imposed the high-low skill substitution elasticity of 2. Second, immigrants and natives are found to be imperfect substitutes within an age-education group, with a preferred estimate of about 20. While this value is higher than that across education groups, it is still less than infinite and its finite value is a second reason why immigration may have a smaller effect on native wages than one would estimate based on more aggregated models. The upshot of these two modifications of the basic Borjas (2003) model is that immigration is estimated to have had only a very small effect on native wages within skill groups—for example, changing the wages of high school dropouts over the 1990-2006 period by only -0.6% to +0.1%. These estimates take into account the routes through which an increase in the supply of one skill can group can affect the wages of other skill groups.

Ottaviano and Peri (2012) estimate a more detailed set of substitution parameters than previous work has attempted. Moreover, the authors also illustrate that allowing immigrants and natives to be imperfect substitutes and allowing different substitution elasticities between pairs of high and low skill education groups importantly affects one's estimates of the impact of immigration. For example, imposing perfect substitutability between immigrants and natives

and a uniform substitution elasticity across all education groups, they find that immigration lowered the real wages of high school dropouts by 4.1% over the period. In contrast, as noted, in their preferred estimates, immigration only affected dropout wages by -0.6% to +0.1%. While Ottaviano and Peri's results call into question previous findings that immigration had quantitatively important effects on natives' wages, Borjas, Grogger and Hanson (2011) point out that estimates of the two key substitution elasticities—between immigrants and natives and between high school dropouts and high school graduates—are sensitive to the type of data used and the nature of the controls in the underlying production function models. The varying results in the estimates of the substitution elasticities illustrate a potential drawback of this type of approach to estimating the impact of immigration.

The results shown in Table 4 show that immigration to the United States has potentially had negative effects on the relative wages of the less skilled, widening the income distribution, although this conclusion is, we have seen, sensitive to how the production function is specified. Table 4 also shows results from studies using the aggregate production approach to examine the impact of immigration on relative wages in Germany and the United Kingdom. A priori, if all countries use the same technologies, one might expect the impact of supply shocks on wages and employment to reflect the impact of collective bargaining, which is far more extensive in Germany than in the United States and the United Kingdom. This implies that wage effects would be smaller and employment effects more sensitive in Germany than the United States and the United Kingdom. Of course, differences across countries in the substitutability between immigrants and natives, due for example to differences in language assimilation or employment protection for incumbent workers, could also affect international differences in the impact of immigration on natives.

Looking first at the German evidence, Table 4 shows three studies covering different time periods: 1975-97 (Bonin 2005), 1984-89 (De New and Zimmermann 1994), and 1992-2001 (D'Amuri, Ottaviano and Peri 2010). While all three use the aggregate production function as the theoretical basis for their analysis, the first two studies estimate reduced form wage equations: in these models the wages of natives in a given cell (defined, for example, by

education, experience or industry) are estimated to be a function of some controls and the penetration of that cell by immigrants. Bonin (2005) forms cell averages for such analyses, while De New and Zimmermann (1994) use individual microdata and attach immigration measures to the industry where the respondent works. Using OLS, Bonin (2005) finds a relatively small and unstable overall elasticity of roughly -0.10 for native wages with respect to the immigrant share of the cell. While there is some suggestive evidence that the elasticity for the less educated is higher than for more educated workers, even this finding is unstable over time and, overall, not statistically significant. Specifically, the only statistically significant effect Bonin found for wages was for the less educated for the 1985-89 period. There also do not appear to be any unemployment effects in the aggregate or across education groups. In contrast, De New and Zimmermann (1994) find that a higher share of foreign workers in one's industry significantly lowers wages, with a more negative effect for blue collar than white collar workers. The effects are seemingly substantial, with a -4.1% overall effect of a one percentage point increase in the immigrant share, a -5.3% effect for blue collar workers, and an insignificant positive effect of 1.4% for white collar workers. These results emerge from an IV analysis with industry growth rates and industry time trends as the instruments. These instruments would seem to be positively correlated with wages even controlling for the immigrant share of an industry, so one might suppose that even these estimates are positively biased. While De New and Zimmerman's (1994) study does suggest that immigration lowers blue collar workers' wages, its time period is relatively brief: 1984-89, and it is noteworthy that the 1985-89 years were the only period during which Bonin (2005) found a significantly negative effect of immigration on native wages.

D'Amuri, Ottaviano and Peri (2010), the third study of immigration and wages in Germany, use data from 1987-2001 to perform a production function analysis like those described above for the United States. They construct education-experience cells and use the post-1991 influx of Eastern Germans following re-unification as an arguably exogenous instrument for skill group quantities in wage regressions. They then use their parameter estimates to simulate the effect of the post-reunification immigration on the labor market

outcomes of natives and previous immigrants. Overall, D'Amuri, Ottaviano and Peri find that immigrants have raised the wages of less educated natives by 1.7% and lowered the wages of more educated natives by about 1%. These results reflect the influx of more skilled immigrants during the period; for example, the share of workers with higher education (i.e., more than vocational education) grew faster for immigrants than natives during the period. These are relatively small simulated wage effects but they do suggest that immigration of skilled workers can reduce wage inequality. An interesting additional set of findings concerns the impact of the new immigration on long term immigrants (those who were already in Germany). Specifically, while immigration has only modestly negative effects on older immigrants' wages, their employment levels are substantially negatively affected. The authors interpret this combination of results are reflecting the wage rigidities of a highly unionized economy, in which labor supply shocks mainly affect employment rather than wages. In contrast, native employment is not affected by immigration. The difference between the effects of new immigration on immigrant vs. native employment suggests that immigrants and natives are not perfect substitutes within skill groups. Overall, the three studies of Germany do not suggest major effects of immigration on natives' absolute wage levels or the relative wages of specific skill groups other than the negative effects found for low skill workers during the 1984-89 period.

The final study of immigration and relative wages using the aggregate production function approach shown in Table 4 is for the United Kingdom. Manacorda, Manning and Wadsworth (2012) examine the 1975-2005 period using an approach very similar to Ottaviano and Peri (2012). They find imperfect substitution between immigrants and natives within skill groups and very little overall effect on native wages. Unlike the United States, immigration into the United Kingdom has been disproportionately high skilled; given the authors' estimates of a relatively low degree of immigrant-native substitutability, the main impact of this immigration has been to lower the relative wages of highly educated prior immigrants.

Summarizing the studies based on aggregate production functions, we find that, overall, immigration has had small effects on income distribution in Germany and the United Kingdom, with mixed results for the effects in the United States. Some estimates show important negative

effects on the less skilled, implying that immigration widens the income distribution; however, other estimates suggest very small effects. It is important to point out that these simulations are based on production functions and assumptions about market clearing wages and, in some cases, immigrant-native substitutability. In contrast, many studies of the impact of immigration on natives directly estimate such effects without imposing the structure of a production function with its attendant estimation difficulties. We now review these studies, which are summarized in Table 5.

6.2 Cross-Area, Occupation or Industry Approaches

The studies shown in Table 5 use spatial correlation (or in the case of Austria, cross-industry correlation) methods to study the impact of immigration on native wages. Most of the studies using spatial correlation have addressed the issue of the endogeneity of immigration by using IV analysis, and some have addressed the issue of whether immigration causes equilibrating changes in internal migration. Both of these possible sources of bias would lead us to underestimate the magnitude of any negative effects of immigration on native wages. Borjas, Freeman and Katz's (1997) comparison of the impact of immigration on relative wages using a) regions; b) states; or c) metropolitan areas as the unit of analysis provides some evidence on these possible biases. Specifically, they find that for men during the 1980-90 period, the spatial correlation between immigration of low skill workers and low skill natives' wages is more negative the larger the unit observation (i.e., regions vs. states or states vs. metropolitan areas). (There was no relationship between immigration and native wages for women.) The pattern for men suggests either that internal migration biases are less severe across regions than across metropolitan areas or that immigration is more exogenous with respect to a region than with respect to a particular metropolitan area.

Two early studies using the spatial correlation approach examine the United States between 1970 and 1980, a period of rapidly-rising immigration following 1965 legislation that liberalized entry. Altonji and Card (1991) regress employment and wage outcomes of less educated natives in a given metropolitan area on the area's total immigrant share and other controls. By using the total immigrant share, the authors in effect allow for cross-skill effects of

immigration. In addition, they estimate first difference (1970-80) equations to control for area-specific effects and use as an instrument for the change in immigration the initial year (1970) share of immigrants in the population. Using the past immigration stock as an instrument for the 1970-80 change in immigration is based on the idea the immigrants tend to live in enclaves (Bartel 1989). As long as the local labor market conditions that were in place in 1970 no longer directly affect an area's labor market in 1980, then this will be a valid instrument. We note that Blanchard and Katz's (1992) finding that the wage effects of local employment shocks die out within ten years would support the use of this instrument. In addition, to the extent that the stock of immigration in 1970 is measured with less error than the increment between 1970 and 1980, the IV approach also addresses the measurement error issue in OLS analyses of the spatial correlation approach with area fixed effects (Aydemir and Borjas 2011). Using the first difference approach with IV, Altonji and Card (1991) find that, overall, immigration reduced the wages of less skilled natives by about 1.2%, a modest effect. However, this may be underestimate of the magnitude of the effect since local immigration may have caused outmigration or deterred others from entering the area.[10]

A second study of the 1970-80 period, by LaLonde and Topel (1992), uses the spatial first-differencing approach to estimate the impact of new immigration on the earnings of different arrival cohorts of immigrants and also young native black and Hispanic workers. They find that new immigration reduced the earnings of recent immigrants by perhaps 3% but that this effect dissipated for longer term immigrants, suggesting imperfect substitution even within immigrant groups, as well as between new immigrants and natives. Moreover, their analysis does not show any negative effects of immigration on the wages of young native black or Hispanic workers. While recognizing that internal migration may lead to an understatement of the effects of immigration, LaLonde and Topel (1992) conclude, like Altonji and Card (1991), that immigration has not had a quantitatively important effect on the native income distribution.

More recent interarea studies of immigration and the native labor market in the United States come to similar conclusions. Card (2001, 2005 and 2009) studied the effects of

[10] This issue is addressed in some of the research discussed below.

immigration for 1990, 2000, and 1980-2005/6. He addresses the issue of endogenous immigration by using the past immigrant stock instrument, as in Altonji and Card (2001). In addition, in these studies, Card also addresses the problem of endogenous internal migration as well as the question of substitution between high school graduates and high school dropouts examined in some of the aggregate production function analysis described earlier.

First, Card (2001) uses 1990 Census data to study the local impact of migration on occupation-specific relative wages and employment of natives. He controls for the endogeneity of local immigration using past immigrant stocks to build an instrument that is the predicted immigration level within an occupation, a similar approach to that used in Altonji and Card (1991). He addresses the issue of native out-migration by estimating outmigration models for natives and older immigrants as a function of recent foreign immigration, again taking into account the endogeneity of immigration.[11] He finds that low-skill migration does in fact raise the supply of less skilled workers in an area and that this does lower the wages of less-skilled natives by at most 3% in high-immigration cities. Second, Card (2005) updates the analysis to 2000 and finds that immigration by then had no effect on the wages of high school dropouts vs. high school graduates. Finally, in Card (2009), he uses cross-section, time series changes over the 1980-2005/6 period and again finds that immigration has not had much effect on skill differentials. An additional finding in Card (2005) and Card (2009) that helps explain the relatively small effects on the less skilled is that high school dropouts and those with exactly a high school degree appear to be perfect substitutes in the labor market, similar to Ottaviano and Peri's (2012) results. In this case, as explained earlier, even a large inflow of immigrants who have less than a high school education will not greatly affect the supply of the high school dropout-high school graduate aggregate.

While Card's research suggests few effects of immigration on native wages, as noted, earlier studies such as LaLonde and Topel (1991) suggested that immigrants negatively affect the

[11] There is a literature on the impact of immigration on native outmigration, which is obviously relevant to the usefulness of the spatial correlation approach to estimating the impact of migration on native earnings. See, for example, Filer (1992), Wright, Ellis, and Reibel (1997), Borjas, Freeman and Katz (1997), and White and Liang (1994). We will discuss the design and results of such studies below when we evaluate the aggregate production and spatial correlation approaches to migration.

wages of previous immigrants. Cortés (2008) further explores this issue in her study of the impact of immigration on local labor markets during the 1980-2000 period. Like Card, she uses IV methods with previous immigrant settlements as the instrument. Similar to Card (2001, 2005 and 2009), she finds that low skilled immigration does not affect the wages of low-skilled natives overall. However, she does find that the wages of low-skilled previous immigrants and low-skilled native Hispanics are negatively affected; the elasticities are relatively small in absolute value (-0.13) for low skilled previous immigrants but somewhat larger in magnitude for low-skilled native Hispanics (roughly -0.3). Cortés's findings suggest that immigrants raise the overall level of wage inequality by reducing the wages of immigrants and Hispanic natives moderately. The difference in the effects of immigration on the wages of native vs. previous immigrants obtained by Cortés provides further evidence that, within skill groups, immigrants and natives are less than perfect substitutes. Lewis (2011a) also finds evidence suggesting imperfect substitutability between immigrants and natives. His analysis suggests that the wages of immigrants relative to those of natives in the same skill group are much more sensitive to the supply of immigrants among those with poor English skills than among those with excellent English skills. This suggests that immigrants with low English skills are much less substitutable for natives than those with good English skills. Imperfect substitution of immigrants for natives among the less skilled therefore remains a possible explanation for the results of studies that find little effect of immigration on the native distribution.

Similar to the findings for the United States, research using spatial correlation methods for the United Kingdom also generally does not find evidence of strong effects of immigration on the wage distribution. First, Dustmann, Fabbri and Preston (2005) study the impact of foreign immigration into a local labor market on native wages by skill group, controlling for the supply of natives within skill groups. The design uses total immigration as the key explanatory variable, thus implicitly allowing for cross-skill effects, although a breakdown of the skill composition of the immigrant population would have been even more informative. In addition, controlling for the native supply of various skill groups implicitly controls for the effects of internal migration in response to foreign immigration. And, the authors address the endogeneities of both the

immigration influx and the native skill group shares by using lagged values of these variables as instruments. This strategy will of course produce valid results as long as the serial correlation of the omitted factors affecting these variables is not too severe.[12] The authors find for 1983-2000 that immigration does not have statistically significant effects on any education group. Second, for the 1997-2005 period, Dustmann, Frattini and Preston (forthcoming) study the effects of immigration in the United Kingdom using the spatial approach and defining skill by position in the wage distribution. An IV approach, using past immigration settlements in the area as the instrument, is taken. They find that immigration lowers wages at the 5^{th} and 10^{th} percentiles of the native wage distribution, with relatively large negative elasticities of the effect of immigration on the log of native wages (-0.5 to -0.6).[13] However, they find *positive* elasticities at each of the other percentiles examined (ranging from the 25^{th} to the 95^{th}), and a positive elasticity at the median of 0.66). The authors speculate that immigrants receive wages below their marginal product, yielding a surplus that native workers share on average. But the overall effect of immigration is to increase wage inequality at the bottom of the distribution.

The next study shown in Table 5 is closely related to the theme emphasized by Dustmann, Frattini and Preston (forthcoming) that immigrants may be exploitable by native firms, to the indirect benefit of at least some native workers. Specifically, Winter-Ebmer and Zweimüller (1996) study the effects of immigration in Austria using either a cross-industry or a cross-region approach for 1991. In addition, the authors use firm data to examine the effect of immigrant employment within a firm on the wages of young, native blue collar workers. The level of immigration in a region or industry is endogenous, and Winter-Ebmer and Zweimüller use past employment growth as an instrument for immigration. They find that immigration raises native wages using the regional approach but do not do so under the cross-industry design, using their most detailed specification. In addition, at the firm level, immigration appears to raise the native wage level. While the validity of the excluded instruments can be questioned

[12] Recall that Blanchard and Katz's (1992) study of regional evolutions in the United States would appear to validate Altonji and Card's (1991) use of 1970 immigrant stock as an instrument (i.e. a ten year lag). However, the exogeneity of past settlements may be a less reasonable assumption when the lag is shorter, as in Dustmann, Fabbri and Preston's (2005) approach, which uses three and four year lags.

[13] Here, "elasticity" refers to the effect on the log of natives wages of an increase in immigration equal to 1% of the native population.

here, the findings suggest that immigrants produce a surplus that firms and blue collar workers share. Like the Dustmann, Frattini and Preston (forthcoming) analysis, this study of Austria suggests that native workers can on average gain from immigration. This conclusion is not consistent with models where wages for each group are equal to its marginal revenue product, as in competitive models of the labor market. Specifically, even with different skill types, one predicts that an increase in immigration will lower average native wages if capital does not fully adjust or will leave average wages unchanged if capital is fully mobile (Borjas 2009).

The final study shown in Table 5 by González and Ortega (2008) examines the effect of low skill migration into Spain during the 2001-6 period on the relative wages and employment of less skilled construction workers. A spatial correlation approach is used, and past immigration settlements are used as an instrument for immigration during 2001-6. The authors find that low skilled immigration does raise the factor proportion of less skilled labor without affecting this group's relative wages in construction. While this study sheds light on the impact of immigration on relative wages and employment, its main purpose was to examine the impact of immigration on the industrial mix, as discussed in the literature linking immigration and international trade. We will return to this study later.

6.3 Episodes of Immigration Shocks

As we have emphasized, a central issue in studies correlating native economic outcomes to immigrant inflows is the endogeneity of immigrant inflows. There is a long tradition in economics of studying the basic hypothesis that individuals with higher expected returns to immigration are more likely to migrate than those with lower expected returns (Chiswick 1978; Borjas 1987). The studies in Table 5 that take account of the endogeneity of the immigration decision to settle in the local area largely use past decisions by earlier immigrant cohorts as an instrument for current levels of immigration. However, there is also a group of studies, summarized in Table 6, which exploit the information obtained from episodic immigration events that may be considered orthogonal to particular individuals' economic returns to immigration. Of course, the circumstances of such events may not be representative of typical

increases in immigration. However, they may nonetheless provide more convincing sources of exogenous variation in the extent of immigration than the other instrumental variables reviewed in the previous subsection.

The studies shown in Table 6 examine the impacts of the release from Cuba (the Mariel Boatlift) of many unskilled men in 1980 (Card 1990), the repatriation of French-Algerians following the end of colonial rule there in 1962 (Hunt 1992), the repatriation of Portuguese residents from former colonies in Africa in 1974 (Carrington and De Lima 1996), the permitted emigration of Jews from the former Soviet Union in 1990 following the fall of Communism (Friedberg 2001; Cohen-Goldner and Paserman 2011), and the repatriation of ethnic Germans from Eastern Europe and the former Soviet Union following German reunification (Glitz 2012).

In the cases of the Cuban, French and Portugese emigration, the authors used as identifying variation differences in the likelihood that these new immigrants would locate in particular areas of the country. In the case of the Mariel Boatlift, this was the nearby Miami metropolitan area; in France, immigrants went disproportionately to regions closest to Algeria and most similar in climate; and in Portugal, the returnees went disproportionately to the urban areas of Lisbon, Porto, and Setubal. In Israel, immigrants came from specific occupations in the former Soviet Union (Friedberg 2001) and settled disproportionately in different areas, worked in different industries, and had different skill levels from natives (Cohen-Goldner and Paserman 2011). In Germany, following passage of a 1996 law, ethnic Germans from the former Soviet Union and Eastern Europe (not including the former East Germany) were allocated to various regions of Germany based on a government assignment program that explicitly made an even distribution of immigrants its goal and carried significant sanctions against those who did not comply. Since the skill composition of existing German residents varied across regions, the new immigration represented an exogenous supply shock that differed by skill group for the different regions (Glitz 2012).

The migration episodes represented large shocks, particularly to some local markets. Specifically, the Mariel Boatlift migration represented 7% of Miami's population, with a larger shock for low skilled labor markets (Card 1990); the Portuguese returnees raised that country's

population by roughly 10% during 1974-5 (Carrington and De Lima 1996); the French repatriates from Algeria raised the country's total labor supply by 1.6%, with increases of 4-6% in some districts in Southern France (Hunt 1992); the entry into Israel of immigrants from the former Soviet raised the size of the potential labor force by 8% during 1990-91 (Cohen-Goldner and Paserman 2011); and over the 1996-2001 period, the inflow of ethnic German immigrants totaled about 0.83% of the average regional native population.

While the studies are not unanimous, there is at most weak evidence from Table 6 that these episodes had important effects on the level or distribution of native wages, despite the size of the immigration shocks. Card (1990), for example, does not detect negative effects of the Mariel Boatlift on less skilled workers' wages or employment, although he does find some evidence of the kind of internal migration adjustment which would dissipate any local effect. Hunt (1992) obtains a variety of evidence, but concludes that a one percentage point increase in repatriates' local share lowers native wages by no more than 0.8%, which she interprets as a small effect. Moreover, she does not find any evidence of offsetting native internal migration. Carrington and De Lima (1996) find conflicting results, with internal Portuguese comparisons suggesting an important negative effect on construction wages where returnees disproportionately relocated, but comparisons with France and Spain not indicating any negative effect on Portuguese wages. The authors take the international comparisons as more valid since the apparent internal effects seem too persistent, given internal migration, to have been caused by the mid-1970s migration episode. For Israel, Friedberg (2001) finds no adverse short-run effect on native wages within occupations. Goldner and Paserman (2011) find no effect in the short run or medium run (4-7 years) on the wages of white collar workers; they do, however, find a short-run negative impact on the wages of blue collar workers that dissipates after 4-7 years.

Finally, Glitz (2012) relates the change in skill-specific employment and wages in an area to the change in its relative size in the labor force over the 1996-2001 period. The change in its size is instrumented by the immigrant influx of ethnic Germans in the skill group. He finds that immigrants do displace natives from employment, with a displacement of about 3 unemployed workers for each 10 immigrants employed. However, he does not find evidence of significant

wage effects and points out that the employment displacement effect is a short-run impact that might not hold up over time. He interprets this combination of results as reflecting the highly unionized German labor market, in which wages are constrained from responding to market forces.

The effects of repatriation into France, Portugal and Germany just discussed are especially noteworthy in their findings of relatively small effects of immigration on natives, since immigrants are likely to share the same language as natives and also to some degree a common cultural heritage. Because of these similarities, one might assume that immigrants and natives in these cases do strongly compete with each other in the labor market. In contrast, in countries such as the United States where immigrants face a native language deficit, the scope for immigrants to compete in the same labor market as natives may be more limited.

6.4 An Evaluation of the Evidence on the Impact of Immigration on Relative Wages

In evaluating the studies in Tables 4-6 which use different methodologies to study the impact of immigration on relative wages, it is important to note that most of the evidence of negative effects on the less skilled comes from aggregate production function studies of the United States. Moreover, even these results are highly sensitive to the form of the production function, and a recent, carefully-executed study finds little effect on the native wage distribution (Ottaviano and Peri 2012). This approach assumes competitive markets, a view that has been questioned by studies of the impact of immigration in the United Kingdom (Dustmann, Frattini and Preston forthcoming) and Austria (Winter-Ebmer and Zweimüller 1996); these authors find evidence consistent with the idea that immigrants have less market power than natives, perhaps allowing native workers to appropriate some of the gains in national income that would have otherwise gone to owners of capital.

The cross-sectional studies in Tables 5 and 6 generally find smaller effects of immigration on the native wage distribution, and one possible explanation for this result is, as noted, equilibrating changes in internal migration in response to local foreign immigration. A number of authors have studied this issue, although only some have taken account of the endogeneity of immigration. This is a potentially important aspect of the research design, since

regressing native net outflows (which are of course negative for areas experiencing native inflows) on immigration inflows is likely to be contaminated by the same factors that have caused the immigrant inflow. If, for example, high levels of demand for specific types of labor lead immigrants to enter an area, then a simple OLS regression of native outflows on immigrant inflows will not capture the full (negative) effect of immigration.

Early studies of the impact of immigration on native outflows used OLS methods and found that the results were sensitive to the specification of the basic model. For example, White and Liang (1998) used 1981-1990 Current Population Survey (CPS) data and found some evidence that immigration into a state lowered the retention of Anglo workers and deterred new Anglo internal migration. However, Wright, Ellis and Reibel (1997) found that when one controlled for area population, immigration was either positively related or not related to internal migration. And Borjas, Freeman and Katz (1997) pointed out that controlling for pre-existing area trends in internal migration had a major effect on one's estimate of the impact of foreign immigration on internal migration. Specifically, only controlling for pre-existing levels (through a simple first difference analysis), it appeared that between 1980 and 1990, immigration of foreigners caused higher internal migration into an area. But when the authors employed a double difference estimator (e.g., taking the differences in differences in internal migration between 1970 and 1990 vs 1960 and 1970), a design that accounts for pre-existing trends, foreign migration was significantly negatively associated with internal migration into an area.

While taking first or second differences in internal migration addresses some forms of omitted variable bias (e.g., area fixed effects or area trends), this design cannot account for endogeneity biases caused by contemporaneous changes in the levels of omitted variables or their rate of change. Filer (1992) addresses the endogeneity of foreign migration by applying IV analysis to the study of native net migration by metropolitan area using the 1980 Census. The excluded instruments are measures of climate, the availability of apartments, and the predicted employment growth rate. Each of these is assumed to affect foreign migration without affecting native migration, although one can easily imagine that climate, housing and jobs would also affect natives. Using this simultaneous equations framework, Filer (1992) finds that foreign

migration into an area does cause a significant reduction in native internal migration. As Filer (1992) points out, however, the size of this effect—roughly 3.3 deterred native internal migrants for each new immigrant—was too large to be credible, leading one to perhaps question the validity of the instruments.

Card and DiNardo (2000) and Card (2005) use past immigration settlements as an instrument to study the effect of foreign migration on net internal native migration. In both cases, foreign migration is found not to affect native migration, implying an immigration of less-skilled workers equaling 1 percent of the local supply of unskilled workers does lead on-net to a 1 percent increase in the supply of such workers. Further, in her study, Cortés (2008) combines the IV approach of Card and DiNardo (2000) and Card (2005)—i.e. using past immigration settlements as an instrument for current immigration—with the inclusion of city fixed effects and area trends. She finds that, controlling for city fixed effects, immigrants actually attract natives, although the effect is not statistically significant; however, controlling for area trends and city fixed effects, there is some displacement of natives, although it is small. Again, we cannot reject the hypothesis of zero displacement, although the point estimate suggests a displacement of 3 natives for each 10 immigrants. Finally, Glitz (2012) uses OLS methods and finds no evidence that the influx of ethnic German immigrants to an area affected the internal migration decisions of natives or previous immigrants. While, as noted, one can criticize such methods if the initial influx of immigrants is endogenous, Glitz's (2012) research design uses the exogenous assignment of ethnic German immigrants stipulated in the 1996 German legislation as a source of variation in the initial inflow.

Most of the studies we have reviewed, particularly the cross-sectional studies, have found at most modest effects of immigration on the native wage distribution. There is some, albeit fragile, evidence that internal migration responses may explain part of these smaller effects. However, as we have seen, a number of careful studies of induced internal migration do not find evidence of such a response, implying that an increase in immigration of a given skill level to a local labor market in fact does raise the net supply of such skills to that market. This would imply that cross-sectional estimates of the impact of immigration on relative wages do have

some validity. Moreover, even in some of the most detailed aggregate level studies, immigration has been found to have only small effects on native wages. In our survey of economic theories about immigration's effects, we mentioned two factors that could possibly explain a seemingly small impact: Heckscher-Ohlin adjustments in the mix of output among traded goods and technological change that was induced by the increased supply of the types of labor immigrants bring. In the next section, we discuss some evidence on these possible explanations of a small effect of immigration on the native wage distribution.

6.5 Evidence on Adjustments in Output Mix and Induced Technological Change

We begin by considering the evidence on the impact of immigration on industry size. Lewis (2003), Card and Lewis (2007), and González and Ortega (2008) study the impact of immigration on the industrial structure of local markets, with particular attention to the size of traded goods sectors. Lewis (2003) studies the local industry response between 1980 and 1990 to changes in the supply of low skilled labor. Overall, he finds relatively little change in the industry mix as a result of such supply changes; rather, the within-industry factor proportions change, with little change in relative wages. The implication is that increases in labor supply due to foreign immigration of less educated workers do not lead to the relative expansion of industries intensively employing workers with low skill levels. Card and Lewis (2007) study the absorption of Mexican immigrants during the 1990-2000 period, an especially interesting group to study, since Mexico is by far the largest source of immigrants to the United States and immigrants from Mexico have low education levels on average.[14] They find that the influx of Mexican immigrants into a metropolitan area did raise the supply of less-educated workers but did not have major effects on the industrial mix. Rather, the factor proportions within industries changed to accommodate the Mexican immigration, results much like Lewis's (2003) findings for low-skilled workers generally.

As we mentioned earlier, González and Ortega (2008) study the impact of immigration of different skill groups into Spanish regions on the industrial structure over the 2001-6 period.

[14] According to the 2010 ACS, Mexican immigrants were 30% of the foreign born between the ages of 18 and 65; the next most highly-represented source country was India at 4.5%. Moreover, among Mexican immigrants, 53% had 11 or fewer years of schooling, compared to 8.3% of natives and 14% of other immigrants.

This period is noteworthy, since during that time the fraction of the population in Spain that was born abroad rose from 4.8 to 10.8%; moreover, this influx was heavily weighted toward individuals with low schooling levels. The authors use a spatial correlation methodology and instrument the local immigration influx by skill group using past immigration settlements. The findings are very similar to those of Lewis (2003) and Card and Lewis (2007). Specifically, immigration of less skilled workers does not appear to affect the industrial structure; instead factor proportions adjust.

While not a study of industrial mix, Cortés's (2008) analysis of the impact of immigrants on the relative prices of services is relevant to the discussion of immigration and industry mix. Specifically, she studies the impact of low-skilled immigration on the relative prices of services using low-skill labor such as housekeeping and gardening. She finds that such immigration lowers the prices of these services, primarily by lowering the wages of low-skill immigrants and native Hispanic workers. An implication of these findings is that low skill immigration can change the industrial mix by leading to an expansion of the nontraded sector through price effects in consumers' budgets. However, as noted earlier, the lack of an overall effect on native wages other than those of Hispanic workers suggests a low degree substitutability between immigrants and natives.

Overall, the results of these studies of the United States and Spain suggest that the kind of international trade adjustment discussed by Samuelson (1948) and later analysts does not appear to be an important reason for a possibly small effect of immigration on the native wage distribution.

In the Lewis (2003), Card and Lewis (2007), and González and Ortega (2008) studies, the fact that new immigrants were absorbed *within* industries without a reduction in the relative wages of less educated workers is consistent with the idea of induced technical change as developed by Acemoglu (1998 and 2002). In such models, we can observe an increase in the supply of a given type of labor without a deterioration in its relative wage. Further evidence on the impact of immigration on technical change comes from Lewis's (2011b) study of the impact of immigration on the use of new technologies in U.S. manufacturing during the 1988-93 period.

Specifically, Lewis (2011b) uses 1988 and 1993 Survey of Manufacturing Technology data to find a significantly negative cross-sectional relationship between an area's inflow of less educated workers and adoption of new technologies. Past immigration settlements of less skilled individuals serve as an instrument for the supply shock. He finds that increases in the supply of unskilled labor do in fact induce the use of more labor-intensive technologies, suggesting that capital and skill are indeed complementary. These results suggest that technological change buffers what would otherwise be the negative effects of immigration on the relative wages of high school dropouts, which he finds to be only marginally negatively affected by immigration.

7. Additional Evidence on Foreign Migration: Emigration

While almost all research on international migration and the income distribution focuses on immigration, some authors have studied the impact of emigration for several countries in which emigration represents an important fraction of the population. First, an important portion of the Mexican-born population has migrated to the United States, presenting researchers with an opportunity to study the impact of emigration on labor markets. For example, of the total population which had been born in Mexico, the fraction currently living in the United States increased from 1.7% to 8.6% between 1970 and 2000 (Hanson 2007, p. 289). Hanson (2007) and Mishra (2007) both study the impact of Mexican emigration on the wage structure in Mexico. Hanson (2007) notes that different regions have experienced different levels of emigration, while Mishra (2007) shows that the distribution of emigration differs across experience-education groups. Thus Hanson (2007) uses a region-based research design, while Mishra (2007) uses national-level data on emigration by subgroup. Both find that emigration raised Mexican wages during the 1990s. Mishra (2007) shows that high school graduates and those with some college but less than a college degree were disproportionately likely to emigrate between 1990 and 2000 and that this change in labor supply raised these groups' relative wages. These effects were quantitatively large, accounting for 37% of the increase in the relative wages of high school graduates and 14% of the increase in the relative wages of those with some

college education but less than a college degree. Hanson (2007) finds that emigration raised the wages in high vs. low emigration states with disproportionately large effects for individuals with 9-15 years of schooling, a similar finding to Mishra (2007). Thus, in Mexico, emigration appears to have increased middle-level wages relative to those at the bottom and the top of the skill distribution.

Second, the transition from Communism in Eastern Europe and European Union (EU) enlargement have led to an exogenous increase in emigration from Eastern Europe to countries such as Ireland and the United Kingdom. For example, Elsner (2011) estimates that roughly 5% of the population of Lithuania emigrated to these two countries during the 2002-6 period. Calibrating a structural demand model of the labor market by education-experience cells, he finds that emigration raised younger workers' wages in Lithuania by about 6%, with little effect on older workers. While he finds that overall education differentials were not affected, since younger workers tend to earn less than older workers, his results imply that emigration has narrowed the overall distribution of wages in Lithuania.

Third, in 1998, Hurricane Mitch led to an exodus from Honduras to the United States, and Gagnon (2011) studies the effects of this emigration on the labor market in Honduras. By 2005, the stock of emigrants from Honduras to the United States had reached 5.8% of the source country population. He finds very large elasticities of wages in Honduras with respect to the emigration share, on the order of 1, with especially positive emigration effects on the wages of women, those with post-secondary education, private sector workers and those in rural areas. These effects in principle have somewhat offsetting effects on the wage distribution, with some low-wage workers such as women benefitting but some high-wage workers such as the highly educated also gaining. While the point estimates appear to be large relative to other studies of immigration we have surveyed here, the author notes that the effect appeared to be diminishing by 2007, a finding reminiscent of Cohen-Goldner and Paserman's (2011) that the effect of immigration on Israeli wages also diminished after 4-7 years.

8. Beyond Wage Effects: Immigration, Child Care, Native Women's Labor Supply, and the Family Income Distribution

The research reviewed so far has studied the effects of international population movements on factor prices and the output mix of production. While these factor prices are a major force affecting the distribution of income across individuals and families, labor supply decisions potentially also have an important effects. Family income is of course affected both by income earning opportunities and the labor supply decisions of family members, particularly those of women, for whom labor supply is more elastic than for men (Blau and Kahn 2007). As suggested in Table 2, the incidence of low education levels is higher among immigrants than natives in many countries. Several recent studies have exploited this feature of immigration to examine its effect on highly skilled native women's labor supply in the United States, Spain, and Hong Kong (Farré, González, and Ortega 2010; Furtado and Hock 2010; Cortés and Pan 2009; Cortés and Tessada 2011). The hypothesis to be tested is whether the immigration of low skilled women lowers the cost and raises the availability of child care and housecleaning services, thus lowering the cost of labor force participation for women, given a traditional division of labor in the family. This effect is expected to be strongest for highly educated native women, who are said to comprise a disproportionate share of the demand for these services.

If the availability of child care services affects highly educated women more than those with lower schooling levels, then this difference will affect the family distribution of income, since highly educated women tend to be married to highly educated men. For example, Schwartz and Mare (2005) document an increasing trend toward educational homogamy in the United States over the 1960-2003 period. They find that by 2000, 89% of married women with at least a college degree were married to men who had attended college, and about three-quarters of these men also had college degrees. Thus, factors that increase the labor supply of highly educated women will likely raise family income inequality, since they are likely to be married to highly educated men who have higher income than less educated men.[15]

[15] For example, the 2010 ACS data show that among married men, family income for 2009 was about 90% higher for those with college degrees than among those without college degrees.

Each of the studies mentioned above that examine the impact of low-skill immigration on native women's labor supply finds a noticeably positive effect. For example, both Furtado and Hock (2010) and Cortés and Tessado (2011) study this issue using United States data from 1980 to 2000, employing the spatial cross-section approach. They both use prior immigration settlements as an instrument to account for the endogeneity of the supply of low-skill immigrations to an area. Both find a significantly positive effect of the supply of low-skill immigrants on the labor supply of high-skill natives absolutely, and Cortés and Tessado (2011) find a larger effect on more highly educated native women. Farré, González, and Ortega (2010) use a similar methodology for Spain for the 1999-2008 period and obtain similar results: immigration can explain about 1/3 of the increases in the labor force participation of Spanish women with college degrees who also have family responsibilities. These studies thus imply that the immigration of low skill individuals has likely raised family income inequality among natives by raising the labor supply of highly educated women.

Finally, Cortés and Pan (2009) study the effects of low skill immigration on the labor supply of women in Hong Kong. The authors note that as of 2006, more than 1/3 of families in Hong Kong with small children employed an immigrant household worker, a policy that the government encourages through its immigration regulations. The authors compare the growth of female labor supply in Hong Kong over the 1976-2006 period with that in Taiwan, which has a much more restrictive immigration policy. Additionally, the authors use Hong Kong microdata to analyze the effect of hiring an immigrant household worker on the labor supply of Hong Kong women with children. House size is used as an instrument for this key explanatory variable, which is clearly endogenous to the female labor supply decision. In both analyses, the authors find a strong positive effect of foreign household workers on Hong Kong women's labor supply. The largest effect of expanding the number of such workers was found to be for women with middle level education levels, followed by effects for highly educated women. Thus, the program would appear to raise income inequality between less educated women and others but to possibly narrow income inequality between women with middle levels of education and those with high levels of schooling.

9. Immigration and the World Income Distribution

Up to now, we have considered evidence of the impact of immigration on the income distribution within host and source countries, and much of the research has obtained somewhat modest effects. Nonetheless, immigrants themselves often experience large gains in income in the host country relative to what they would have earned in their source country, and these gains have the potential to affect world poverty levels and the distribution of world incomes generally. For example, Jasso, Rosenzweig, and Smith (2008) use 1996 New Immigrant Pilot Survey data on employment-based immigrants to the United States to estimate income gains to migration. The data show that in United States purchasing power, immigrants' earnings improved from about $17,000 in their source countries to roughly $38,000 in the United States, or about a 122% increase.[16] Moreover, Clemens and Pritchett (2008) used data from the patterns of migration from individual source countries to individual host countries around the world to infer income gains to migration among individuals born in each country.[17] They estimate that there are many low income countries for which the average income of those born in the country (both those currently residing there and emigrants) has been substantially raised through emigration. For example, Clemens and Pritchett infer that roughly 1 billion people (or about 14% of world population, according to the United States Bureau of the Census: http://www.census.gov/main/www/popclock.html , accessed January 12, 2012) live in countries where the average income of those born there would be at least 10% lower if one did not count the incomes of emigrants. In some low income countries, this difference is even higher, including Jamaica (45%), Liberia (34%), or Albania (38%).

While emigration has the potential to greatly improve the living standards of the emigrants themselves, as well as family members to whom they send remittances, only about 3% of the world's population lives outside the country where they were born in (Kapur and McHale 2009).

[16] This gain refers to those who worked both before and after migrating to the United States.

[17] The authors used immigrant incomes in the United States and source country characteristics to simulate the incomes of immigrants from a given source country to other countries. Data on intercountry population flows were then used to infer total income gains.

This small share limits the degree to which international population movements can affect the world distribution of income. Using data on population movements between countries and Clemens and Pritchett's (2008) simulations of emigrant wages, Kapur and McHale (2009) estimate that international migration reduces one measure of intercountry income inequality by only about 2%. This estimate assumes that migration does not affect growth in the source or host countries, although these could be affected as well, through "brain drain" effects, remittances, or schooling decisions made in anticipation of migrating. Nonetheless, migration can have very large effects on migrants and their families that are as substantial as the impact of many types of economic development (Clemens and Pritchett 2008).

10. Summary and Conclusions

In this Chapter, we have reviewed theories and evidence on the impact of immigration on the distribution of income. We first noted that immigration can affect the distribution of income among residents of a country (including the immigrants themselves) by affecting the composition of the population. For example, since immigrants may be much poorer than natives, increased immigration can raise the size of a low income group, thus raising overall inequality. In addition, the distribution of income among immigrants may be more dispersed than among natives; this would be the case if, as is true on average in the OECD, immigrants are disproportionately concentrated in the lowest and in the highest education groups. Thus increased immigration can also increase the overall dispersion of incomes by raising the size of the group with a high level of within-group income inequality. Using microdata from the United States, we showed that these composition effects were relatively small as of 2009; however, the increase in immigration around the world and in the United States in particular raises the possibility that these composition effects could eventually become important.

Our discussion of economic theory and the impact of immigration on income distribution then shifted to an analysis of the impact of immigration on factor prices, including the return to capital and earnings of various skill levels of labor. A key determinant of the impact of

immigration is the degree of international competition in product markets. Economic theory predicts that with a sufficient number of internationally-traded goods, immigration may have little to no effect on factor prices and therefore the distribution of income. However, in a relatively closed economy or one with a large non-traded sector, immigration can affect factor prices. We then discussed theoretical models of the impact of immigration in a closed economy. Its predicted effects depend crucially on whether capital is mobile, on the nature of substitution and complementarity relationships among various types of labor, and of course on the number and composition of immigrants relative to natives.

We then moved on to consider empirical strategies to uncover the impact of immigration on relative wages and income distribution. Research methodologies in this area mirror the array of research designs in labor economics (see, for example, Ashenfelter and Card 1999). On the one hand, we have seen attempts to estimate structural models of the labor market. These designs involve the specification and estimation of production functions. Once one has estimates of the parameters of these functions, one can then simulate the effects of immigration if one assumes that labor markets are competitive. On the other hand, we have seen reduced form models that relate labor market outcomes directly to changes in immigration. We discussed the advantages and disadvantages of each of these approaches.

We then reviewed empirical research on the impact of immigration on factor prices, primarily on wage differentials across skill groups of natives. While some studies do find important effects, overall, it seems to us that most research does not find quantitatively important effects of immigration on native wage levels or the wage distribution. If wage levels are not greatly affected, then neither is the return to capital likely to be greatly influenced by immigration. However, a finding that often comes up is that new immigration does reduce the relative earnings of previous immigrants, especially those who arrived recently.

In our review, we discussed possible reasons for the seemingly small effects of immigration on the native income distribution that many studies have found. First, it is possible that the open economy model of factor prices that are invariant to relative factor supply movements within a country applies. However, the evidence on the impact of immigration on

industrial shifts seems inconsistent with this reasoning, since immigration does not appear to cause large changes in the overall industry structure/product mix. Second, it is possible that increases in the supply of immigrant labor of a given skill level induce the use of technologies that are intensive in that type of labor. There is some evidence in favor of this view, which in effect says that the supply of immigrant labor creates its own factor demand within industries. Third, it is possible that substitution between high school dropouts and high school graduates is very high. If so, then increased immigration of less skilled workers, as is common in most OECD countries, will only change relative wages if immigration causes an increase in the aggregate of less skilled and medium skilled workers. There is some evidence for a high degree of substitutability between these two types of labor, although it is not unanimous.

Finally, it is possible that immigrants and natives are imperfect substitutes even within detailed education-experience groups. Researchers have found that production function estimates of immigrant-native substitutability are sensitive to specification; however, a recurring theme in the literature on immigration and wages is that immigration has larger effects on the wages of prior immigrants than on natives. This pattern does suggest imperfect substitution and implies that immigration primarily affects the immigrants themselves. A similar conclusion is reached in research on the impact of immigration on the world distribution of income which finds that the primary gains to emigration are reaped in the form of wage gains to those who emigrate or receive remittances from these individuals rather than inducing large effects more broadly on the source country population. This latter conclusion is of course based on current levels of international migration which are, by and large, too small to have important aggregate effects on the world income distribution.

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Table 1: Percent Foreign-Born Population, OECD Countries, 1988-1991 and 2000-2001

	1988-1991	2000-2001	Absolute Change	Relative Change
Australia	22.9	23.0	0.1	0.4%
Austria	4.5	12.5	8.0	177.8%
Belgium	8.8	10.7	1.9	21.6%
Canada	16.1	19.3	3.2	19.9%
Switzerland	15.2	22.4	7.2	47.4%
Czech Republic		4.5		
Germany	7.3	12.1	4.8	65.8%
Denmark	2.8	6.8	4.0	142.9%
Spain	0.9	5.3	4.4	488.9%
Finland	0.4	2.5	2.1	525.0%
France	6.3	10.0	3.7	58.7%
United Kingdom	3.2	8.3	5.1	159.4%
Greece		10.3		
Hungary		2.9		
Ireland	2.4	10.4	8.0	333.3%
Italy	1.1	3.9	2.8	254.5%
Japan	0.8	1.2	0.4	50.0%
Korea	0.1	0.3	0.2	200.0%
Luxembourg	27.4	32.6	5.2	19.0%
Mexico		0.5		
Netherlands	4.2	10.1	5.9	140.5%
Norway	3.2	7.3	4.1	128.1%
New Zealand		19.5		
Poland		2.1		
Portugal	1.0	6.3	5.3	530.0%
Slovak Republic		2.5		
Sweden	5.0	12.0	7.0	140.0%
Turkey		1.9		
United States	7.9	12.3	4.4	55.7%
OECD (weighted)		7.5		
OECD (unweighted)		9.4		

Sources: OECD (2001, p. 170); OECD (2008, p.59). 1988-1991 figures refer to 1988, except the following: France (1990); Italy (1991); Belgium (1989); Japan (1992); United States (1990); Australia and Canada (1991). 2000-2001 figures refer to 2001 except as follows: Denmark and Ireland (2002); Switzerland, Finland, Japan, Mexico, Turkey, and the United States (2000); Norway and Sweden (2003); France (1999); Germany (1998-2005, 2005); the Netherlands (1998-2002). See OECD (2008, p. 192).

Table 2: Educational Attainment of Native and Foreign-Population, 2000-2001 (% of age 15+ population)

	Primary Schooling			Secondary Schooling			Tertiary Schooling		
	Natives	Immigrants	Total	Natives	Immigrants	Total	Natives	Immigrants	Total
Australia	48.5%	41.3%	46.7%	31.6%	32.8%	31.9%	20.0%	25.8%	21.4%
Austria	33.4%	49.4%	35.6%	55.7%	39.3%	53.4%	10.9%	11.3%	11.0%
Belgium	46.5%	53.3%	47.3%	30.1%	23.8%	29.4%	23.3%	23.0%	23.3%
Canada	31.6%	30.1%	31.3%	36.9%	31.9%	35.8%	31.5%	38.0%	32.9%
Switzerland	25.6%	41.6%	29.5%	56.3%	34.7%	51.3%	18.1%	23.7%	19.2%
Czech Republic	22.8%	38.6%	23.8%	67.0%	48.7%	65.9%	10.2%	12.8%	10.3%
Germany	24.2%	45.8%	27.2%	56.5%	39.3%	54.1%	19.3%	14.9%	18.7%
Denmark	37.6%	36.9%	37.5%	42.6%	39.2%	42.3%	19.9%	23.9%	20.1%
Spain	66.4%	56.3%	65.9%	15.6%	22.6%	15.9%	18.0%	21.1%	18.2%
Finland	40.3%	52.6%	40.6%	36.3%	28.5%	36.1%	23.4%	18.9%	23.3%
France	45.8%	54.8%	46.8%	37.4%	27.2%	36.2%	16.9%	18.1%	17.0%
United Kingdom	51.2%	40.6%	50.2%	28.7%	24.5%	28.3%	20.1%	34.8%	21.6%
Greece	52.5%	42.7%	51.4%	33.5%	41.4%	34.4%	14.0%	15.9%	14.2%
Hungary	45.1%	41.1%	45.0%	44.2%	39.1%	44.0%	10.7%	19.8%	11.0%
Ireland	47.8%	29.6%	45.8%	29.5%	29.3%	29.5%	22.7%	41.1%	24.7%
Italy	63.6%	54.3%	63.3%	28.3%	33.5%	28.5%	8.1%	12.2%	8.3%
Japan	25.1%	25.9%	25.1%	47.1%	44.2%	47.1%	27.8%	30.0%	27.8%
Luxembourg	28.7%	36.7%	31.7%	58.6%	41.6%	52.4%	12.8%	21.7%	16.0%
Mexico	70.5%	39.0%	70.4%	16.7%	26.2%	16.7%	12.8%	34.8%	12.8%
Netherlands	40.5%	49.2%	41.5%	40.6%	31.6%	39.6%	18.8%	19.2%	18.9%
Norway	20.3%	18.3%	20.2%	56.7%	51.2%	56.3%	23.0%	30.5%	23.5%
New Zealand	30.1%	18.7%	27.6%	42.7%	50.4%	44.4%	27.2%	31.0%	27.9%
Poland	31.2%	47.9%	31.6%	58.4%	40.3%	57.9%	10.4%	11.9%	10.5%
Portugal	80.0%	54.7%	78.3%	12.2%	25.9%	13.1%	7.7%	19.3%	8.5%
Slovak Republic	28.0%	29.3%	28.3%	61.4%	55.0%	61.2%	10.6%	15.7%	10.5%
Sweden	25.0%	29.5%	25.6%	52.2%	46.2%	51.4%	22.8%	24.3%	23.0%
Turkey	75.6%	53.6%	75.1%	17.6%	31.2%	17.9%	6.8%	15.2%	7.0%
United States	20.3%	39.2%	23.1%	52.2%	34.7%	49.7%	27.4%	26.1%	27.3%
OECD (weighted)	39.9%	41.9%	40.0%	40.2%	33.8%	39.7%	19.9%	24.3%	20.3%
OECD (unweighted)	41.4%	41.1%	41.7%	40.9%	36.2%	40.2%	17.7%	22.7%	18.2%

Source: OECD (2008, pp. 82-3).
Figures refer to 2001 except as follows:
Denmark and Ireland (2002); Switzerland, Finland, Japan, Mexico, Turkey, and the United States (2000); Norway and Sweden (2003); France (1999); Germany (1998-2002, 2005); the Netherlands (1998-2002). See OECD (2008, p. 192).

Table 3: Analysis of Changes in the Variance of Log Hourly Earnings for the United States (2009 dollars)

A. Summary Statistics

	1980		2010	
	Men	Women	Men	Women
Fraction Immigrants	0.0635	0.0632	0.1913	0.1543
Variance of log wages, all workers	0.3775	0.3278	0.5526	0.4804
Mean log wages, all workers	2.8888	2.4707	2.9027	2.7152
Variance of log wages, natives	0.3742	0.3267	0.5460	0.4735
Variance of log wages, immigrants	0.4241	0.3432	0.5619	0.5132
Mean log wage, natives	2.8924	2.4701	2.9319	2.7269
Mean log wage, Immigrants	2.8360	2.4798	2.7795	2.6513

B. Decomposition of Changes in the Variance of Log Hourly Earnings, 1980 to 2010

	Base: 1980 shares, 2010 variances and means		Base: 2010 shares, 1980 variances and means	
	Men	Women	Men	Women
Within Group Variance Effect	0.1696	0.1483	0.1653	0.1504
Within Group Composition Effect	0.0020	0.0036	0.0064	0.0015
Between Group Wage Differential Effect	0.0016	0.0004	0.0030	0.0007
Between Group Composition Effect	0.0019	0.0003	0.0004	0.0000
Total Change	0.1751	0.1526	0.1751	0.1526

Sources: 1980 Census and 2010 ACS. Sample is restricted to wage and salary workers who had no self employment income and with measured hourly earnings at least $2 and at most $250 in 2009 dollars using the Personal Consumption Expenditures deflator.

Table 4: Summary of Selected Studies of the Effect of Immigration on Native Wages, Aggregate Production Function Approaches

Study	Sample	Methods	Results
Borjas, Freeman and Katz (1997)	US 1980-95, men and women	Apply estimated substitution elasticity of low skilled for high skilled workers to immigrant share	Wage elasticity is -0.322; immigrants lowered relative wages of high school dropouts to high school grads fby 4.8%
Borjas (2003)	US men 1980-2000	Nested production function, IV methods	Immigrants lower wages of dropouts by 8.9% and college grads by 4.9%
Ottoviano and Peri (2012)	US 1990-2006	Nested production function, IV methods	Immigrants have very small effects on wages of dropouts (effect ranges from -0.1 to +0.6%_
D'Amuri, Ottaviano and Peri (2010)	Western Germany 1992-2001	Nested production function, IV methods	Immigration raises less educated workers' wages by 1.68%, lowers wages of highly educated workers 1.01%
Bonin (2005)	German men, 1975-1997	Nested production function	Immigration lowers native wages with elasticity=-0.10, more negative for low skill workers
De New and Zimmermann (1994)	Western German men, 1984-1989	Aggregate production function, individual wage regressions, IV methods	Immigrants lower average native wages, more negative effects for blue collar than white collar workers
Manacorda, Manning and Wadsworth (2012)	UK 1975-2005	Nested production function	Immigrants don't affect native wages

Table 5: Summary of Selected Studies of the Effect of Immigration on Native Wages, Cross-Area, Occupation or Industry Approaches

Study	Sample	Methods	Results
Altonji and Card (1991)	US men and women, 1970-1980	Spatial correlation, IV methods	1 pct. point increase in immigrant share lowers native wage by 1.2%
LaLonde and Topel (1991)	US men, 1970-1980	Spatial correlation	Immigrants lower wages of other immigrants, don't affect wages of natives
Card (2001)	US men and women, 1990	Spatial-occupation correlation, IV methods	Immigrants lower wages of less skilled natives; effect is at most 3% in high immigrant cities
Card (2005)	US men, 2000	Spatial correlation, IV methods	Immigrants don't affect wages of dropouts vs. high school grads
Card (2009)	US men, 1980-2005/6	Spatial correlation, IV methods	Immigrants have small positive effect on wages of dropout vs. high school grads; lower wages of college grads vs high school grads (elasticity=-0.28)
Cortés (2008)	US Men and Women, 1980-2000	Spatial correlation, IV methods	Low skill immigrants don't affect native wages overall; previous immigrants' and native Hispanic wages are lowered
Dustmann, Fabbri and Preston (2005)	UK men and women, 1983-2000	Spatial correlation, IV methods	Immigration has statistically insignificant effects on wages of each skill group
Dustmann, Fratini and Preston (2008)	UK men and women, 1997-2005	Spatial correlation by wage percentile, IV methods	Immigration lowers wages at 5th and 10th percentiles, raises average and above median wages
Winter-Ebmer and Zweimüller (1996)	Austrian young men, 1991	Cross-region or cross-industry design, IV methods	By region: immigrants raise native wages; by industry: immigrants don't affect native wages; within firms, immigrants raise native wages
González and Ortega (2008)	Spanish construction workers, 2001-6	Spatial correlation, IV methods	Low skill immigration lowers skill intensity in construction without affecting less skill workers' relative wages

Table 6: Summary of Selected Studies of the Effect of Immigration on Native Wages, Episodes of Immigration Shocks

Study	Sample	Migration Shock	Results
Card (1990)	Miami, men and women, 1980-85	1980 Mariel Boatlift sends low skilled immigrants to Miami	No effect on wages or unemployment of unskilled workers
Hunt (1992)	French workers 1962-68	Repatriation from Algeria, 1962	At most, 1 pct. Point in repatriates' local share lowers native wages by 0.8%
Carrington and DeLima (1996)	Portuguese construction workers, 1973-81	Repatriation from Africa, 1974	Across districts, repatriates lower construction wages; compared to France and Spain, there is no effect
Friedberg (2001)	Israeli men and women, 1990-94	Migration from Former Soviet Union, post 1990, IV methods	No adverse effect on native wages by occupation
Cohen-Goldner and Paserman (2011)	Israeli men and women, 1989-99	Migration from Former Soviet Union	Short run: immigration lowers blue collar wages, effect dissipates after 4-7 years; no effect on white collar wages
Glitz (2012)	German men and women, 1996-2001	Repatriation of ethnic Germans after reunification: government assignment by region	Immigration displaces native employment by skill group but does not affect native wages