The Labour Market Impact and Performance of Immigrants

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Declaration

1. All parts of this thesis have been written by myself and not been presented to any other university or institution for a degree.
2. Chapter 4 is based on conjoint work with Christian Dustmann from University College London.
3. Chapter 5 is based on conjoint work with Christian Dustmann from University College London and Thorsten Vogel from Humboldt University Berlin.

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Abstract

In many countries, the extent to which immigration affects the labour market of the host economy is one of the key concerns in the public debate on immigration policies.

Chapter 2 of this thesis provides a thorough review of the economic literature on the labour market impact of immigration and summarises the current empirical evidence.

Chapter 3 investigates the impact of immigrants on the German labour market during the 1990s. This analysis takes advantage of a natural experiment in which a particular group of immigrants was exogenously allocated to specific regions across the country by the government. The empirical analysis focuses on the effect of these exogenous inflows on relative skill-specific employment and wage rates of the resident population.

Chapter 4 of the thesis investigates how industries and firms respond to a change in the skill mix of local labour supply induced by an inflow of immigrants. One way to absorb these changes is an expansion in size of those industries and firms that use the corresponding skill group most intensively. Alternatively, industries and firms can adjust their production process and switch to a technology that uses the corresponding skill group more intensively. Based on German micro data, the analysis assesses which of these channels is dominant and quantifies their relative contributions.

One of the key assumptions in many impact analyses is that natives and immigrants of the same observable skill level are perfect substitutes in the labour market and are thus equally affected by aggregate economic shocks. Chapter 5 of the thesis tests this assumption by analysing the way different immigrant groups in Germany and the UK respond to the economic cycle relative to comparable native workers.

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Chapter 1

Introduction

Since Jean Grossman's study on the substitutability of natives and immigrants in production (Grossman, 1982), researchers have taken on the task of empirically measuring the impact of immigration on their host countries' labour markets. Due to its obvious political sensitivity, this issue has received considerable attention from both policy makers and the media. The wide public interest coupled with the economic complexity, the variety of methodological approaches available, and the ambiguity of empirical results have fostered the emergence of a highly fertile research area over the last 25 years. Despite clear theoretical predictions that an inflow of immigrants into a labour market should, *other things being equal*, lead to a decrease in wages of those native workers with which the immigrants compete in the labour market, most of the empirical evidence suggests that the wage effects of immigration are very small. One reason for that could be that immigrants do in fact not compete with natives in the labour market. Another explanation could be that immigrants settle in those areas that offer the best economic prospects. In that case the true impact of immigration on wages is disguised by a positive relationship between the size of the immigrant inflow and economic conditions. Finally, there is a multitude of alternative channels through which a labour market can adjust to immigrant inflows. In reality, other things are rarely equal and rather than through wages, labour markets can respond through changes in their output mix, changes in production technologies, or the out-migration of native workers (or a combination of all of these). Also, immigrants could affect prices in a labour market, in particular in the service sector and the housing market, so that even with no effect on

nominal wages, real wages and purchasing power may change as a consequence of immigration. The economic interdependence of all these mechanisms make the analysis of the labour market impact of immigration a complex issue. In this thesis, I will provide a comprehensive overview of the status quo of this research area and address three of the issues raised above: the self-selection of immigrants into particular labour markets, the adjustment of output mix and production technologies, and the substitutability of immigrants and natives.

In Chapter 2, I first briefly present the economic theory that underlies most of the empirical work on the labour market impact of immigration. After introducing the main methodological approaches and pointing towards the potential problems associated with them, I thoroughly review the economic literature up to date and summarise the current empirical evidence, classifying studies according to the methodology they employ and the country for which they have been carried out.[1]

Chapter 3 focuses on the core question of whether and to what extent immigrant inflows affect local labour markets by analysing the unique episode of ethnic German immigration during the 1990s. With the fall of the Berlin Wall in 1989, ethnic Germans living in the former Soviet Union and the Warsaw Pact countries were given the chance to migrate to Germany. Within 15 years, 2.8 million individuals moved. Upon arrival, these immigrants were exogenously allocated to different regions by the government in order to ensure an even distribution across the country. Their inflows can therefore be seen as a natural experiment of immigration, avoiding the major problem encountered in previous studies of endogenous self-selection of immigrants into booming labour market regions. I analyse the effect of these exogenous inflows on relative skill-specific employment and wage rates of the resident population in different geographical areas between 1996 and 2001. The variation I exploit in the empirical estimations arises primarily from differences in the initial skill composition across regions. The underlying idea is that the same inflow of immigrants in terms of size and skills has different effects on the receiving local labour markets depending on

[1]Parts of this chapter draw on an earlier CEPR Report entitled "Immigration, Jobs and Wages: Theory, Evidence and Opinion" (Dustmann and Glitz, 2005).

the skill composition of their resident workforce. In this analysis skill groups are defined either based on occupations or educational attainment. For both skill definitions, my results indicate a displacement effect of around 4 unemployed resident workers for every 10 immigrants that find a job. However, there is no evidence of any detrimental effect on relative wages.

As pointed out earlier, the absence of a negative impact of immigration on relative wages that is found in the majority of empirical studies stands in contrast to economic theory which predicts that with a downward sloping labour demand curve an increase in labour supply due to an inflow of immigrants will lead to a reduction in wages. One of the most prominent explanations put forward in the literature for this apparent contradiction is that the changes in local factor supplies that are induced by immigration are absorbed by an expansion in size of those industries in a locality that use the corresponding skill group most intensively with fixed relative factor inputs within industries. This explanation, which implies a change in the output mix in a locality in response to immigration, has its roots in trade theoretic models and, in particular, the Factor Price Insensitivity Theorem (Leamer and Levinsohn, 1995). More recently, however, an alternative explanation has been offered, namely that industries adjust their production process and switch to a technology that uses the more abundant skill group more intensively. Chapter 3 investigates in a first step these two alternative explanations in detail and shows which of them was dominant in Germany between 1985 and 1995, distinguishing between tradable and non-tradable industries. I then extend the analysis to the firm level using administrative data that include the entirety of workers and their skill levels in all firms in Germany between 1985 and 1995. I distinguish between small and large firms as well as permanent and newly established firms. The empirical findings on the industry level show that changes in relative labour supply are accommodated within, rather than between industries, supporting recent results for the U.S. by Lewis (2004). The breakdown on the firm level suggests that the within industry adjustment is, to a large extent, due to within firm technology adjustments, mostly of firms in tradable industries, and that the creation of new firms plays an important role in absorbing changes in relative factor supplies. The results of this chapter are important in understanding how local labour

markets adjust to relative labour supply shocks caused by immigration and cast doubt on the ability of trade theoretic models in explaining these adjustment mechanisms.

One of the key assumptions in many impact analyses as well as studies that look at the assimilation of immigrants in the host country is that natives and immigrants of the same observable skill level are perfect substitutes in the production process and that they are thus equally affected by aggregate economic shocks. In the final chapter of this thesis, I investigate the way different immigrant groups respond to the economic cycle relative to comparable native workers. Based on over two decades of micro data, my investigation comprises two of the largest immigrant receiving countries in Europe, Germany and the UK, which are characterised by both heterogenous immigrant populations and distinct patterns in their economic cycles. Differences in responses to the economic cycle may be due to differences in the skill composition of immigrants and natives, or differences in demand for immigrants and natives of the same skills due to their differential allocation across industries and regions. The results show that there are substantial differences in cyclical responses between immigrants and natives and that these persist even within narrowly defined skill groups. The estimation of a structural factor-type model that separates responses to economic shocks from a secular trend using regional variation in economic conditions provides summary measures of these differences within education groups. The results confirm the larger cyclical response of unemployment for immigrants - in particular those from non-OECD countries - in both Germany and the UK. Depending on the skill level, non-OECD immigrants react between 1.5 and 2.4 and between 1.4 and 1.6 times stronger to business cycle shocks in Germany and the UK, respectively, than native workers with the same observable skill level. This differential responsiveness casts doubt on the common assumption of perfect substitutability of immigrants and natives of the same skill level in many impact analyses and has wider implications for other areas of the migration literature, in particular the literature concerned with estimating the assimilation profiles of immigrants in their host economies.

Chapter 2

The Labour Market Impact of Immigration

2.1 Economic Theory

One of the key questions regarding immigration concerns its benefits and costs for the receiving economies. Fears that immigration may, at least in the short run, have adverse effects on the labour market opportunities of the resident population are a main reason for opposition to more liberal migration policies. In this chapter, I explain some of the possible mechanisms by which immigration may lead to negative wage and employment effects for the native workforce and the circumstances under which adverse effects may not occur.

The first question that arises is how to model immigrants. Some early papers assume a closed economy, with only one skill type, and capital complementary to labour. Immigrants are considered as a distinct factor of labour (see e.g. Grossman, 1982). Such models provide valuable insights into the effects of immigration on wages and returns to capital. However, much of the debate on immigration is about whether immigrants are skilled or unskilled, and how the inflow of immigrants with particular skill endowments affects the economic outcomes of various groups in the resident population. It seems therefore natural to distinguish between different skill groups when modelling the impact of immigration.

In what follows, I discuss a simple model framework and extend it slightly in

directions that seem important for studying the possible labour market effects of immigration. I distinguish between skilled and unskilled workers who may be natives (born in the destination country) or immigrants (born in a country other than the destination country). I also assume that immigrants and natives within a particular skill group are perfect substitutes, i.e. they are interchangeable. Finally, I assume throughout that capital supply is perfectly elastic. This means that firms obtain capital at a fixed interest rate, which could be thought of as being set on an international market. I thus exclude from my consideration possible redistributional effects of migration from workers to capital owners (see Borjas, 1995b, for discussion) and concentrate on possible redistribution between skilled and unskilled workers.

Suppose that, before immigration occurs, the economy is in labour market equilibrium in the sense that all workers are employed at equilibrium wages, which may vary by skill level. If the newly arriving immigrants differ in their skill endowments from native workers, they will induce a change in the overall skill composition in the economy, which in turn will lead to a disequilibrium between supply of and cost-minimising demand for different labour types at existing wages and output levels. For example, if all immigrants are unskilled, there will be an excess supply of unskilled workers at the going wage rate. An absorption of these new workers into the economy and restoration of equilibrium will therefore almost certainly involve short-run changes in wages and employment levels of different skill types. A first key observation in this set-up is that immigration only affects wages and possibly employment rates of resident workers if the skill distribution of immigrants differs from that of the native workforce. Only in that case will their inflow lead to changes in the relative supply of different skill groups and thus to a disequilibrium in the labour market of the host economy. If the skill distribution of immigrants is equal to that of natives and capital supply is fully elastic, then immigration will simply lead to an increase in the scale of the economy through an increase in output with no effect on wages and the employment of natives.

Whether the effects on wages and employment are permanent or only temporary depends on some characteristics of our economy which I have not yet

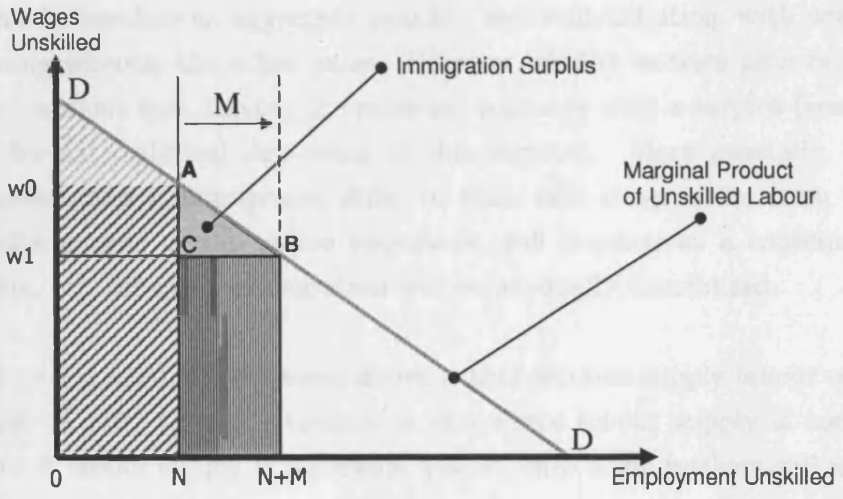
discussed. In particular, it depends on the different possibilities of the economy to adjust to the labour supply shock induced by immigration and the consequent changes in the relative supply of skilled and unskilled workers. In the simplest case, the economy produces one good only, and any adjustment to a change in the skill composition of the labour force through immigration will be through wages. In more realistic cases, where the economy consists of multiple sectors, adjustment can also take place by changing the output mix. For illustration, I compare below the effects of immigration on an economy with only one output good with that on an economy with multiple traded output goods. Technical details can be found in Dustmann et al. (2005) or Dustmann and Preston (2006). See also Altonji and Card (1991), Borjas (1995b), Friedberg and Hunt (1995), Borjas (1999b), Gaston and Nelson (2000), and Card (2001) for related discussions.

2.1.1 One Output, Skilled and Unskilled Labour

The simplest case is one where the economy produces only one output good with a constant returns to scale technology. A constant returns to scale technology is a technology where output is doubled if all factors of production are doubled. The three factors of production used in our economy are capital, skilled labour, and unskilled labour. Assume that the rate of return to capital (the interest rate) is set on the world market, and supply of capital is therefore perfectly elastic. Furthermore, assume that the labour supply of both skill groups is completely inelastic. This means that workers are willing to work at whatever wage is offered to them. I will relax this assumption later. Finally, assume that the skill composition of immigrants differs from that of native workers. For illustration, I will consider the extreme case where all immigrants are unskilled. Immigration will now lead to an excess supply of unskilled labour at the pre-immigration wages. Because unskilled labour is in excess supply, firms will be able to satisfy their demand for labour even at lower wages. This leads to a decrease in wages of unskilled workers, which, in turn, increases demand, until all unskilled workers (immigrants and natives) are employed, but at a lower wage than the pre-immigration wage.

Accordingly, unskilled native workers lose as a consequence of immigration. However, a supply shock of unskilled workers leads to a relative scarcity of skilled

Figure 2.1: Wage effects of unskilled immigration



workers in our economy, driving up their wages. Skilled workers therefore enjoy a gain from immigration. While wages of unskilled workers fall, wages of skilled workers rise. In our simple economy, the surplus accruing to skilled workers will be higher than the loss to unskilled workers (with the difference often referred to as the "immigration surplus").[1] I have demonstrated this in Figure 2.1, concentrating on unskilled workers only. The vertical axis shows wages and the horizontal axis employment. In the pre-migration period, all native workers N are employed at wages w_0, and the pre-migration equilibrium is in point A. Immigration of size M leads to a shift in the (perfectly inelastic) labour supply schedule. As skilled labour remains constant, this leads to a relative excess supply of unskilled labour, thus driving wages down the marginal product curve D. The new equilibrium is in point B, where wages have decreased to w_1. In this new situation, the total output share that goes to unskilled workers has decreased by an amount reflected by the area of the rectangle $(w_0 - A - C - w_1)$. This share of output falls now to skilled labour. As all unskilled workers including immigrants work at a wage that is equal to the marginal product of the last immigrant, immigrants create an additional surplus, which is given by the area $(A - B - C)$

[1] Note that the owners of capital will neither lose nor win, as the interest rate is assumed to be set on international markets and, thus, capital will be supplied perfectly elastically.

and which also falls to skilled native workers.

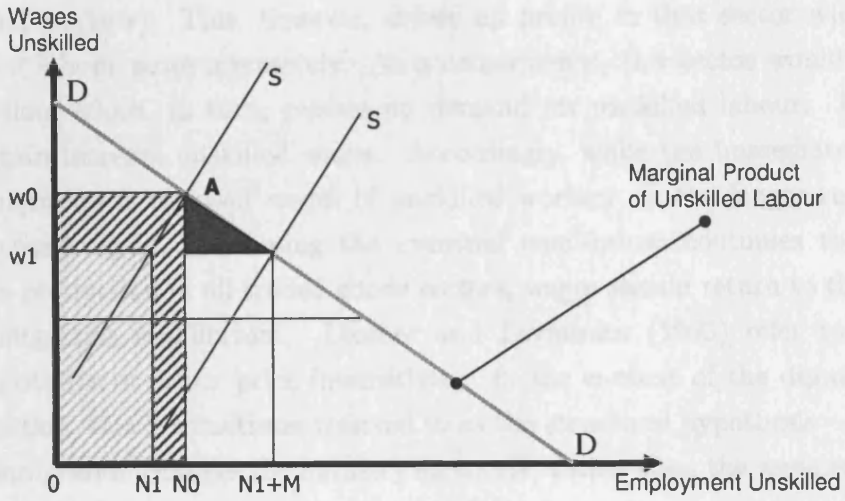
There is therefore an aggregate gain but also redistribution, with one labour type losing whereas the other gains. However, skilled workers gain more than unskilled workers lose, leaving the receiving economy with a surplus (see Borjas, 1995b, for an analytical derivation of this surplus). More generally, in such an economy, and if immigrants differ in their skill composition from natives, per capita income of the native population will increase as a consequence of migration, but the gains of migration will be unequally distributed.

One strong assumption I make above is that workers supply labour whatever the wage - I refer to that situation as one where labour supply is completely inelastic. If labour supply is somewhat elastic, then some workers will not want to work any more if wages are decreasing, and rather choose unemployment. In this situation, there are equilibrium employment effects. Immigration may cause (voluntary) unemployment among those native workers whose wages fall. I illustrate this in Figure 2.2. Here the labour supply curve is upward sloping, and an increase in labour supply through migration leads to some native workers not being prepared any more to work at the new, lower equilibrium wage. These workers (given by N0-N1 in Figure 2.2) remain therefore voluntarily unemployed.

My example focussed on the case where all immigration is unskilled, thus changing the skill composition towards unskilled labour. Of course, if I assume the other extreme case that all immigrants are skilled, it will be unskilled wages that rise, and skilled wages that fall, creating a redistribution and a surplus that favours unskilled rather than skilled labour. More generally, in this simple setting, the beneficiary of migration will always be the skill group whose relative supply has decreased as a consequence of immigration. As I stress above, no effects are to be expected if the skill composition of immigrants resembles that of the native population.

The model outlined in this section is the basis for much of the empirical work done in the area (see e.g. Altonji and Card, 1991, for a derivation of the corresponding empirical model). It is attractive because of its simplicity and clear-

Figure 2.2: Employment effects of unskilled immigration



cut implications. However, it does not capture all the channels of adjustment of the receiving economy to an inflow of immigrants, and I will discuss a simple extension in the following section.

2.1.2 Multiple Outputs, Skilled and Unskilled Labour

The economy I have characterized above is a one-sector economy, where only one output good is produced. Such an economy can only react to a change in the composition of its workforce (e.g. due to immigration) through changes in the wage structure. Now assume a multi-sector economy, where each sector produces one output good. Assume also that all output goods can be traded, with output prices fixed on world markets. Such an economy has an additional way of adjusting to changes in the skill composition of its workforce, namely by adjusting the mix of output goods it is producing.

To focus ideas, I assume again that labour supply is inelastic, i.e. that all workers will supply their labour whatever the wage level is. I also assume that there are only two sectors, one being intensive in the use of unskilled labour, and one being intensive in the use of skilled labour. These two sectors produce two output goods, both traded on world markets. Furthermore, assume, as above,

that all immigration is unskilled. Holding the output ratio fixed, immigration would, as before, drive down wages of unskilled workers (and increase wages of skilled workers). This, however, drives up profits in that sector which uses unskilled labour more intensively. As a consequence, this sector would expand production, which, in turn, pushes up demand for unskilled labour. This will then again increase unskilled wages. Accordingly, while the immediate impact of immigration is to lower wages of unskilled workers, in the longer run wages will increase again. Assuming the eventual equilibrium continues to involve positive production in all traded goods sectors, wages should return to the initial pre-immigration equilibrium. Leamer and Levinsohn (1995) refer to this as the hypothesis of factor price insensitivity. In the context of the discussion on immigration, this is sometimes referred to as the structural hypothesis - meaning that immigration changes the industry structure, rather than the wage structure.

As before, if labour supply is elastic, there may be both employment and wage effects in the short run, before the output mix can fully adjust. As in the one output case, no effects of immigration on wages and employment are to be expected (neither in the short nor in the long run) if the composition of migrant labour resembles that of the resident pre-migration population.

These results can be generalised to multiple input factors and multiple outputs, and can be extended to the case of non-traded goods, with the relevant algebra being detailed in trade theory models (see e.g. Ethier, 1984b, and Woodland, 1982). The key requirement to allow the economy to react through flexibility in its output mix is that there are more traded goods in the economy than there are factors of production.

2.2 Measuring the Immigrant Impact on the Labour Market

How can the effect of immigration on native employment and wages be estimated, what are the problems of empirical assessment, and what is the empirical evidence on the effects of immigration on wages and employment of resident workers? In this section, I first discuss the problems that may arise in the empirical analysis,

and the methods that are used to address them. I then review the literature up to date in Section 2.3 and summarise the findings.

2.2.1 The Spatial Correlation Approach

The most common approach in the literature is motivated by the following thought experiment. Consider an economy that can be divided into two regional labour markets R1 and R2, both identical to each other. Now suppose immigration takes place, and all immigrants are sent to labour market R1. The effect of immigration on wages and employment could now be measured by comparing wages and employment between labour market R1 and labour market R2, and relate the difference to the relative magnitude of immigration. In this example, labour market R2 serves as the counterfactual: it represents labour market R1 in the absence of immigration.

Following this thought experiment, and extending it to more than 2 regions, an empirical implementation would then regress a measure of employment or wages of resident workers in a given area on the relative quantities of immigrants in that particular locality and appropriate controls. This approach is often referred to as the spatial correlation approach. Spatial units are intended to correspond to geographical labour markets. In the U.S. context, for instance, the spatial units usually used for the empirical analysis are standard metropolitan statistical areas.

Permanent Effects

Underlying this approach, however, are a number of assumptions. Most importantly, it is assumed that the allocation of immigrants is random and independent of permanent labour market conditions in the destination region. However, pre-migration conditions in local labour markets are usually not identical (e.g. Greater London is economically more successful than the South-West of the UK), and the allocation of immigrants to local labour markets is a choice of immigrants. Typically, immigrants will choose the local labour market that provides the best economic prospects. Immigrant populations may also be concentrated in areas of enduring low or high economic prosperity as a consequence of historic settlement patterns and policies. This may lead to a positive or negative statistical

correlation between immigrant concentration and economic outcomes (depending on whether immigrants tend to settle in areas with persistently low or high economic performance), even in the absence of any genuine effects of immigration on outcomes of native workers. In other words, the levels of immigrant shares and levels of labour market outcomes may be spatially correlated because of common fixed influences.

The way to deal with this problem is to estimate models that remove any such "fixed effects". Two approaches to this are common. One is to estimate the relationship using differences, that is to relate the *changes* in immigrant concentration between two points in time to *changes* in economic outcomes. Using differences eliminates any persistent effects present in all periods. Following the example above, one would relate the *change* in economic outcomes of the resident population (such as employment or wages) to the *change* in the concentration of immigrants in R1 relative to R2. A similar approach, known as *within groups estimation*, is equivalent to including a full set of dummy variables for the relevant spatial units.

The idea of this approach is that the additional variation within regions (by observing outcomes as well as immigrant ratios at two points in time) allows for conditioning on region-specific fixed effects. In the absence of longitudinal data, other approaches are possible to eliminate such permanent region-specific effects if additional variation within regions is available. Card (2001) allocates immigrants and natives to six different skill groups, assuming that within each skill group, immigrants and natives are perfect substitutes. Since he observes in each local labour market six different occupation groups, he is able to condition on region-specific fixed effects. I will discuss Card's study in more detail below.

Simultaneity

However, the within groups and difference approach is problematic, too. Suppose that there are two periods, and economic conditions are identical in both regions at the start of period 1. At the end of period 1, a positive shock hits region R2. Immigrants enter the economy at the start of period 2. They are free to choose the region of residence, and they observe the shock before they decide about

where to settle. Obviously, it is likely that they choose region R2 over region R1.

The direction of causality between immigrant inflows and labour market outcomes is therefore not necessarily clear-cut, even if one relates differences in economic outcomes to differences in the immigrant concentration. Immigrants may be attracted to those areas that are enjoying current economic success. In this case not only may immigrant inflows drive labour market changes, but labour market changes may drive inflows. This selective settlement would lead to an upward biased estimate of the effects of immigrants' concentration on labour market outcomes. Specifically, any depressive impact of immigration on wages or employment could be masked by the fact that the inflows of immigrants occur most strongly in regions where the effect is offset by positive economic shocks.

One way to address this problem empirically is based on the following thought experiment. Suppose the decision of immigrants about where to settle is based on two factors. First, immigrants may take the relative economic prosperity of an area, caused by transitory economic shocks, as one reason for settlement - this is what creates the problem. They may, however, also take account of other aspects of an area, such as existing networks and the presence of individuals with the same culture and language as themselves. Thus, besides possibly choosing areas that were subject to favourable recent economic shocks, immigrants may tend to settle in areas with already high immigrant concentrations. Bartel (1989) was the first to empirically show this tendency of new immigrants to move to enclaves established by older immigrant cohorts of the same origin or ethnicity. In fact, her analysis suggests that the existing ethnic concentration in a locality is the most important factor in the locational choice of new immigrants. Pre-existing immigrant concentrations are now unlikely to be correlated with current economic shocks if measured with a sufficient time lag. Therefore, historic settlement patterns may help to solve the simultaneity problem and identify the effect of the inflow of immigrants on economic outcomes. A number of empirical studies follow this approach (for instance Altonji and Card, 1991, Hunt, 1992, Card, 2001, Dustmann et al., 2005, Card and Lewis, 2007). The idea of estimation in this case is to utilise the variation in the regional allocation of immigrants that can be solely explained by variation in existing networks

(which are uncorrelated with current economic shocks) to estimate the effect of migration after differencing out permanent regional differences. This technique is called *instrumental variables regression* and historic settlement patterns are in this case the *instrument.* The approach amounts to regressing *differences* in regional economic outcomes on *differences* in immigrant/resident ratios, using past immigrant densities as an instrument for the latter.

It has to be stressed that the assumption that lagged values of immigrant densities are correlated with employment changes only through their relation with immigrant inflows is an identifying assumption that is not testable. It could be problematic if local economic shocks were persistent and instruments were insufficiently lagged. The strength of correlation between lagged concentrations and current inflows is observable in the data and can therefore be assessed.

Measurement Error

A further problem is directly related to the poor data quality often encountered by researchers, in particular for countries where estimation depends on survey information. Measures of immigrant concentrations may suffer from measurement error due to small sample sizes (see Aydemir and Borjas, 2006). Furthermore, the consequences of any measurement error in measures of regional concentration of immigrants are aggravated when using the methods proposed above for eliminating the problem of fixed effects, since these tend to magnify the importance of the measurement error relative to the informative variation in the data. Measurement error leads to a tendency towards finding no effect even when one is present in reality. The mis-measured inflows will be less strongly associated with labour market outcomes than the true inflows, and the estimated effects may therefore be biased towards zero. This is known as attenuation bias. It will typically be a minor problem where sample sizes used to derive measures of immigrant inflows are large (for instance when large sub-samples from national censuses are used), but may be more serious where smaller data sources are employed. One solution to this problem is the same as that to simultaneity - instrumental variable estimation. As long as the effect of immigrant concentration on economic outcomes of the resident population is linear, the instrumental variable estimator discussed in the previous section will remedy both problems. Other examples of suitable

instruments in the context of measurement error would be alternative measures of immigrant flows from other surveys, or variables that are believed to exert a causal influence on the true immigrant flows and are measured with uncorrelated measurement error.

Out-migration of Natives

A last problem arises from the fact that local labour markets are not closed economies and workers are free to move in or out. If immigration does drive down local wages for certain skill groups then one would expect there to be pressure for currently resident workers of that skill type to move elsewhere to gain higher wages. This will tend to disperse the wage impact of immigration throughout the national economy and undermine the ability to identify the wage impact from looking at effects within localities. It leads to estimates of the effect of immigration on wages and employment of workers currently resident in local labour markets that are not as negative as the effects which one would obtain without internal migration responses.

There are several ways the literature has responded to this problem. One is to address it in two stages. If one could establish in a first step that out-migration of native workers as a reaction to immigration into a particular spatial unit is unimportant, then the problem can in principle be ignored when estimating the effects of immigration on employment and wages. The U.S. literature contains conflicting opinions on whether out-migration is in fact modest or not. While Card and DiNardo (2000) and Card (2001, 2005) find little to no evidence for this phenomenon, Filer (1992), Frey (1995, 1996), Borjas et al. (1997) and Borjas (2003, 2006c) consider out-migration of natives a far more important factor, leading to a bias towards zero when estimating the labour market effects of immigration using the spatial correlation approach.

Another way to remedy this problem is to consider the econometric problem arising as one of an omitted term in the estimated equation. One obvious solution to this is to measure outflows of residents and incorporate them directly into the estimation. However such outflows are likely to be correlated with shocks to local economic conditions for the same reasons as immigrant flows, discussed

above, creating a further simultaneity issue. These outflows therefore also need instrumenting and it is theoretically unclear what would serve as a suitable instrument; lags are one option. This approach has been taken by Dustmann et al. (2005).

Finally, the problem may be more severe when using small spatial units, such as, in the UK context, wards. Using larger spatial units may lead to the internalisation of possible native migration responses. For example, if natives react to immigration to South London by moving out, it is likely that they will move to North London rather than, say, Manchester.

2.2.2 The Simulation-based Approach

Simulation-based approaches are used to avoid identification of the effects of immigration from local labour market information alone. The counterfactual - the labour market conditions in the absence of immigration - is constructed by simulation (see Borjas et al., 1997). The basic idea of what these authors call the *aggregate factor proportions approach* is a comparison of the actual supplies of workers in particular skill groups to those that would prevail in the absence of immigration. These changed factor proportions due to immigration will lead to different wages and employment situations for native skilled and unskilled workers.

The simulation-based approach creates the counterfactual situation based on a structural economic model and pre-estimated parameters rather than on direct estimation. Therefore, it produces results that are sensitive to the chosen model structure, as well as the underlying parameters that are used for simulation. A key parameter in this context is the responsiveness of relative wages to relative skill supplies, the elasticity of substitution. An advantage of the simulation-based approach is that it provides additional insight into the way immigration relates to, for example, trade (see Borjas et al., 1997). The model does, however, not allow for factor price equalisation which may lead to adjustments through output mix rather than factor prices.

The simulation approach relies on a few crucial assumptions. Most impor-

tantly, it is not clear what the counterfactual situation looks like - what, for instance, the trend in relative demand has been for different skill groups during the period of analysis. This uncertainty is reflected in the choice of the elasticity of substitution between skilled and unskilled labour, which translates the changes in relative labour supply into wage and employment effects, and which is very much driving the results for the immigrant impact on native outcomes. Also, as Friedberg and Hunt (1995) point out, the increase in relative supply of unskilled workers on wages is by construction assumed to be the same, independent of whether the increase occurs due to immigrants or natives. For that reason, an important assumption for obtaining unbiased results is that natives and immigrants are perfect substitutes within each skill group.

2.2.3 The Skill Cell Correlation Approach

In a relatively recent paper, Borjas (2003) suggests an alternative estimation method to retrieve possible wage and employment effects. Arguing that the spatial correlation approach may lead to an underestimation of wage- and employment effects, he suggests using an analysis that is based on the national level and therefore robust to the problem of out-migration or, for that matter, other ways of adjustment of local labour markets. Borjas argues that workers are not necessarily perfect substitutes within education groups, as labour market experience is adding another important component of human capital. Following this argument he defines skill groups as education-experience cells and assumes that workers within education-experience groups are perfect substitutes. Consequently, immigrants in the lowest education group compete most with workers of the same group that have a similar level of work experience. Borjas then estimates the impact of immigration on native employment and wages by regressing the cell-specific native outcomes on the immigrant share in the respective education-experience group.

In principle, the skill cell correlation approach is similar to Card's (2001) idea of distinguishing between six skill groups, in that it creates additional variation that can be used for estimation. For a sufficiently large number of cells and with additional time variation, estimation does not need to rely on variation obtained from spatial units. In his study, Borjas (2003) uses data comprising four

decades. He has therefore variation over time, and across education and experience groups. While the key identification assumption in the spatial correlation approach that uses data over time and conditions on region and time effects is that the impact of migration can be identified from changes in the immigrant concentration within spatial units over time, Borjas's identifying assumption in this approach is that the impact of immigration can be identified from changes within education-experience cells over time. In particular, it excludes the possibility that immigrants select into those skill cells where economic conditions are better, or that immigrants are "downgraded" in the host economy's labour market, so that the actual skill cell in which they compete in the labour market does not coincide with their observed skill level.

As pointed out earlier, an important assumption underlying the skill cell correlation approach is the perfect substitutability between natives and immigrants within skill cells.[2] Two recent studies by Manacorda et al. (2006) and Ottaviano and Peri (2006a) analyse to what extent this assumption is valid for the UK and the U.S. respectively. Both studies find that immigrants are not perfect substitutes for natives even within narrowly defined skill groups but partly complement their skills, so that their effect on native wages is substantially smaller than previously estimated. With imperfect substitutability of natives and immigrants within skill cell, the group most affected by new immigrant inflows are according to both studies previous immigrants. However, in the U.S. context there is some controversy whether or not immigrants and natives are indeed imperfect substitutes. Running seemingly the same regressions as Ottaviano and Peri (2006a), Borjas et al. (2006) do not find any evidence that immigrants and natives are imperfect substitutes within education-experience groups and that therefore a definition of skill groups based on education and experience as in Borjas (2003) is sufficient to simulate the labour market impact of immigration on natives.

An additional important prerequisite of the skill cell correlation approach is

[2]The perfect substitutability assumption is, of course, also underlying most spatial correlation studies and leads to similar issues regarding the interpretability of the empirical results. In Borjas (2003) study, imperfect substitutability would have important implications for the simulation of his structural model but less so on his reduced form estimation result.

that immigrants can be allocated to skill groups based on their observable characteristics. This, however, may be very difficult, as immigrants are often occupationally downgraded during the first few years after arrival, and only gradually improve their economic position thereafter. This may make a pre-allocation to particular skill groups difficult. Friedberg (2001) and Dustmann et al. (2007) provide evidence for Israel and the UK, respectively, that initial downgrading is indeed substantial.

2.3 Empirical Findings: A Survey of the Literature

In this section, I provide a broad survey of the empirical findings on the labour market impact of immigration in the literature, highlighting the different empirical approaches along the lines of the discussion in the previous section. Other such surveys include Friedberg and Hunt (1995), Smith and Edmonston (1997) and Gaston and Nelson (2002).[3]

2.3.1 Estimating Production Functions

Some of the first studies in the literature that try empirically to assess the impact of immigration on wages and employment in the host economy were guided by neoclassical input demand theory. These studies estimated production functions and distinguished between different labour inputs and capital. The estimated parameters from these models inform about the substitutability or complementarity between the different factors and thus allow assessing the effects which changes in their relative supply might have.

Grossman (1982) was among the first to estimate such models. In her study she estimates a translog production function for the U.S. to obtain elasticities of factor complementarity between natives, second-generation natives, foreign-born workers and capital.[4] Estimations are based on 19 SMSAs (Standard Metropolitan Statistical Areas), using data from the National Origin and Language Subject

[3]Gaston and Nelson (2002) provide a comprehensive survey of the empirical literature with a particular emphasis on the distinction between labour- and trade-theoretic approaches.

[4]For a detailed discussion of factor substitutability and complementarity in production see Hamermesh (1993).

Report, the County and City Data Book, the U.S. Census from 1970, the Census of Manufacturing, and the Annual Survey of Manufactures (ASM). Among her main findings are that, first, second-generation workers and foreign-born workers are both substitutes for native workers in production, with the former being more highly substitutable for natives than the latter. Second, foreign-born workers substitute for second-generation workers more easily than for natives. Finally, capital is complementary with all types of labour, but strongest with foreign-born and weakest with native workers. With regard to the impact of immigration, she finds small but non-negligible effects on native workers with estimated employment and wage elasticities of -0.08 and -0.10, respectively, and somewhat larger effects on wages of foreign-born workers with an elasticity of -0.23, although these results vary with the maintained assumption on wage flexibility in the economy.

Borjas (1987) argues that Grossman's analysis may mask important channels by which immigration can affect wages and employment in that it neglects race-specific differences. He extends the analysis by choosing a generalised Leontief technology and distinguishing between immigrants' race and ethnic origins. Based on 1980 U.S. Census data and data on the capital stock for 84 SMSAs from the Census of Manufactures and the ASM, he finds that immigrants are substitutes for some labour market groups (e.g. native white men) and complements for others (black native-born men). Furthermore, all numerical effects of an increase in immigrant supply on the earnings of native-born men are small. His analysis, however, confirms non-trivial effects on wages of resident immigrants, leading to the conclusion that immigrants' main competitors in the labour market are other immigrants.

In contrast to the previous two studies, Gang and Rivera-Batiz (1994) do not consider immigrants and natives as different factors in production, but distinguish between education, unskilled labour and experience inputs. In a first step they estimate a translog production function from which they obtain factor price elasticities between these three inputs. Both for the U.S. and Europe, their results imply that education, unskilled labour and experience are complementary inputs. They then proceed by calculating composite elasticities of complementarity be-

tween natives and immigrants using their average human capital characteristics. Based on these results, they find that the simulated impact of immigration on native residents is very small.

2.3.2 Using Spatial Correlations

One of the most influential papers on the impact of immigration on local labour markets is by Card (1990), who takes advantage of a natural experiment to investigate this issue. He evaluates the effects of the Mariel boatlift on wages and unemployment rates of less-skilled workers. After a remarkable sequence of events, the Cuban president Castro allowed all Cubans who wished to do so to emigrate to the United States from the harbour of Mariel. As a result, some 125,000 Cuban immigrants arrived in Miami between May and September 1980, increasing Miami's labour force by 7%. It is not unreasonable to assume that this inflow of low-skilled immigrants was exogenous to the local labour market conditions in Miami. An analysis of this particular immigration event does therefore not suffer from the simultaneity problem that is typical in spatial correlation studies (see the discussion in Section 2.2). Card compares wages, employment and unemployment in the pre-migration situation with those after the Mariel boatlift, controlling for common trends by comparing the outcomes in Miami with those of four other major cities: Atlanta, Houston, Los Angeles and Tampa-St. Petersburg. In his analysis, which is based on Current Population Survey (CPS) data, he distinguishes between effects on whites, blacks, Cubans and Hispanics. Somewhat surprisingly, perhaps, the empirical results of this study show neither an effect of the Cuban immigrant inflow on the wage rates nor on the unemployment rate of the less-skilled non-Cuban population in Miami. This suggests a rapid absorption of immigrants into the labour force. Card points out, however, that the Miami labour market may be atypical of other local labour markets in the U.S., because Miami's industry structure, with a high concentration of apparel and textile industries, was particularly well-suited to incorporate low-skill immigrants. Also, the high existing concentration of Hispanics could have facilitated integration. Finally, domestic native and earlier immigrant migration into Miami slowed down significantly after the boatlift, hence the *Mariels* may have partly displaced potential other migrants.

Altonji and Card (1991) use the spatial correlation approach to examine the effect of changes in immigrant density across 120 SMSAs on the labour market outcomes of the native population. Their analysis focuses on less-skilled natives (male native high school dropouts, black males and females and white females with high school education or less), arguing that these groups are likely to be most affected by immigrant inflows. The authors base their estimation equation on a model similar to the one discussed in Section 2.1, where factors of production are capital, skilled labour and unskilled labour. In their paper, they first investigate whether immigrant inflows have displaced less-skilled natives from particular industries. For this purpose they calculate an index of competition between immigrants and different native groups which reflects the overlap in their respective industry distributions. They then estimate the effect of immigration on various labour market outcomes of native unskilled workers. In these estimations, which are based on U.S. Census data for 1970 and 1980, they use the stock of immigrants in 1970 as an instrument for the change in the fraction of immigrants in the population between 1970 and 1980 to control for the endogenous immigrant choice of region (see the discussion in Section 2.2). This instrumental variable approach uses the fact that immigrants tend to go where earlier immigrant cohorts have already established immigrant enclaves (see Bartel, 1989). Altonji and Card find some evidence of native displacement out of low-wage immigrant-intensive industries. The estimated effects for wages and employment are relatively small: a 1 percentage point increase in the fraction of immigrants in an SMSA reduces the number of natives who worked by 0.25 percentage points and reduces their wages by at most 1.2%. There is no evidence of a significant effect on the labour force participation or the employment/population rate. Altonji and Card conclude that the degree of competition between immigrants and less-skilled natives is modest.

LaLonde and Topel (1991) use changes in the immigrant supply in 119 SMSAs in the U.S. between 1970 and 1980 to identify the wage effects on natives and immigrants of older cohorts. The distinctive feature of this study is that different cohorts of immigrants are treated as different inputs within local labour markets. The analysis focuses on the effect of newly arriving immigrants on all the other immigrant cohorts, which, they argue, serves as an upper bound

for the impact on native workers. As expected and consistent with the assimilation of immigrants over time, new immigrants reduce earnings of other new immigrants the most and this effect dissipates for increasingly older immigrant cohorts. Thus, the best substitute for an immigrant is another immigrant of the same cohort, whereas the substitutability between an immigrant cohort and native workers increases with the cohort's time spent in the country. Overall they conclude that the effect on natives appears to be quantitatively unimportant.

A further paper based on the spatial correlation approach by Butcher and Card (1991) deals with the question whether the decline in the earnings of the least-skilled workers in the U.S. in the 1980s can be related to immigration. For that purpose, Butcher and Card look at changes in the lower tail of the wage distribution, in particular of the 10th percentile of wages, in 24 major cities during the period 1979-1989 and how they correlate with changes in immigrant densities. Using data from the CPS for the years 1979 to 1980 and 1988 to 1989 and the U.S. Census for 1980, they find that there is no evidence of any effect of immigration on the level of wages across cities in 1979-1980. Furthermore, wages in the upper end of the wage distribution grew significantly faster than those in the lower end during the 1980s. Although the rise in wage inequality was bigger in cities with bigger immigrant inflows, this is due to a more rapid increase in the 90th percentile of wages, rather than a decline in the 10th percentile. They thus find no evidence of a significant adverse effect of immigration on wages.

Card (2001) examines the impact of immigration on the relative labour market outcomes of individuals in specific skill groups in 175 metropolitan statistical areas (MSAs), using U.S. Census data from 1990. In the underlying theoretical model, he defines six different labour inputs based on occupational groups, within which immigrants and natives are perfect substitutes.[5] In this model the effect of immigration then arises through the induced changes in the relative supply of different labour inputs, in particular an increase in the supply of workers in low-skill occupation groups. Unobserved demand and productivity shocks which

[5]In an earlier version of this paper, Card (1997) defines skill groups by estimating a wage distribution and stratifying individuals into deciles of that distribution. Hence, there are 10 different labour inputs within which natives and immigrants are again treated as perfect substitutes.

would render the immigrant inflows into a specific region-occupation group endogenous are instrumented with the so called supply-push component, which is the expected inflow rate into an occupation on the basis of earlier immigrant settlement patterns. The results of the empirical analysis show that the effects on native wages and employment are small: a 10% increase in the population share of a particular skill group through immigration reduces the employment/population rate of that group by 1.0 to 1.5 percentage points and the relative wage of that group by around 1.5%. Furthermore, Card does not find evidence that inflows of new immigrants lead to offsetting mobility flows of natives or earlier immigrants which would lead to an underestimation of the effect of immigration on wages and employment. A more recent analysis by Card (2005) confirms both the result on the weak relationship between immigration and relative wages and employment rates and the result on the absence of compensating native mobility flows using U.S. Census data from 2000 for 325 MSAs. In this study, a 10% increase in the supply of high school dropouts relative to high school graduates decreases their relative employment/population rate by a mere 0.12% and has no effect on relative wages.

2.3.3 Simulating the Impact of Immigration

As pointed out earlier, instead of estimating the effects of immigration by means of spatial correlation analyses, an alternative approach has been put forward: the simulation or factor proportions approach.

In a first paper following this approach, Borjas et al. (1992) analyse how immigration and trade have affected the - in the latter case implicit - aggregate supply of workers in particular skill groups in the U.S. economy between 1980 and 1988 using CPS data and the 1980 U.S. Census. They compare the prevailing wages and employment outcomes to the case which would have occurred in the absence of immigration or trade, using an economy-wide estimated elasticity of substitution to simulate the counterfactual outcomes. As in the paper by Butcher and Card (1991), the motivation for this study is to investigate whether immigration and trade are potential reasons for the increase in wage inequality in the U.S. over the 1980s. Borjas et al. observe that both immigration and trade increase the factor which is relatively scarce in the U.S., unskilled labour,

whereupon the annual increase in implicit labour supply due to trade is larger than the one due to immigrants. Overall they conclude that immigration had only a small effect on the college/high school wage differential in the 1980s but a substantial negative effect on the earnings and employment opportunities of high school dropouts. For this group, the changes in relative skill endowments induced by trade and immigration together can explain over 40% of the relative wage earnings decline during the 1980s.

Revisiting their previous work, Borjas et al. (1996) directly compare the results from their factor proportions approach with estimates obtained from a spatial correlation model, using U.S. Census data for 1980 and 1990. For their spatial correlation analysis they examine the effect of the immigrant/native ratio and changes thereof, both overall and within education groups, on the weekly earnings of an individual. In an interesting experiment they use increasingly larger geographic areas as the units for their estimations. Controlling for local labour market conditions and education fixed effects and taking first differences, they obtain different estimates of the effect of immigration on native earnings, dependent on the regional unit of analysis. The estimated coefficient on the immigrant/native ratio tends to become more negative the larger the area of analysis: it is 0.001 for metropolitan areas, -0.037 for states and -0.043 for even larger regions. For this phenomenon they offer two explanations: native out-migration on the one hand and the re-allocation of capital in response to immigrant inflows on the other. They then turn towards the factor proportions analysis, following a similar strategy as in their previous paper to estimate how immigration and trade have changed the national supply of different skill groups. Since this approach looks at nationwide changes in relative supplies and translates these into changes in relative earnings, it is not affected by either native migratory responses to immigration or changes in the allocation of capital. As before, they conclude that immigration has been important in reducing the pay of high school dropouts, while immigration and trade have contributed only modestly to the falling pay of high school equivalent workers.

In another paper on this issue a year later, Borjas et al. (1997) extend their work in various directions. Most importantly they study a longer time horizon

using U.S. Census data for 1960 to 1990. Again they first carry out a spatial correlation analysis separately for each decade. Their findings show that the correlation between changes in immigrant shares and changes in wages by state switches from +0.591 in 1960-1970 to -0.103 in 1980-1990 for men, and from +0.203 to -0.022 for women, respectively. They conclude from these results that in using a spatial correlation approach, inferences about the impact of immigration will differ according to which period is analysed. They argue that unobserved structural forces, which have little to do with immigration, are the main drivers of the regional wage structure and that they dominate any effect immigrants might have on native wages and employment. They conclude that the spatial correlation approach is therefore not suitable to identify the causal impact of immigration on native labour market outcomes. They then proceed by investigating whether immigrant inflows into a labour market induce native outflows. In their estimations for the period 1970-1990 they also include pre-1970 demographic trends, basically estimating a difference in difference specification, in order to control for the growth trend in a labour market before immigration occurs. While their initial findings show a positive correlation between immigrant inflows and native inflows, this specification reveals a significant negative effect of immigration on the growth trend of the native population, suggesting a considerable displacement of native workers. These results are compatible with the hypothesis that the impact of immigration is diffused across the country through native migration flows. As before they then turn towards the factor proportions approach, basically confirming their earlier results: immigration has had a strong negative impact on the relative wage of high school dropouts, explaining between 44 to 55 percent of the decline in the relative wages of high school dropouts over the period 1980-1995. Trade on the other hand can explain less than 10 percent of that decline. Finally, neither immigration nor trade seem to explain much of the increase in the college-high school wage differential.

In a study based on data from the 1980 and 1990 U.S. Censuses, Jaeger (1996) estimates a nested production function in which natives and immigrants are disaggregated by sex and educational attainment to obtain elasticities of substitution between natives and immigrants of the same sex and with similar skills. In this analysis he adjusts the relative quantities of supplied labour for changes in relative

average productivity of immigrants and natives. Furthermore, he takes account of potential measurement error in the size and wages of the immigrant population relative to natives which would upward bias the elasticity of substitution by instrumenting with the real relative population changes taken from the 1980 and 1990 Censuses. The important finding of this first part of the study is that immigrants and natives are essentially perfect substitutes in production within sex-skill groups. Using this result, Jaeger then proceeds to estimate the impact of immigration on native wages by assuming an aggregate nationwide production function, which is nested such that dropouts and high-school graduates form a low-skill, and those with some college education form a high-skill labour aggregate. He then simulates the wage effects of the immigrant inflow with various values for the elasticities of substitution between high- and low-skill workers on the one hand, and dropouts and high school graduates on the other. The results imply that immigration lowered the native dropout wage by up to 3%, accounting for up to one third of its decline during the 1980s. It also reduced the wage of high school graduates by about 1% and increased the wage of college equivalents by about 1%. Overall, according to these results, immigration accounts for approximately 15-25% of the increase in the wage gap between low and high skill workers during the 1980s.

2.3.4 Using Skill Cell Correlations

In the last few years renewed attempts have been made to identify the causal impact of immigration on the labour market, using the skill cell correlation approach to avoid some of the problems encountered in earlier studies.

Borjas (2003) uses U.S. Census data for the years 1960 to 1990 and CPS data for 1998 to 2001 and exploits variation in supply shifts across education-experience groups in the economy. The underlying assumption is that individuals with similar education but different experience are not perfect substitutes but separate labour inputs. Skill groups are then defined in terms of education and work experience. Changes in relative supplies of these skill groups are observed at the national level, which avoids the problem of migratory responses of natives. By incorporating these assumptions into a three level CES production function, Borjas then proceeds by estimating both own and cross factor price elasticities

which are subsequently used to calculate the wage impact of the actual immigrant inflow into the U.S. between 1980 and 2000. His empirical results imply that a 10% increase in the immigrant share reduces the wages of competing native workers by 3-4%. The actual immigrant inflow between 1980 and 2000, which increased the labour supply of working men by 11%, reduced the wages of the average native by 3.2%, high-school dropouts by 8.9%, college graduates by 4.9%, high school graduates by 2.6%, and barely changed the wages for workers with some college. Overall these estimates imply that the immigration of the 1980s and 1990s has substantially worsened the labour market opportunities for most groups of natives.

Using data from the U.S. Censuses 1960 to 2000, Borjas et al. (2006) specifically turn the attention to the immigrant impact on the wages and employment rates of African-Americans (see also Altonji and Card, 1991; Borjas, 1987; LaLonde and Topel, 1991) and link immigrant inflows to black incarceration rates. In their model, a reduction in wages induces natives to exit the labour force and either shift to leisure or into illegal activities. Their empirical results show that a 10% increase in skill-specific labour supply due to immigration lowers the corresponding black wage rate by 4%, lowers the employment rate of black men by 3.5 percentage points and increases the incarceration rate of blacks by about 0.8 percentage points. While the wage elasticity is similar for whites, the effects of immigration on employment and incarceration are significantly larger for blacks than for whites. With these results being potentially highly controversial, the authors emphasise that although the immigrant effect seems to be numerically important, much of the decline in employment and increase in incarceration in the black population between 1960 and 2000 still remains unexplained.

While most of the emphasis in the literature is on the immigrant impact on low-skilled natives, Borjas (2006a) focuses on the high skill sector and investigates the effect of foreign student inflows on the earnings of doctorates in the U.S. using data from the Survey of Earned Doctorates and the Survey of Doctoral Recipients for the years 1993 to 2001. Defining skill groups by 22 doctoral fields in science and engineering and by the year of graduation, he uses variation in the supply shock to these groups at different points in time caused by the influx

of foreign students to identify the wage impact of immigration on high-skilled workers. The estimated wage elasticities imply that a 10% increase in the supply of doctorates due to immigration lowers the wages of competing native doctorates by 3% to 4%, with about half of this wage effect being explained by an increased prevalence of post-doctoral appointments in fields that are subjected to immigration. Overall, the inflow of foreign students between 1993 and 2001 increased the supply of doctorates by 13.9% and reduced the wage of the average doctorate in science and engineering by around 3.6%, although there are some fields that experienced substantially larger wage losses of up to 10% such as computer science and mechanical engineering. The author points out though, that these simulation results are based on the assumption that there are no spill-overs between different doctorate fields, for instance by students moving to other departments in response to the inflow of foreign students, and that all other factors such as the demand of firms for doctorate students and the supply of native students are held constant. Therefore, the results are best interpreted as the short-run impact of high-skill immigration before any additional adjustments to immigration have taken place.

Ottaviano and Peri (2006a) claim that the assumption of perfect substitutability within experience-education cells, as assumed by Borjas (2003) or Borjas et al. (2006), may be inappropriate. They set up a general equilibrium framework in which they allow for imperfect substitutability between natives and immigrants within skill cells as well as short- and long-run responses of physical capital. Defining skill groups by education and experience and using U.S. Census data for the period 1960 to 2000 and the American Community Survey sample (ACS) for 2004, their key finding is that, even within the same education-experience group, immigrants and natives are only imperfect substitutes with an estimated elasticity of substitution between 5 and 10. This result stands in contrast to earlier results by Jaeger (1996). As a consequence of this imperfect substitutability, Ottaviano and Peri's calculations of the impact of immigration on native wages substantially revise earlier estimates. Accordingly, the average wage rate of all U.S.-born workers increased significantly by 1.8% as a result of immigration during the 1990 to 2004 period. The only native group suffering a negative wage effect were the least-educated workers with a long-run real wage

decline of moderate 1.1%. All other native groups gained from immigration with wage increases between 0.7% and 3.4%. The groups most negatively affected were previous cohorts of immigrants, confirming earlier results in the literature of, for instance, Borjas (1987) and LaLonde and Topel (1991). These groups suffered substantial wage decreases of around 20%.

Using the same data and following a similar approach, Peri (2006) analyses the particular case of California. As a consequence of moving from the national level to the state level, potential inter-state migratory responses of native workers to immigration become a concern as in typical spatial correlation studies so the author shows in a first step that there is no evidence of a negative migratory response of natives in California over the period 1960 to 2004. The advantage of focussing on California is that it allows the use of a novel instrumental variable to address the problem of unobserved labour demand shocks that attract workers into particular skill groups and could lead to biased estimates of the elasticities of substitution which are subsequently used to simulate the wage impact of immigration. Specifically, the author uses immigrant flows to other U.S. states by skill group as instruments for immigration to California. The idea is that immigrant flows to other states share the same push component as those in California but are unrelated to California-specific pull factors due to labour demand shocks. The empirical results show first of all again that immigrants and natives are imperfect substitutes within skill groups with an elasticity of substitution between 3 and 10. Furthermore, there is no evidence that immigration had a detrimental effect on native employment rates. With regard to wages, the estimated effects confirm earlier results for the U.S. on the national level (Ottaviano and Peri, 2006a). While the average wage of previous immigrants decreased by around 17% as a result of immigration, the average wage of natives in California increased by 4% between 1990 and 2004 with small wage gains of 0.2% to 0.7% for high school dropouts and large gains of up to 6.7% for workers with at least a high school degree. Due to the complementarity of immigrants and natives, immigration to California has thus benefited rather than harmed native workers' productivity.

In a couple of further related papers, Ottaviano and Peri (2005a,b) emphasise the importance of distinguishing between the average and the relative wage effects

of immigrant inflows and, in that context, link the skill cell correlation approach to earlier simulation-based approaches. By including a comprehensive number of fixed effects, estimates based on the skill cell correlation approach as well as most spatial correlation studies only provide measures of partial wage elasticities that capture how a skill group's wage changes relative to the wages of other groups. They do not identify the total effect of immigration on wages or the effect on average wage levels. For that, both "own" and "cross" skill group wage elasticities have to be taken into account. Based on these estimated structural parameters, one can then simulate the impact of immigration on average wages under suitable assumptions regarding the adjustment of the capital stock. Hence, while the analysis of relative wages addresses questions of redistribution as a result of immigration, it does not answer the question of the overall gain from immigration. As already pointed out in Section 2.1, despite a negative effect of, for instance, low skill immigration on the relative wages of low-skilled workers, it is possible that the overall effect on average wages is positive and even, in principle, that the average wages of low-skilled native workers increase as a result of immigration, as long as natives and immigrants are imperfect substitutes within skill groups.

2.3.5 Studies for Countries Outside the U.S.

In addition to the studies above, which were all conducted for the U.S. labour market, there is a substantial literature for other countries which tries to answer the question about the effect of immigration on native labour market outcomes in the context of their country-specific labour markets and immigration experiences, the most important of which I will now present.

France

One of the first papers for a European country was a study by Hunt (1992) which analyses the impact of the large immigrant inflow from Algeria into the French labour market as a consequence of Algeria's independence from France in 1962. Within the space of a year, 900,000 individuals of European origin, called repatriates, returned from Algeria to France, constituting a significant labour supply shock to the economy. In her study, which uses French Census data for 1962 and

1968, Hunt uses regional variation in the proportion of immigrants and changes thereof for 88 regions to evaluate the effect of the repatriates on wages, unemployment and the labour force participation of non-repatriates, and the migration decisions of other groups. She argues that the immigrant inflow after Algeria's independence can be viewed as a natural experiment since the timing of the inflows does not depend on economic conditions in France. Furthermore, since basically everyone of European origin returned to France, selection of immigrants does not seem to be an issue in this case. Finally, observing that the location choice of the repatriates is driven by cultural and climatic factors, she uses the average temperature and the stock of pre-1962 repatriates in a region as instruments for the change in the immigrant share. The empirical results imply that a 1 percentage point increase in the immigrant share of the labour force reduces the average wage in a region by at most 0.8% and increases the unemployment rate of natives by 0.2 percentage points. Compared to U.S. studies (e.g. Altonji and Card, 1991), these results imply more adjustment through employment than through earnings, which might be due to France's strong wage setting institutions. Also, there is no evidence that potential immigrants from abroad and migrants within France were discouraged from moving to areas with many repatriates. Hunt concludes that the inflow of repatriates to France after 1962 had little impact on the labour market outcomes of native Frenchmen.

Portugal

In a similar case study for Portugal, Carrington and de Lima (1996) evaluate the effects of the inflow of repatriates from Mozambique and Angola to Portugal in the aftermath of Portugal's loss of its African colonies in 1974-1976. During these years around 600,000 immigrants came to Portugal, increasing its labour force by some 10%. In order to identify their effect on wages, unemployment and the employment/population rate, Carrington and de Lima choose two different approaches. First, they use Spain and France as the comparison group, arguing that especially Spain was in a similar situation to Portugal before the immigrant shock occurred. Second, they look at spatial correlations between the repatriate densities and changes in the daily wages in the construction industry within Portugal's 18 regions. In one specification they use the fraction of repatriates in 1981 as an instrument for the change in a district's population. From their time-series

comparison with Spain and France, they conclude that the immigration of repatriates did cause some short-run unemployment but this effect is overshadowed by European-wide increases in unemployment. In the spatial correlation analysis, high immigration districts showed much slower wage growth in the decade after the immigration than before. However, the timing and persistence of the wage effects raise the question of whether the immigrants were the causal reason for this downturn.

Germany

In a panel analysis for Germany for the period 1984-1989, DeNew and Zimmermann (1994) examine to what extent immigrant concentrations in an industry affect native wages. Using individual level data from the German Socio-Economic Panel (GSOEP), they distinguish two labour inputs, blue and white collar workers, within which immigrants and natives are substitutes and use the variation in the immigrant share across industries to identify the wage effect of immigration. In order to control for the endogenous choice of the industry sector, the authors use industry dummies, industry growth rates and overall and industry-specific time trends as instruments. Their estimates imply that a 1 percentage point increase in the share of immigrants reduces the hourly wage of blue collar workers by 5.9% and increases the wage of low-experience white collar workers by 3.5%. In a similar study, using the same framework and data, Haisken-DeNew and Zimmermann (1995) identify the effect of immigrants on native wages using regional variation in the foreign share in an industry. Contrary to the results of their previous work, their estimates point towards complementarity between immigrants and natives with no significant wage effects for native white collar workers and positive effects on experienced native blue collar workers.

In another study for Germany, Pischke and Velling (1997) look at spatial correlations between the immigrant share and native employment in 167 German regions between 1985 and 1989 using aggregate data from the German Federal Statistical Office and the Federal Institute for Regional Planning (*Bundesforschungsanstalt für Landeskunde und Raumordnung*) in Germany. They observe that the unemployment rate in Germany does not follow a random walk but is strongly mean reverting over the period 1985 to 1989. Therefore the use

of lagged levels of immigrant shares as an instrument as proposed by Altonji and Card (1991) is unsuitable for the German context. Instead they use previous labour market outcomes as instruments for potential immigrant selection into local labour markets. To check whether native migratory responses to immigration might have diffused the effect on wages, they also regress internal migration rates of Germans on contemporaneous migration flows of foreigners from abroad and other regions in Germany. The empirical results show no effect of increased immigration on the unemployment rate but some evidence that a larger inflow of foreigners lowers the employment rate for natives: a change in the foreign share of 1 percentage point reduces the employment/population rate of Germans by 0.44 percentage points. Furthermore, there is no evidence that foreign immigration affects native migration patterns. Pischke and Velling conclude that there are no significant displacement effects due to immigration in the German labour market.

Instead of using regional or industry variation in the immigrant share for the empirical analysis, Bauer (1998) follows Grossman (1982) in estimating a translog production function to obtain elasticities of complementarity between natives and immigrants of different skill levels in Germany, using data from the German Labour Force Survey for 1990. Under the assumption of separability between capital and labour inputs, the empirical results show that white collar immigrants are substitutes for low-skill blue collar and white collar natives with cross factor price elasticities of -0.021 and -0.008 respectively. Furthermore, low-skill blue collar immigrants detrimentally affect high-skill blue collar natives with a cross factor price elasticity of -0.008. All other groups of immigrants and natives are complements. Bauer concludes that overall the wage effects of immigrants on different native skill groups are small.

Bonin (2005) reaches the same conclusion applying the skill cell correlation approach to the German case. Defining skill groups according to educational attainment and work experience and based on the IAB Employment Subsample for the years 1975 to 1997, he does not find evidence for a significant effect of immigration on wages and unemployment rates of native men. His empirical results imply that a 10% increase in the share of immigrants in a skill group reduces native wages by less than 1%, about a fourth of what is typically found

for the U.S., and does not have an effect on native unemployment rates. There is some evidence that the adverse effect is stronger for the less-educated and older workers, but overall the relatively small magnitude of the estimated effects stands in contrast to the results Borjas's (2003) finds in his parallel study for the U.S..

Spain

In a recent paper for Spain, Carrasco et al. (2007) also use the skill cell correlation methodology and estimate the impact of both legal and illegal immigration flows on the employment rates and wages of native workers between 1991 and 2002. To obtain the required data they use three different sources: the Census of Population for 1991 and 2001 which includes both legal and illegal immigrants, the Register of Work Permits for 1993 to 1999 and the Wage Structure Survey for 2002. Their results show overall no evidence of a significant negative effect of immigration on either employment rates or wages of native workers.

Austria

In a couple of studies, Winter-Ebmer and Zweimüller (1996, 1999) examine the Austrian case. Using data from the Austrian Social Security Records, they estimate the impact of immigration on the earnings of young male native blue collar workers by regressing their log monthly earnings on the immigrant share in either 93 labour market regions or in 78 industries for the period 1988 to 1991 (Winter-Ebmer and Zweimüller, 1996). The endogenous immigrant share in a region (or industry) is instrumented with the lagged foreign share and the average wage among immigrants, as well as the employment growth, the share of women and the share of blue collar workers. In contrast to other studies (e.g. DeNew and Zimmermann, 1994), nearly all regressions show a positive and significant effect of the immigrant share on native earnings: at the regional level, a 1 percentage point increase in the share of foreign workers increases native male blue collar earnings by 2.1% to 3.7%, on the industry level by 0.2% to 1.0%. These results are not reconcilable with the expectation of substitutability between natives and immigrants. For that reason the authors proceed by presenting a two-tier bargaining model which can explain a positive wage impact of increased immigration even if natives and immigrants are substitutes. Using

firm level data they then estimate a simultaneous-equation system of the joint determination of the natives' wage rate and the share of foreigners in the firm's workforce. The results confirm the earlier finding that natives seem to be able to exploit the presence of foreigners in a two-tier wage system - employing more foreigners at a lower wage increases the firm's profit, from which natives can benefit through bargaining.

In a second paper for the same period, Winter-Ebmer and Zweimüller (1999) turn their attention to the displacement risk of young natives arguing that it measures the "first-round effect" of increased immigration. They estimate a probit model that relates the experience of unemployment to the immigrant share in 76 regions or 46 industries, focussing on young native workers below the age of 35. As in their earlier study, they use variables describing the structure of employment as instruments for the endogenous immigrant share in a region (sector). The estimation results indicate no effect of the immigrant share on the unemployment risk on the regional level. For certain subgroups on the sectoral level such as seasonal workers and foreign employees, however, the effects of immigrant density on the unemployment probability are quantitatively large.

Italy

An interesting feature is offered by a study by Venturini (1999) who examines the Italian case. In her empirical analysis she focuses on the effect of illegally working immigrants on native Italians' legal employment, using Central Statistical Office figures for the period 1980 to 1995. Based on a production function with three labour inputs - regular natives and foreigners, non-regular natives, and non-regular foreigners - she estimates elasticities of labour demand which provide evidence of the relationship between these types of labour. The results imply that non-regular labour, both of natives and immigrants, has a small adverse effect on legal employment. The estimated long-run elasticities vary between -0.02 and -0.01 so that an inflow of illegal workers of 10% reduces labour demand for legal employment by 0.2%. These results vary significantly according to the economic sector in question with strong negative effects particularly in the agricultural sector and complementarity in the non-tradable services sector. Overall, however, the conclusion is that non-regular foreign workers do not seem to have displaced

native workers in any significant way.

The Netherlands, UK, Norway

Hartog and Zorlu (2005) estimate wage elasticities in The Netherlands, the UK and Norway, relating ethnicity-specific immigrant shares in geographical areas to wages of natives and other immigrants in each country, using micro-level data. They incorporate three different types of labour inputs, and distinguish between wage effects for the low-, medium- and high-skilled workers. However, they do not control for region-specific fixed effects due to data limitations. They find relatively small wage effects with no dominant robust pattern of complementarity or substitutability between immigrants and natives of different skill levels. Immigrants seem to be substitutes for low-skilled natives in The Netherlands (with an elasticity of -0.036) but complements in Norway (with an elasticity of 0.070). For the UK, the estimated parameters are not significant. The effects on wages of earlier immigrants are generally larger but less precise. As the authors acknowledge, one potential problem in their estimations is the lack of information on the actual skill composition of the immigrant population in each country.

UK

In a recent study which focuses on the UK, Dustmann et al. (2005) examine how the immigrant share and changes thereof in 17 regions affect native wages (for 1992-2000), employment, participation, and unemployment (for 1983-2000), using panel data taken from the Labour Force Surveys (LFS) between 1983 and 2000. They first point out that in the UK, and in contrast to many other European countries, the educational structure of resident immigrants as well as recent immigrants resembles very much that of natives, suggesting that immigration may lead to more modest changes in the overall skill distribution. In their empirical work they instrument changes in the immigrant share in a region with the lagged immigrant share, making use of the idea that immigrants move where earlier immigrants have already settled. Their empirical results show no evidence of significant overall adverse effects of immigration on native outcomes, but suggest that effects are different across educational groups. The employment of natives with intermediate educational levels is most detrimentally affected but

this negative effect is more than offset in the aggregate by positive effects on the employment of better qualified natives.

On 1 May 2004, eight countries from Central and Eastern Europe plus Cyprus and Malta joined the European Union. As opposed to most other old EU member states, the UK (as well as Ireland and Sweden) granted all workers from the new accession countries free access to the UK labour market. Between May 2004 and September 2005, around 300,000 individuals, mostly from Poland (58%), Lithuania (14%) and Slovakia (11%), registered on the Worker Registration Scheme (WRS) to work in the UK, equivalent to roughly 1% of total employment.[6] During the same period, claimant unemployment in the UK rose by over 90,000. Using variation in the proportion of migrants from the new accession countries across local authority districts, Gilpin et al. (2006) investigate in detail to what extent the immigrant inflows are part of the explanation for this rise in unemployment. Combining data on claimant unemployment with data from the WRS and the LFS, the authors estimate a comprehensive set of regression models for various groups of workers. In all specifications, the presence of new accession migrants has a small and insignificant effect on the claimant count rate of UK natives. The inflow of immigrants from the new EU member states does therefore not seem to have caused the rise in claimant unemployment in the UK since May 2004.

Following the skill cell correlation approach and allowing for imperfect substitutability between immigrants and natives within the same skill group, Manacorda et al. (2006) investigate for the UK to what extent the immigrant inflows over the period 1975 to 2005 have affected both native and immigrant average real wages. Using data from the LFS as well as the General Household Survey (GHS) and starting from a multi-level CES production function, they first estimate elasticities of substitution between immigrants and natives and between workers in different age and education groups. They then proceed by simulating

[6]Since there is no requirement to de-register from the WRS, this number reflects gross inflows only and does not take into account migrants who work in the UK for only a short period. According to data from the Labour Force Survey, the stock of migrants from the new accession countries aged 16 and over increased by only around 120,000 between spring 2004 and summer 2005.

the effect of immigration to the UK between 1975 and 2005 on the return to education among natives and the overall native-migrant wage differential. Similar to Ottaviano and Peri (2006a), they find evidence that natives and immigrants are imperfect substitutes within the same age-education cell with an estimated elasticity of substitution of around 6. Their empirical findings then show that immigration has raised the return to education for natives by a very modest 0.4% but has increased the native-migrant wage differential by 5.5%. They conclude that the immigrant impact on the wage distribution of the native population is small and that immigration in the UK primarily impacts the wages of immigrants who are already in the country.

Dustmann et al. (2007) use 1997-2005 LFS data and data from the Annual Survey of Hours and Earnings (ASHE) to study the impact of immigration on natives' wages and the wage distribution in the UK. They first present a theoretical model where they show that if capital is supplied at a price fixed on international markets, immigration will have a positive effect on the average wage of natives, as long as immigrants differ from natives in their skill composition. This is a direct consequence of the immigration surplus being allocated to native workers. However, along the distribution of wages, some workers will lose, while others will gain. They propose an estimation method along the distribution of wages that does not necessitate a pre-allocation of immigrants to particular skill groups. In accordance with the implications of their theory, they find evidence of an overall positive wage effect of immigration over the period of study. Their estimates suggest a magnitude that would associate an increase in the immigrant population by 1% of the native population with an increase in native wages of between 0.3% and 0.4%. Through simulation they show that these positive native wage effects are too large to be solely attributable to conventional immigration surplus effects and suggest the ability of immigrants to smooth out inefficiencies in the allocation of native labour across markets as a possible explanation. The authors' investigation of the effects of immigration along the distribution of wages of non-immigrant workers suggests that there are clear and significant differences. Non-immigrants in the middle of the wage distribution gain from immigration, while individuals at the bottom of the distribution lose in terms of wages. This is compatible with evidence on the relative location of recent immigrants in the non-immigrant

wage distribution. Over the period 1997 to 2005, immigrants tended to be more concentrated than natives below the first quartile of the native wage distribution - exactly where the authors find evidence that wages were held back - and less concentrated from there on upwards, where they find positive wage effects.

Israel

Israel experienced an enormous immigrant inflow in the 1990s, predominantly from the former Soviet Union, increasing its population by 18%. Friedberg (2001) analyses the effects this inflow had on the national Israeli labour market in the years 1990 to 1994, using variation in immigrant inflows across occupations. To control for the selection of immigrants into specific occupations, she uses the immigrants' former occupations abroad as instruments. Friedberg estimates both on an individual and on an aggregate occupation level, using data from three different sources: the Israeli Immigrant Employment Survey, the Israeli Income Surveys, and the Labor Force Surveys 1989 and 1994. As in the case of the French repatriates (Hunt, 1992) and the Mariel immigrants (Card, 1990), the immigration to Israel in the early 1990s can be seen as exogenous due to the lifting of emigration restrictions in the Soviet Union. In contrast to the Mariel immigrants, however, the immigrant labour force in Israel was highly skilled and had substantial labour market experience. In a first result based on OLS estimations, Friedberg finds that natives in occupations which received more immigrants experienced lower wage growth. However, controlling for the endogeneity of the occupational choice, the hypothesis that the Russian immigration did not affect the earnings or employment of native Israelis cannot be rejected. At the individual level the effect of immigration on wage growth of natives is significantly positive which could indicate complementarity between immigrants and native workers. The effects on employment are not significantly different from zero. The IV results imply that the negative effects which are initially found in the OLS specification are due to the fact that immigrants enter occupations with low wages, low wage growth and contracting employment as opposed to a genuine causal effect of immigration on native labour market outcomes.

In another paper on the immigrant inflows to Israel of the early 1990s, Cohen-Goldner and Hsieh (2001) choose a different approach. They look at national level

time series of unemployment rates, wages and labour force participation rates and focus in particular on the mechanisms by which the Israeli economy adjusted to the very significant supply shock. They set up a standard neoclassical model with an aggregate production function, competitive markets, adjustment costs of labour and capital, and standard preferences over consumption and labour supply, to examine whether the immigration shock induced capital accumulation in Israel. They find that this model explains very well both the short- and the medium-run response of the Israeli economy to the Russian supply shock. Initially the average effective wages of native Israelis fell by 20% between 1990 and 1991, while the return to capital increased sharply. By 1997, however, both average wages and the return to capital had returned to pre-immigration levels because of an externally funded investment boom. Furthermore, Rybczynski-type changes in the product-mix do not seem to explain the absorption of the Russian immigrants; the primary reason for this phenomenon is the increase in the relative utilisation of skilled natives and immigrants within industries (see also Lewis, 2004b). An important factor in this context which prevented a reduction of the skill-premia for native Israelis despite the high educational levels of the Russian Jews was their substantial occupational downgrading on the Israeli labour market. Cohen and Hsieh conclude that the Russian immigration has been a classical labour endowment shock with a large short-run effect on wages of all native Israelis, which did, however, not exert a downward pressure on the skill-premia of native Israelis despite the high educational levels of the Russian immigrants.

Puerto Rico

In a recent working paper, Borjas (2006b) investigates the case of Puerto Rico using Puerto Rican and U.S. Census data for 1970 to 2000. Puerto Rico is both the source and the recipient of substantial labour flows, predominantly to and from the U.S., which differ significantly in their skill composition. As Borjas shows, inflows and outflows have opposing effects on the wage structure in Puerto Rico with the inflows lowering the wages of competing workers in the Puerto Rican labour market, and the outflows increasing them. A 10% shift in labour supply due to immigration leads to an opposite-signed change of 2% to 4% in the wage rate of competing Puerto Rican workers, which is in line with the magnitude of earlier estimates for the the U.S. (Borjas, 2003), Canada (Aydemir and Borjas,

2007) and Mexico (Mishra, 2007). Based on these results, the overall migrant flows to and from Puerto Rico between 1980 and 2000 reduced the relative wages of low-skilled workers by between 15% and 20% but had only a negligible impact on the average Puerto Rican wage.

Mexico

Finally, Mishra (2007) also uses the skill cell correlation approach and offers an interesting new perspective by analysing the effect of Mexican emigration to the U.S. on wages in Mexico, using data from both the Mexican and the U.S. Censuses 1970 to 2000. So rather than focussing on the receiving country, this study turns the attention to the labour market impact of immigration in the sending country. Distinguishing skill groups by schooling and experience, the empirical results show a strong positive relationship between emigration and Mexican wages. Accordingly, a 10% decrease in labour supply due to emigration increases the skill group specific wage rate by 4%. Overall, Mexican emigrant outflows between 1970 and 2000 increased the wage of the average Mexican worker by 8%, of high school dropouts by 5%, of high school graduates by 15%, of those with some college education by 13%, and of college graduates by around 2%, and hence provide a complementary explanation for the increasing wage inequality in Mexico over that period.

2.3.6 Alternative Adjustment Mechanisms

The overwhelmingly small estimated effects of immigration on native labour market outcomes in spatial correlation studies have led to the question of how local labour markets are able to absorb the, in some cases, very significant immigrant inflows. Two explanations in particular have been put forward: first it could be that natives respond to immigrant inflows by moving out of a labour market, thus compensating for the relative supply changes induced by immigrants. Second, in a multi-sector economy, the industry structure and the output-mix could adjust to changes in the skill composition of its labour force. In the case of unskilled immigration, this would mean an expansion of production in those sectors which use unskilled labour more intensively. There are a number of studies which directly aim at evaluating the validity of these explanations.

Native Migratory Responses

In an important study for the period 1975 to 1980, Filer (1992) examines whether the arrival of immigrants in a local labour market in the U.S. induces native migration responses. Using U.S. Census data from 1980, the author presents both simple correlations between native and immigrant locational decisions, and regression results where native mobility patterns are related to immigrant arrival rates. Besides estimating by OLS, three-stage least squares estimations are performed to account for the endogeneity of the locational choice of immigrants. The results from this analysis show that the arrival of immigrants both reduced native in-migration and, at the same time, increased native out-migration so that overall the natives' migratory response more than offset the arrival of immigrants. In particular, the mobility responses seem to be concentrated among low-skilled natives and stronger among whites than other minorities. Filer concludes that a high concentration of recent immigrants has a negative impact on the attractiveness of an area for native workers, which may partly be attributed to psychological reasons.[7] A similar conclusion is reached in studies by Frey (1995), who evaluates immigration-induced out-migration of natives from California, and Walker et al. (1992).

However, the conclusion that immigrant inflows lead to net native outflows is controversial. In an empirical study by Wright et al. (1997), no evidence for a native response to the presence of immigrants in a local labour market could be found. Using U.S. Census data for 1980 and 1990 and distinguishing between five categories of education in the native-born labour force, the authors use a model in which the effect of immigration and the effect of metropolitan area size are separated. Their results show that the net migration loss of unskilled native workers from metropolitan areas is likely to be a function of those cities' population size rather than immigrant inflows. They then proceed by checking the consistency of these results by using different samples of metropolitan areas and excluding high immigration cities from the estimation (especially New York and Los Angeles). From these robustness checks it becomes clear that model

[7]There is an extensive sociological literature on this phenomenon under the catch phrase "white flight". See, for instance, Harris (1999), Crowder (2000) and Krysan (2002).

specification plays a critical role in assessing the relationship between immigration and internal migration.

More recently, Card and DiNardo (2000) analyse to what extent immigrant inflows have changed the skill distribution across cities between 1980 and 1990. Their approach is to examine the correlation of the relative movements of native workers in different skill groups with the relative inflow rates of immigrants. They test the alternative scenarios of "demographic balkanization", in which natives move out of the labour markets in response to immigration, against the case of no such migratory response. To control for the endogeneity of immigrants' location choice, the authors use the past fraction of Mexican immigrants in a city as an instrument. Their empirical results, which are based on U.S. Census data for 1970 to 1990 and 119 larger MSAs, show that there is not much native out-migration in response to immigration. On the contrary, increases in the immigrant population in a skill group seem to lead to slight increases of the native-born population. Therefore, immigration did have quite a significant effect on the skill distribution of some MSAs. Card and DiNardo thus conclude that the measured effects of immigration on the labour market outcomes of the native population in spatial correlation studies are mitigated by other adjustment mechanisms, such as endogenous shifts in the local industry structure, rather than by a compensating native migration response.

Instead of looking for evidence of native out-migration or the absence thereof separately, Borjas (2006c) models the influence of immigrant supply shocks on the joint determination of wages and internal migration decisions in local labour markets using data from the 1960 to 2000 U.S. Censuses. In this model, immigration leads to an immediate wage effect upon which native workers base their future internal migration decisions. The theoretical model predicts that the factor price elasticity that measures the wage impact of immigration on the national level can be obtained from the elasticity estimated from cross-regional wage regressions by scaling the latter by a factor that incorporates the relationship between in-migration of immigrants and net out-migration of natives. The empirical analysis reveals that immigration is associated with lower wages, lower in-migration rates and higher out-migration rates and thus with a decline in the

growth rate of the native workforce. Accordingly, for every 10 immigrants who enter a particular state 2 fewer natives choose to live in that area and for every 10 immigrants that enter a particular metropolitan area between 3 and 6 natives will choose not to live there. Depending on the geographic definition of a local labour market, the results furthermore imply that native migratory responses attenuate the measured wage impact of immigration in spatial correlation studies and can account for 40% to 60% of the difference in the measured impact between analyses carried out on the national level and those carried out on the local level.

In a recent study for the UK spanning two decades from 1981 to 2000, Hatton and Tani (2005) use National Health Service registration flow data and data from the International Passenger Survey to investigate the relationship between net immigration and the net internal migration between the 11 regions of the UK. Controlling for inter-regional differences in vacancy inflow rates, unemployment rates, average earnings and house prices, the empirical results show a significant negative correlation between the pairwise difference in foreign immigrant inflow rates between two regions and their net internal migration rates, with particularly strong effects in the six southern regions of the UK where immigration of foreign citizens is most concentrated. Estimates for the effect of total net immigration on total net internal migration show that for every 100 immigrants arriving in a region from abroad, 35 individuals migrate to other regions, although these estimates are not significant at conventional levels. Again, the displacement effects are larger for the southern regions with an outflow of 44 individuals for every 100 immigrants arriving from abroad. Hatton and Tani thus conclude that inter-regional migration may be an important channel through which the UK labour market adjusts to foreign immigration.

Industry and Technology Adjustments

Lewis (2004b) thoroughly investigates the potential adjustment to immigrant-induced changes in the labour supply of a local labour market through adjustments in the industry structure. In his analysis he evaluates two possible explanations for the surprisingly small effects of immigration on relative labour market outcomes found in the literature: 1. interregional trade that mitigates the impact of supply shocks through immigration, and 2. production technology

that rapidly adapts to the new mix of labour inputs. He estimates the effect of increases in relative supplies of skill groups on the relative growth of different industries (between industry changes) and their relative utilisation of those labour inputs (within industry changes). Similar to the analysis of Card (2001), he uses the supply-push component of immigration, which is the predicted immigrant inflow to a local labour market based on the historical settlement pattern of older immigrants of the same nationality, to instrument for the endogeneity of the locational choice of immigrants. To assess whether the adoption of skill-complementary technologies in response to changes in the local worker mix can explain the lack of impact on wages and employment, Lewis then examines in a case study whether changes in the share of high-skilled workers have induced industries to take-up computers more quickly. The data sources for his work are the U.S. Census for 1970 to 1990 and, for the establishment-level data on output and employment, the ASM. In a first step he repeats the common spatial correlation estimations for 179 metropolitan areas, finding that a 10% increase in the labour supply of a particular skill group (defined by education) reduces the mean wage by 0.9% and the employment/labour force rate by 0.4%. He then focuses his analysis on the industry adjustments. The empirical results show that changes in the relative supply of skill groups have only little effect on the local industry mix but lead to increases in the relative factor intensity of the now more abundant skill group. The absorption of immigrant-induced local labour supply changes takes place primarily within industries (74%) rather than between industries (4%), with relative wages remaining more or less unchanged within a locale. Lewis concludes that the standard Heckscher-Ohlin model is not a good description of how local labour markets adjust to changes in the labour supply mix. Instead of an expansion of those industries that use low-skilled labour more intensively, industries seem to adjust their production technology to complement the factor supply mix they are facing (see also Card, 2005). This finding is supported by the fact that on the job computer use expands most rapidly in those areas where the relative supply of skilled labour grows fastest, a finding corroborated in Doms and Lewis (2006).

Lewis (2004a) assesses the importance of industry adjustments for the absorption of immigrant inflows in the well-known case of the Mariel boatlift

(see Card, 1990) using confidential data from the ASM. Again distinguishing within and between industry effects, he shows that after the boatlift the relative output of manufacturing industries in Miami trended similarly to the output in comparable cities, thus ruling out industry mix adjustments as an explanation of how Miami was able to absorb the Mariels without major effects on the labour market outcomes of natives. On the other hand, Lewis finds that the utilisation of Cuban labour in Miami's industries grew proportionately to the increase in its supply while at the same time computer use at work in Miami was lower than in cities that had similar levels of computer use before the boatlift. These results imply that Miami's industries reacted to the shock in relative local labour supply by employing more unskilled-intensive production technologies, which explains the apparent insensitivity of native wages in Miami to the substantial inflow of Cuban immigrants.

Having identified changes in production technology as the main channel of adjustment to shifts in local labour supply, Lewis (2005) uses plant-level data from the 1988 and 1993 Surveys of Manufacturing Technology and U.S. Census data to investigate more directly to what extent the skill mix of the local workforce in a manufacturing plant's MSA affects its use of a number of automation techniques. The empirical findings show that in areas with a larger relative supply of unskilled workers, comparable plants operating in the same narrow industry use substantially less automation. A 10 percentage point increase in the supply of low-skilled workers accordingly reduces the number of technologies in use at a typical worker's plant by about 8%. The observed relationship between skill supplies and automation use points towards an endogenous adoption of production technologies by firms as suggested by Beaudry and Green (2003, 2005). Such technology adoption could then again explain why in many impact analyses relative wages do not respond negatively to labour supply shocks caused by immigration.

Beaudry et al. (2006) take up this last point in more detail and specifically examine cross-city differences in PC-adoption, relative wages and changes in relative wages over the period 1980 to 2000 using U.S. Census data and establishment-level data which include information on the use of technologies. Within the framework

of a neoclassical model of endogenous technological adoption, which links the supply of skills, the returns to skills, technology adoption, and changes in the returns to skills, the authors derive a set of predictions which they then test empirically on a sample of 230 U.S. cities. Consistent with the theoretical predictions, in regions with a relatively large and thus cheap skilled workforce, the adoption of PCs took place more aggressively than in regions with a relatively small and expensive skilled workforce. As a result, the returns to skills increased the most in those regions in which PCs were most intensively implemented, however, not so much as to create a positive association between the relative supply of skills (or the PC intensity) and the return to skill. Overall, their results support the existence of endogenous technology adoption of firms in response to local factor supply conditions.

2.3.7 Alternative Perspectives

Besides the more standard spatial correlation, simulation, and skill cell correlation approaches, a number of studies have chosen alternative ways and perspectives to look at the impact of immigrants on the labour market.

The Dynamic Effect of Immigration

In a couple of recent papers looking at Israel, the dynamic aspect of the impact of immigration on the host economy's labour market has moved into the centre of attention. In the first instance, Hercowitz and Yashiv (2002) look at Israel's mass immigration experience from the former USSR between 1990 and 1999 from a macroeconomic open economy perspective. They try to identify the dynamic effects this inflow might have had on native employment. Key to their approach is the modelling of dynamic effects of immigration on not only labour supply but also labour demand via the immigrants' participation in the local goods market. Most importantly, they allow for differential entry of immigrants into the goods and the labour market at different points in time. They estimate their dynamic model of two equations, one for the native employment rate and one for the relative price of domestic goods, using data from Israeli Labour Force Surveys. The empirical results show that in early stages of immigration, immigrants tend to participate more in the goods market relative to the labour market, i.e. they

start consuming domestic goods immediately after arrival but only enter the labour market with a delay. Such differential participation initially increases the relative prices of domestic goods which in turn leads to increases in labour demand and native employment. Negative employment effects only appear with a delay of about a year after arrival, when the immigrants' relative participation in the goods market declines and the direct substitution effect of immigrants for natives dominates the labour demand effect.

In a different study, Cohen-Goldner and Paserman (2004) evaluate the dynamic impact of immigration using the skill cell correlation approach. In particular they try to distinguish between short- and long-run effects of immigrant inflows. Looking at the period of mass immigration to Israel between 1989 and 1999 using Income and Labor Force Survey data, they first set up a dynamic model in which immigrants with different local experience in the labour market can have different effects on native wages and employment. In this way they avoid imposing the assumption of homogeneous immigration effects over time that is common in most other studies. Their empirical results from this model enable the authors to assess opposing hypotheses about the substitutability of natives and immigrants at the time of arrival and over time. Controlling for immigrant cohort effects and the selection of immigrants into low wage or low wage growth segments, they find that immigration had a short-run adverse effect on native wages: a 10% increase in the share of immigrants reduced native wages by 1.2% to 5.7%. However, this effect died out after 5 to 7 years. In contrast, they find no evidence of any immediate or delayed detrimental effect on native employment. On the basis of these results they conclude that within occupation-based segments immigrants are close substitutes to natives in the short run and depress their wages until the labour market adjusts to the changes in labour supply through changes in other factors of production, such as capital or technology, which diffuse the adverse effect in the long run.

Effect on Self-Employment

Fairlie and Meyer (2003) turn the attention towards the effect of immigration on native self-employment. They first set up a general equilibrium model of self-employment and wage/salary work that predicts small negative effects of

immigration on native self-employment rates and earnings for a range of plausible parameter values. Using U.S. Census data for 1980 and 1990, they then examine the relationship between changes in immigration and native self-employment rates and earnings exploiting variation in the immigrant share across the 132 largest metropolitan areas in the U.S.. Their empirical results from a first-difference specification indicate a large negative effect of immigration on the probability of self-employment among native non-blacks. The estimates imply that for each self-employed immigrant, 0.37 to 0.85 self-employed native men and 0.09 to 0.19 self-employed native women are displaced. The large magnitude of these effects stands somewhat in contrast to the predictions of their theoretical model as well as the results of previous work on black self-employment. However, overall native self-employment in the U.S. was on the rise between 1980 and 1990, leading the authors to the conclusion that at the national level immigrants may have primarily taken away opportunities for natives to start new businesses rather than actually pushing self-employed natives out of business. Also contrary to the theoretical predictions, the results for the effects of immigration on native self-employment earnings indicate a positive effect which, as the authors point out, could be explained by immigrants primarily displacing marginal or low-income self-employed natives.

Effect on Output and Housing Prices

There is a general perception that immigration helps keeping inflation low in an economy by restraining wage growth which would otherwise have been passed on by employers to consumers through higher prices. Direct empirical evidence on the impact of immigration on prices, however, is scarce. In a recent paper, Cortes (2006) uses U.S. Census data for 1980 to 2000 and exploits regional variation in immigrant concentrations in the U.S. to analyse the impact of immigration on the prices of goods and services. Her results show that a 10% increase in the share of low-skilled immigrants in the labour force reduces the prices of immigrant-intensive services such as housekeeping and gardening by 1.3% and those of other non-traded goods by 0.2%. The main channel through which these price changes come about is through a negative effect of low-skilled immigration on the wages of low-skilled workers, in particular of low-skilled immigrant workers. Cortes estimates that a 10% increase in the share of low-skilled immigrants reduces

wages of other low-skilled immigrants by 8.0% and those of low-skilled natives by 0.6%. These wage reductions are then passed on to the consumer in the form of lower prices of non-traded goods and services. The apparent differential impact of immigration on other immigrants compared to natives supports the recently promoted view that even within the same skill group, immigrants and natives are imperfect substitutes (compare Ottaviano and Peri, 2006a, and Manacorda et al., 2006).

An additional and very important mechanism through which immigration can affect inflation is through its effect on house prices. Exploiting the immigration shock to Miami in the aftermath of the Mariel boatlift in 1980, (see Card, 1990) which increased Miami's renter population by 9%, Saiz (2003) analyses the short-run response of the housing market to a large immigration shock. He examines the change in rental prices in Miami and compares these to three comparison metropolitan areas. His empirical findings show that the rents in Miami increased by 8% to 11% more than those in the comparison groups between 1979 and 1981 and large parts of this rent differential persisted in subsequent years. While rental units of higher quality were not affected by the immigration shock, those occupied by low-income Hispanic residents before the immigration occurred experienced an extra 8% hike relative to other low-income units. This implies a distributional effect of immigration arising indirectly from its impact on housing prices with a larger negative impact on real consumption wages of unskilled workers since these are more likely to live in low-income rental housing units. The positive effect of immigration on rental prices could also be one of the reasons why some studies (for instance Filer, 1992) find that native workers seem to avoid and migrate out of areas with high levels of immigration. Saiz also finds evidence for a decrease in housing prices in response to the immigrant inflows which could be explained by immigration being perceived as a negative amenity by higher income residents which decide to move out of the Miami metropolitan area. The resulting decrease in demand for higher-quality rental units will lead to vacant units of higher quality which in turn puts downward pressure on the prices of all housing units.

In a related study, Saiz (2006) moves away from Miami and investigates the

short- and long-run impact of immigration on housing rents as well as housing prices at the metropolitan area level throughout the whole of the U.S.. The advantage of this study is that the results are general in the U.S. context and not limited to specific time periods of immigration. As in his earlier study, he finds a positive effect of immigration on housing rents. Accordingly, a 1% immigrant inflow is associated with an increase in rents by 1%. In this study, the author also finds a positive effect on housing prices of about 1%. The fact that rents and prices increase due to immigration is consistent with the idea that immigrants do not displace natives one-for-one, since in that case housing demand would remain unchanged and so should prices.[8] The authors show theoretically that the impact of immigration is lower in the long run than in the short run due to new supply of housing and the potential out-migration of natives. Generally, the impact is higher in cities with inelastic housing supply and lower in cities with a high price elasticity of housing demand or a mobile native population.

The findings of Saiz are supported by a study carried out by Ottaviano and Peri (2006b) who also find a strong positive association between immigration and house prices of native individuals across the U.S.. Because immigrants have lower house ownership rates than natives across all skill levels, the house price increases caused by immigration act, on average, as an income transfer from immigrants to natives both in the short and in the long run. In all reasonable simulations the authors find that the overall wage plus housing income effect of immigration is positive for natives of all skill levels. In particular, even for the average native low-skilled worker, the small negative wage effect from immigration is more than offset by the positive effect on housing prices which they can reap due to their higher house ownership rates. Those most negatively affected from immigration are thus low-skilled natives that are renting and do not own any equities in housing, since for them wages fall while rental rates increase.

Both the empirical results on the impact of immigration on the prices of goods and services and on the impact on housing prices have an important implication

[8]However, even if immigrants displaced natives one-for-one, the type of housing demanded could still change and consequently relative housing prices, for instance if immigrants have a higher tolerance for housing in high density areas or a stronger preference for lower quality housing than natives.

for spatial correlation studies that analyse the wage impact of immigration. So far, all of these studies have adjusted nominal wages in local labour markets relative to a particular base year by using the national consumer price index. However, as long as local price changes are not fully translated into local wage changes, for instance due to a national minimum wage floor or long-term wage agreements, such wage rates inaccurately reflect the changes in purchasing power of the local workforce due to immigration. To fully capture the impact of immigration on real wages, it would therefore be preferable to adjust local nominal wages by using local price indices.

Fiscal Effect

Clearly, immigration affects an economy in many more dimensions than wages, employment and prices. On the one hand, immigrants make demands on public services such as health provisions and schooling and claim benefits, on the other hand they pay taxes and make contributions to an economy's welfare system. Estimating this overall impact of immigration in terms of its net fiscal effect has been the focus of a number of studies. While early attempts have computed the instantaneous net government surplus for a particular year using a cross section of immigrants residing in the host country (e.g. Huddle, 1993, and Borjas, 1994), more recent studies have adopted a dynamic approach by considering the fiscal impact of immigrants over time. Adding a dynamic perspective is important due to the age-dependency of tax and expenditure programs, and the necessity to include future descendants of immigrants in the calculations. Using the methodology of generational accounting (see Auerbach et al., 1994) in which the discounted net tax contribution (taxes net of transfer payments received) of a representative individual in his/her lifetime is calculated, a number of studies have assessed the dynamic effects of immigration on the fiscal balance in a variety of countries.

Based on a calibrated general equilibrium overlapping generations model, Storesletten's (2000) findings for the U.S. show that the discounted net government gain from immigration varies substantially across age and skill levels of new immigrants. For all groups, the net present value of new immigrants' contribution is hump-shaped over their life cycle and peaking between the ages

35 and 44. Using the composition of current new immigrants in the U.S., the net gain of a representative legal immigrant is calculated at $7,400. Distinguishing by skill level, the corresponding gains of a representative high-, medium-, and low-skilled immigrant are calculated to be $96,000, -$2000, and -$36,000 respectively. The discounted government cost of new illegal immigrants can be as large $54,000 per immigrant, compared to $36,000 for legal low-skilled immigrants. If immigrants bring children with them when immigrating, these net contributions are reduced due to the associated government transfers to these children. The author thus concludes that if the aim was to maximise the public coffer contribution per immigrant, the government should target high-skilled immigrants, preferably without children and aged between 40 and 44 years.

Consistent with these findings, Auerbach and Oreopoulos (1999) find very small fiscal effects of current immigration relative to the size of the overall fiscal imbalance in the U.S., so that, in their view, immigration should be viewed as neither a source nor a solution to the existing imbalance in the U.S.. Following an approach similar to Storesletten (2000), Lee and Miller (2000) find a larger net present value of immigrants' contributions to the fiscal system of around $99,000. Their results suggest that a policy of admitting only highly-skilled immigrants could be particularly beneficial. However, they also conclude that overall the fiscal impact of immigration is quite small.

In a recent study for Germany, Bonin (2006) calculates the net contribution of foreigners to the public coffers in Germany in the fiscal year 2004. His findings show that in that year tax revenues exceeded transfer payments by €2,000 per foreigner. This contribution stays positive even after accounting for demographic aging in the future with an expected rest-of-life net government gain of €11,600 per capita in present value terms.

Collado et al. (2004) use data from the European Community Household Panel Survey (ECHP) in order to analyse the impact of immigration on the Spanish welfare state. Employing the generational accounting approach, they simulate the effects of a number of different immigration policies. Their calculations reveal a positive net contribution of immigrants with a present value

of around €98,000 for a representative male immigrant and a corresponding €43,000 for a female immigrant in 2000.

Using a static approach, Gott and Johnston (2002) estimate a net direct fiscal contribution (taxes and contributions paid minus benefits received and public services consumed) of first generation immigrants in the UK in 1999/2000 of 2.5 billion. The authors emphasise that immigrants are heterogeneous and that those who are economically particularly successful are the biggest contributors by paying more taxes and national insurance contributions and receiving less publicly provided services and benefits. Economic outcomes in turn are influenced by characteristics such as age, skills, qualifications and English language proficiency so that policies designed to improve these characteristics are likely to improve fiscal outcomes. Due to its static nature, there are a number of limitations in this analysis so that the authors are quite cautious in the interpretation of their results. Most importantly, the fiscal effect of immigration should be considered over the immigrants' life cycle. Since at present immigrants in the UK are younger than natives, their instantaneous net contribution is likely to be positive but will turn negative once they retire. Other factors not considered are the effects of immigrants on natives. If immigrants push natives into unemployment and lower wages, then the tax income from natives will decline and benefits expenditures to natives will increase, leading to an indirect negative fiscal impact of immigration. Furthermore, infrastructure expenditures to accommodate the immigrants such as additional health facilities, schools and housing have not been taken into account in this study. Finally, the period of analysis, 1999/2000, was a particularly good year in terms of macroeconomic conditions in the UK so that the estimated contribution from immigrants is likely to be an upper bound of their actual annual contribution.

Finally, in a paper that provides a comprehensive overview on the magnitude of the immigrant impact on a number of different dimensions in the immigrant-receiving local economies, Card (2007) follows a somewhat different approach with respect to their fiscal impact by focussing on the local impact. Based on both U.S. Census data for 1980 to 2000 and CPS data, he carries out a spatial correlation analysis relating a variety of indirect measures of local spending and tax revenues

in either the largest 17 metropolitan areas or 100 larger MSAs to the local fraction of immigrants. He uses the fraction of people under 16, the fraction either under 16 or over 65 (the dependent population) and the fraction enrolled in elementary or secondary school as dependent variables to proxy for the magnitude of the local tax burden on the working-age population. Furthermore, he regresses the per capita earnings in a locality (total wages, salaries, and self-employment income per person, including children and retirees) on the immigrant fraction. The idea here is that the higher the per capita earnings, the lower can be the local tax rates without detrimentally affecting the level of government services per capita. The empirical results imply that there is a small positive effect of immigration on local school enrollment rates but no indication of a positive association between the relative size of the dependent population and the presence of immigrants. Also, there is no evidence that a greater fraction of immigrants reduces the per capita earnings and hence the tax base in a locality. On the contrary, there is a small but significant positive effect of immigration on per capita earnings, as predicted by the theoretical model on the immigrant surplus introduced in Section 2.1.

Cross-country and Meta Analysis

Angrist and Kugler (2003) investigate how the native employment rates across 18 Western European countries are related to the corresponding immigrant shares in those countries, using Eurostat data for the period 1983 to 1999, which is compiled from country-specific labour force surveys. In particular, they examine whether the employment consequences vary with labour market institutions in each country which could affect labour market flexibility. Such institutions could be, for example, employment protection legislation, high replacement rates or business entry costs. The initial empirical results imply that a 10% increase in the foreign share reduces native employment by 0.2 to 0.7 percentage points with OLS estimates at the low end and IV estimates mostly larger. As instruments for the potentially endogenous immigrant flows the authors use the distance from Sarajevo and Pristina interacted with year dummies, making use of the significant immigration from Yugoslavia during the 1990s. Turning towards the central issue of the influence of labour market institutions, they reestimate their model introducing interactions between the immigrant share in a country and three institutional indicators: an index of labour standards (employment

protection, administrative and union oversight in hiring and firing decisions, minimum wages, restrictions of work hours and employment contracts), the average replacement rate, and a measure of business entry costs. The estimates from these regressions show larger adverse immigration effects when the labour market flexibility in a country is low, and replacement rates and entry costs are high. These findings suggest that reduced labour market flexibility and restrictive institutions fail to protect natives from job losses due to immigration, and may even make immigration-related job losses worse.

Longhi et al. (2004) take advantage of the large number of studies that look at the effect of immigration on the labour market by performing a meta-analysis using a sample of eighteen papers. They relate the estimated coefficients on the immigrant share in those studies, 344 overall, to various parameters of the research design such as approach chosen (spatial correlation approach, simulation-based approach), country, size of the labour market, affected group, type of immigrants, and definition of wages. They also explicitly account for study quality and publication bias which arises due to the tendency of authors and editors to favour the publication of statistically significant results. Their finding suggests an overall small effect of the proportion of immigrants in the labour force on wages: a 1 percentage point increase of the former lowers wages across the investigated studies by 0.12%. More specifically, the negative impact seems to be larger in EU countries than in the U.S. and immigrants appear to be more in competition with each other than with natives. Their overall finding seems to confirm the broad conclusion in the literature: that the impact of immigration on wages is, if statistically significant, quantitatively small.

To summarise, Figure 2.3 provides a schematic overview of the literature on the impact of immigration that I have just reviewed. The main distinction I make is between studies that are based on regional labour markets and studies that consider a national labour market. Although there are a number of alternative ways in which one could group the literature, I believe this distinction best describes the two dominant starting points and, in fact, views based on which researchers have approached the issue. Due to its complexity and despite the already broad range of the literature, there are still a number of important as-

pects that have not been sufficiently investigated. There is certainly more work necessary with regard to the impact of immigration on local prices as well as the dynamics of how immigration affects the labour market. Also, due to a lack of adequate data, the question of how capital flows respond to immigration is still relatively unknown. As discussed earlier, with fully elastic capital supply, immigration - unless identical in skill composition to the native workforce - leads to a redistribution of income between differently skilled workers and has a positive effect on average native wages in an economy. With capital supply being somewhat inelastic, however, there will be a negative effect on average wages and a redistribution towards capital owners. From a political point of view this could obviously be a crucial difference. In this context, the dynamics of the capital adjustments are again of particular importance as are the dynamics of all the other adjustment processes that take place as a result of immigration, such as native out-migration, changes in output mix or changes in production technologies. There is still an important research agenda to be pursued in order to fully understand the impact immigration has on the labour market of both the host and home country economies.

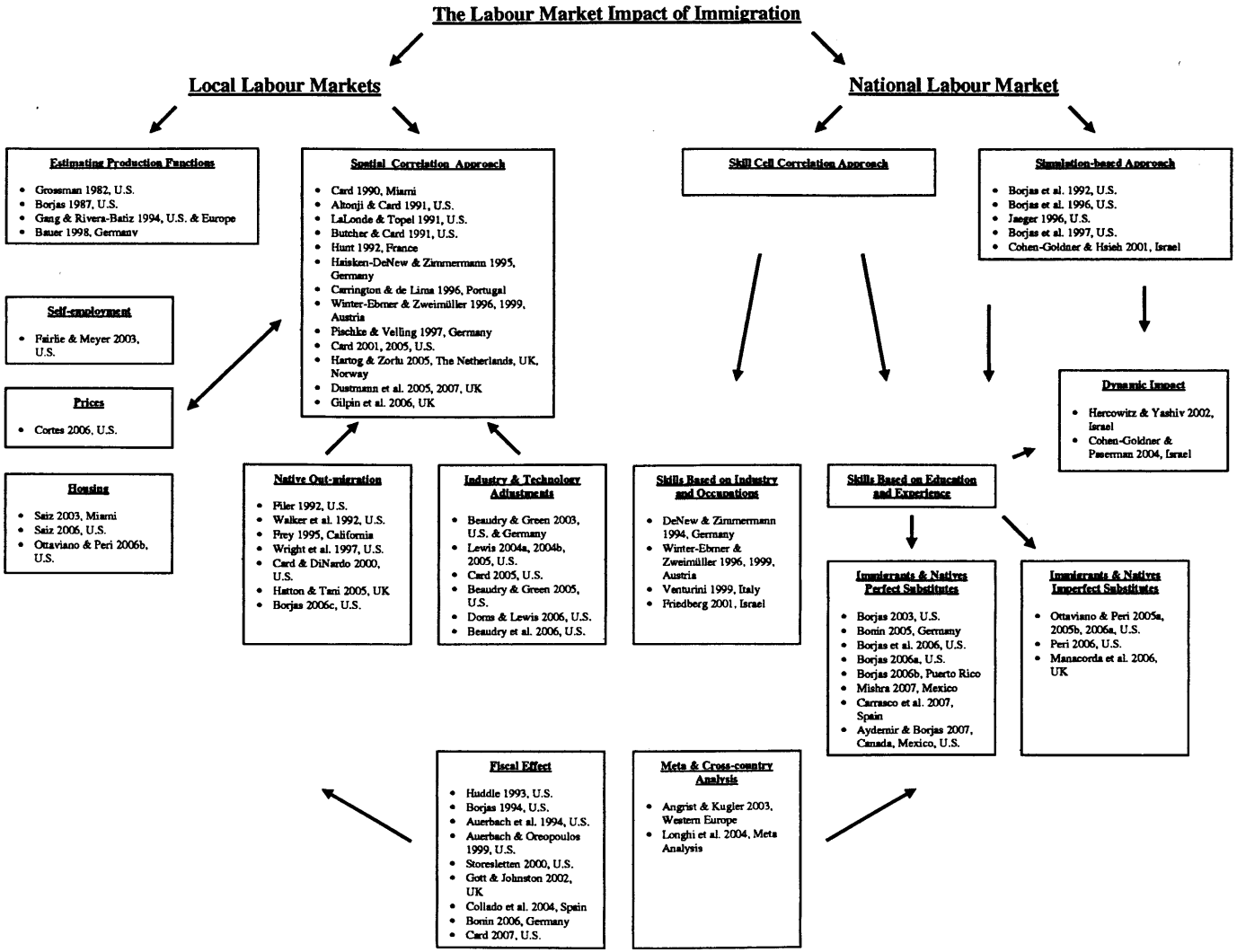


Figure 2.3: Literature overview

Chapter 3

The Labour Market Impact of Immigration: Quasi-Experimental Evidence*

3.1 Introduction

The impact immigration has on the labour market outcomes of the resident population is a central issue in the public debate on immigration policies. In most European countries it has been widely discussed in recent years in connection with the eastern enlargement of the European Union and, in particular, the potential introduction of transitional measures to restrict labour migration from the new member states. There is a widespread concern that immigrants exert downward pressure on wages and reduce job opportunities for resident workers. Since the 1990s, numerous studies have tried to empirically assess the labour market effects of immigration for a number of countries, sometimes

*I am grateful to Christian Dustmann, David Card, Kenneth Chay, Emilia Del Bono, Ian Preston, Imran Rasul, Regina Riphahn and Matti Sarvimäki for helpful comments and suggestions, and to Stefan Bender for invaluable support with the data. I have benefited from many useful comments by conference participants at ESPE 2004, EEA 2005, the COST A23 meeting 2005, the CReAM/TARGET conference 2006, EEA 2006, EALE 2006 and participants of the Labor Lunch Seminar at Berkeley. Parts of this chapter were written while visiting the Department of Economics at Berkeley, which I thank for the hospitality. I also thank the ESRC for funding the project (award No. RES-000-23-0332).

with conflicting results and using a variety of methodological approaches.[1] The most common approach in the literature is the spatial correlation approach, in which a measure of the employment or wage rate of resident workers in a given area is regressed on the relative quantity of immigrants in that same area and appropriate controls.[2] One of the main difficulties of this strategy arises from the immigrants' potentially endogenous choice of place of residence. Immigrants tend to move to those areas that offer the best current labour market opportunities, which typically leads to an underestimation of the true effect they have on the labour market outcomes of the resident population. To address this endogeneity problem, some studies have used instrumental variables that are based on past immigrant concentrations, exploiting the fact that these are good predictors of contemporary immigrant inflows while assuming that they are uncorrelated with current unobserved labour demand shocks.

In this chapter, I follow an alternative approach by taking advantage of a natural experiment in Germany in which a particular group of immigrants was exogenously allocated to specific regions upon arrival by government authorities. The prime objective of the allocation policy was to ensure an even distribution of these immigrants across the country. Since, to an overwhelming extent, the actual allocation decision was based on the proximity of family members and sanctions in case of non-compliance were substantial, the possibility of self-selection into booming labour markets was severely restricted for this group of immigrants, allowing us to view their settlement as exogenous to local labour market conditions and providing a unique opportunity to study its effect on the resident population.

Only in few instances is it feasible to view immigration as a natural experiment in which the immigrant inflows into a particular region are not driven by local labour market conditions. The only example in the literature that uses such an experiment to identify the labour market impact of immigration on the

[1] See Chapter 2 or Friedberg and Hunt (1995) and Gaston and Nelson (2002) for comprehensive surveys of the literature.

[2] Examples include Altonji and Card (1991), LaLonde and Topel (1991), Butcher and Card (1991), and Card (2001) for the U.S., Winter-Ebmer and Zweimüller (1996, 1999) for Austria, Hunt (1992) for France, Pischke and Velling (1997) for Germany, Carrington and de Lima (1996) for Portugal, Dustmann et al. (2005) for the UK, and Hartog and Zorlu (2005) for the Netherlands, the UK and Norway.

resident population is the Mariel boatlift analysed by Card (1990).[3] The main conceptual difference between that study and my analysis is that Card examines a large exogenous inflow into a single local labour market, the city of Miami, whereas this analysis uses exogenous but relatively homogenous inflows into all regions in Germany. As I will show, in this case the main source of variation stems from differences in the skill composition of the resident labour force across regions. Edin et al. (2003), Piil Damm (2006) and Gould et al. (2004) are further studies that are related to my analysis insofar as they use spatial dispersal policies for refugee immigrants in Sweden, Denmark and Israel, respectively, as a source of exogenous initial regional allocations of immigrants. Rather than looking at the labour market impact of these inflows on the resident population, the aim of the former two studies is to assess how living in an ethnic enclave affects immigrants' own labour market outcomes whereas the latter investigates the effect of school quality on the high school performance of immigrant children.

In this chapter, I set up a model in which immigration affects the relative supplies of different skill groups in a locality. I then estimate how changes in these relative supplies affect the employment/labour force rate and wages of the resident population, first by OLS and then using the exogenous immigrant inflows to instrument the potentially endogenous changes in relative skill shares in a locality. I define skill groups in two alternative ways based on either occupations or educational attainment and distinguish between the effect on native Germans and foreign nationals. To investigate whether out-migration of the resident population in response to the immigrant inflows potentially dissipates their labour market impact across the economy, I regress overall and skill-specific local population growth rates on immigrant inflow rates. The results from these regressions also allow an assessment of whether there is any positive association between immigrant inflows and the growth rates of the resident population, which would cast doubt on the exogeneity of the allocation decisions with regard to local demand conditions. Finally, I ascertain whether the initial skill composition in a locality, which turns out to be the main source of variation in my estimations,

[3]There are a number of studies, however, in which the immigrant inflow to a country as a whole - rather than to particular regions within the country - can be seen as a natural experiment, for instance the inflow of repatriates from Algeria to France analysed by Hunt (1992) or the mass migration of Russian immigrants to Israel studied by Friedberg (2001).

has an independent effect on future changes in labour market outcomes that could be driving the results.

The particular group of immigrants at the centre of this study are so called "ethnic German immigrants". These are individuals who were living in large numbers in Central and Eastern Europe and the former Soviet Union and who were particularly affected by the divisive ideological developments in the aftermath of World War II. Only as a result of the political changes in the former Eastern Bloc towards the end of the 1980s did this group gain the opportunity to immigrate to Germany, which, after 40 years of isolation, was eagerly seized. Between 1987 and 2001 more than 2.8 million ethnic German immigrants moved to Germany, increasing its population by 3.5%. Based on Germany's principle of nationality by descent, this particular group of immigrants as well as their descendants are regarded as German by the constitution and granted German citizenship in the event of immigration. I collected annual county-specific inflows of this group of immigrants directly from each of the sixteen federal admission centres and combine these figures with detailed information on local labour markets that I obtained from social security based longitudinal data. The analysis focuses on West Germany, excluding Berlin, and covers the period 1996 to 2001, during which the allocation policy was in effect.

The empirical results point towards the existence of unobserved local demand shocks that are correlated with changes in relative skill shares and lead to upward biased estimates of the labour market impact of immigration from simple OLS regressions. Using the ethnic German immigrant inflows to instrument the endogenous changes in the relative skill shares leads to substantially larger negative effects on the employment/labour force rate. The estimates imply that for every 10 immigrant workers finding employment, about 4 resident workers lose their jobs. Since all regressions are based on annual variation, this displacement effect has to be interpreted as a short-run effect. The increase in magnitude of the estimates by a factor of 3 to 7 when moving from OLS to IV is comparable with the results Card (2001) found in a similar study for the U.S., in which the instrument, however, was based on past immigrant settlement patterns. The fact that I find a negative effect on the employment/labour force rate of

the resident population stands in contrast to a number of earlier studies for Germany, for instance to Pischke and Velling (1997) and Bonin (2005), who do not find such effects. My results do not show evidence of detrimental effects on relative wages of the local population. Finally, there is no indication that the obtained results are underestimates of the immigrant labour market impact due to compensatory outflows of the resident population or that they are driven by an independent effect of initial relative skill shares on future labour market outcomes.

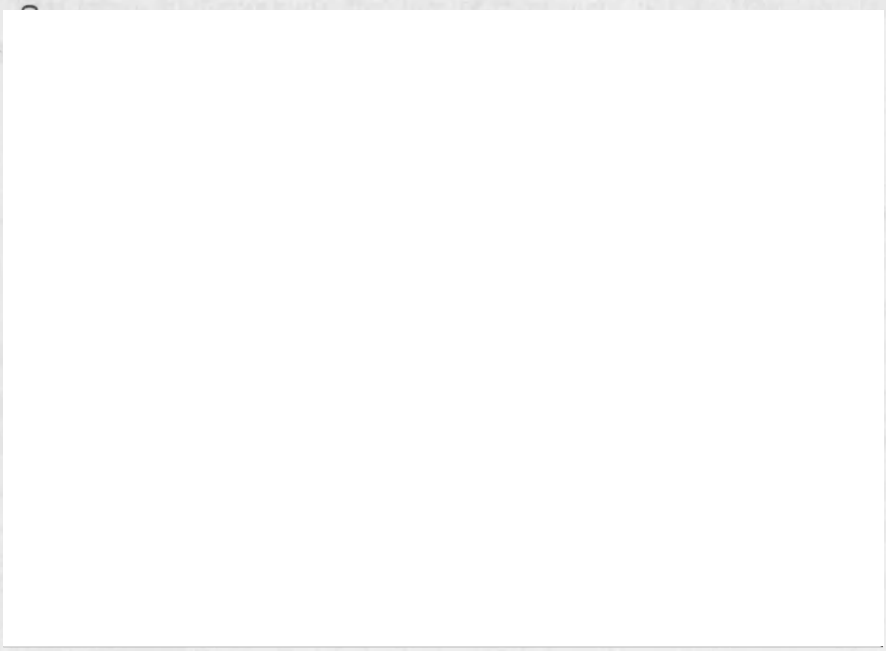
The remainder of this chapter is organised as follows. In the next section, I will provide some background information on ethnic German immigration since World War II and the institutional setting in which it took place. In Section 3.3, I explain the underlying theoretical model and identification strategy of my analysis. I then describe the data sources in Section 3.4 and provide some descriptive evidence in Section 3.5. Finally, I present and discuss the estimation results in Section 3.6. Section 3.7 concludes.

3.2 The German Migration Experience - Some Facts

3.2.1 Historical Background

To understand the origin of ethnic German immigrants we have to consider their historical background. During the terror regime of the National Socialists in Germany, a large number of German citizens fled the country or were forcibly resettled to the eastern occupied territories. After the end of World War II and the ensuing repartitions and forced resettlements across Europe, about 15 million German citizens became refugees or expellees, most of whom moved back to Germany in the immediate post-war years. According to Salt and Clout (1976) some 7.8 million of these refugees had settled in West Germany and 3.5 million in East Germany by 1950. However, many German citizens and their descendants continued to live outside post-war Germany. Their inflows gradually ebbed away as Eastern European countries became increasingly insulated. After the initial post-war displacements, immigration of ethnic Germans, then called *Aussiedler*, took place on the basis of bilateral agreements between Germany and the corresponding source countries. However, after the construction of the Berlin Wall in 1961 and the worsening of the East-West relations, these flows were severely

Figure 3.1: Ethnic German immigrant inflows by country of origin, 1950 to 2001



Source: Bundesverwaltungsamt

limited. Between 1950 and 1987, the number of ethnic Germans who came to West Germany added up to 1.4 million, of which 848,000 had come from Poland, 206,000 from Romania, and 110,000 from the former Soviet Union.[4] In 1988, with the end of the cold war looming, travel restrictions in Central and Eastern Europe were lifted. This caused an immediate resurgence of ethnic German migrations. In 1990 alone some 397,000 individuals, mainly from the former Soviet Union (37%), Poland (34%) and Romania (28%), arrived in Germany (see Figure 3.1). Faced with these enormous movements, the government limited their inflow in subsequent years at a level of around 225,000 per year. This quota was met until 1995 after which the annual inflows gradually decreased. From 1993 onwards more than 90% of the ethnic German immigrants originated from territories of the former Soviet Union. It is important to emphasise that the ethnic German immigrant population I analyse in this study does not include Germans who used

[4]Source: Bundesverwaltungsamt, Jahrestatistik Aussiedler 2003.

to live in East Germany and who moved to West Germany after unification in 1990. This group had complete freedom of movement within Germany from the day of unification.

3.2.2 Institutional Framework

All ethnic German immigrants who want to come to Germany have to apply for a visa at the German embassy in their country of origin and prove their German origin in terms of descent, language, education and culture. Once applications are accepted and a visa is granted, which takes around one year, all arriving immigrants have to pass through a central admission centre where they are initially registered. In case they do not have a job or other source of income that guarantees their livelihood, which applies to the vast majority of immigrants at the time of arrival, they are then allocated to one of the sixteen federal states according to pre-specified state quotas.[5] Within each state, they are subsequently further allocated to particular counties, using a state-specific allocation key as guidance which, with two exceptions, is fixed over time and based on the relative population share of each county.[6] By far the most important factor determining the final destination of the ethnic German immigrants is the proximity of family members or relatives. The responsible authority at the Ministry of the Interior estimates that this has been the decisive factor in the allocation decision in approximately 90% of all cases. Additional factors are the presence of health and care facilities and the infrastructure for single parents. Crucially for this study, the skill level of the immigrants did not play any substantial role in the allocation process.

The legal basis for this system is the "Assigned Place of Residence Act" (*Wohnortzuweisungsgesetz*), which was introduced in 1989 in response to the large inflows experienced at the time. These inflows tended to be concentrated

[5] According to the so-called Königsteiner Distribution Key, the quotas since 1993 have been: Baden-Württemberg 12.3%, Bavaria 14.4%, Berlin 2.7%, Brandenburg 3.5%, Bremen 0.9%, Hamburg 2.1%, Hesse 7.2%, Mecklenburg-Pomerania 2.6%, Lower Saxony 9.2%, North Rhine-Westphalia 21.8%, Rhineland Palatinate 4.7%, Saarland 1.4%, Saxony 6.5%, Saxony-Anhalt 3.9%, Schleswig-Holstein 3.3%, and Thuringia 3.5%.

[6] The exceptions are Lower Saxony where the quotas are annually adjusted for changes in each county's population, and North Rhine-Westphalia where quotas are based on both population and geographical area and annually adjusted to population changes.

towards a few specific regions where they caused considerable shortages in available housing space while in other, particularly rural areas, facilities remained empty.[7] The intention of the law was to ensure a more even distribution of ethnic German immigrants across Germany and avoid a capacity overload of local communes, who are responsible for the initial care of the immigrants. However, in practice, the introduction of this law turned out to be ineffective because the entitlements to considerable statutory provisions such as financial social assistance, free vocational training courses, and language classes were not affected should the ethnic German immigrant choose to settle in a region different from the one allocated upon arrival. As a consequence, unregulated internal migration of ethnic Germans led to the creation of a few enclaves, in some of which their concentration reached up to 20% of the overall population (Klose, 1996). In response to these developments, the Assigned Place of Residence Act was substantially modified on 1 March 1996. As a key feature of the new law, ethnic German immigrants would now lose all their statutory entitlements in case of non-compliance with the allocation decision. Due to the federal structure of Germany it was subject to each of its states to adopt and implement the new legislation. Apart from Bavaria and Rhineland-Palatinate, all West German states chose to do so, most of them with effect from 1 March 1996. Only Lower Saxony and Hesse adopted the law at a later point, the former in April 1997 and the latter in January 2002. For an overview see Table 3.11 in the appendix to this chapter. The perception at both the Ministry of the Interior as well as the Association of German Cities and Towns is that the new provisions and sanctions have been successful and ensured a high compliance with the initial allocation decision.[8]

[7]The problem of housing space was particularly pronounced in the late 1980s and early 1990s when annual inflows of ethnic German immigrants were largest. By the mid 1990s, however, sufficient capacities in social housing and hostels had been established and were even partly shut down again due to the smaller annual inflows. Therefore I do not expect that housing availability, which may depend directly on the state of the local economy, would have affected the number of immigrants allocated to a region and in that way introduced endogeneity into the allocation process.

[8]This is corroborated in the commentarial statement of a related judgment by the Federal Constitutional Court in a case in which an ethnic German immigrant took legal action without avail against the restriction of her freedom of movement (BVerfG, 1 BvR 1266/00 vom 17.3.2004, Absatz-Nr. 1 - 56).

The regional allocation of the ethnic German immigrants becomes void if they can verify that they have sufficient housing space as well as a permanent job from which they can make a living, at the latest, however, three years after initial registration. This suggests that after arrival in the allocated place of residence there is some scope for endogenous self-selection through onward migration. However, it is likely that immigrants will predominantly search for job opportunities in the vicinity of their places of residence. In fact, the difficulties of searching for a job in a different locality arising from the legal provisions of the Assigned Place of Residence Act were acknowledged by the legislator and led to a further amendment of the law on 1 July 2000 that explicitly allowed for temporary residence in alternative localities for the purpose of job search activities without loss of entitlements as long as it did not exceed 30 days.[9]

To sum up, through the introduction of the new legislation in 1996 the authorities implemented a system to allocate a particular group of immigrants exogenously with regard to their skill levels across different regions while at the same time providing for the necessary sanctions to ensure compliance with these allocation decisions. This framework can therefore be regarded as a natural experiment of immigration in which inflows are exogenous to local labour demand conditions.

3.3 Theory

3.3.1 Empirical Model

The empirical analysis in this chapter is based on a model in which immigration impacts local labour markets by changing the relative supplies of different skill groups (compare Card, 2001). Assuming that in each labour market a competitive industry produces a single output good using a CES-type aggregate of skill-specific labour inputs as well as capital, relative wages and, by substituting into a labour supply function, relative employment rates will only depend on the relative supply

[9] I do not explicitly take this change in regulations into account in the analysis since it was only valid for the last six months of the six-year period I cover and did not affect the initial allocation to a particular region.

of each skill group.[10] The equations for the effect on the employment/labour force and wage rates are then given by

$$\Delta \log (N_{jrt}/P_{jrt}) = v'_{jt} + v'_{rt} + \beta_1 \Delta \log f_{jrt} + \Delta v_{jrt} \tag{3.1}$$

$$\Delta \log w_{jrt} = u'_{jt} + u'_{rt} + \beta_2 \Delta \log f_{jrt} + \Delta u_{jrt}, \tag{3.2}$$

where $\Delta \log f_{jrt} = \log (P_{jrt}/P_{rt}) - \log (P_{jrt-1}/P_{rt-1})$ denotes the percentage change in the fraction of the overall labour force in labour market r that falls into skill group j, and v'_{jt}, u'_{jt}, v'_{rt}, and u'_{rt} are interactions of skill group and year fixed effects and region and year fixed effects, respectively. Δv_{jrt} and Δu_{jrt} are unobserved error components that capture skill-, region- and year-specific productivity and demand shocks. For a detailed derivation of these equations see Section 3.8.3 in the appendix to this chapter.

As opposed to Card's study, which only uses one cross section and thus estimates in levels, I am able to control for skill region specific fixed effects (which I difference out) and use variation in local skill shares over time to identify β_1 and β_2. This could potentially be important since otherwise any instrumental variable that is based on past labour market characteristics will be invalid if these characteristics are themselves correlated with unobserved skill region specific fixed effects.[11]

Equations 3.1 and 3.2 relate changes in the local employment and wage rates to changes in the relative factor shares in a locality. Any skill-specific

[10]The key assumptions underlying this model are that capital and labour are separable in the local production function, that the elasticities of substitution across all skill groups are identical, that natives and immigrants are perfect substitutes within skill groups, and that the per-capita labour supply functions for the different skill groups have the same elasticity.

[11]If, as for the U.S. and Germany, immigration has historically been unskilled, then it is likely that any (un)skilled region fixed effect is correlated with the overall number of immigrants living in a locality: unskilled immigrants would have tended to move to those areas that are particularly attractive given their skill level. In a cross sectional analysis skill region fixed effects cannot explicitly be controlled for and are part of the unobserved error component. An instrument that is based on past immigrant concentrations will then be correlated with this error component, rendering it invalid.

local productivity and demand shocks in a given year are captured in the error component. If these shocks raise employment and wage rates in a particular skill group and at the same time attract more workers into that group, this will induce a positive correlation between the error terms Δv_{jrt} and Δu_{jrt} in Equations 3.1 and 3.2 and the change in the relative skill share $\Delta \log f_{jrt}$. In this case, OLS estimates of β_1 and β_2 will be upward biased.

To address this problem, I take advantage of the exogenous allocation of ethnic German immigrants to Germany's counties between 1996 and 2001. Specifically, I assume that their inflows are uncorrelated with any skill-specific productivity and demand shocks and can therefore serve as an instrument for the change in the relative factor shares $\Delta \log f_{jrt}$. I will provide evidence for the validity of this assumption in Section 3.5.4.

I construct my instrument, the skill-specific ethnic German inflow rate, by multiplying the overall inflow ΔI_{rt} into a particular locality with the nationwide fraction of ethnic German immigrants in each skill group where I distinguish skill groups either by educational attainment or by occupation. Let θ_{jt} denote this fraction and let ω_t denote the fraction of ethnic German immigrants that arrive in year t and are aged between 15 and 64. Since individual skills and age did not play a role in the allocation of ethnic Germans to local labour markets, one can expect the skill and age composition of the arriving ethnic German immigrants in each locality to be the same.[12] The predicted skill-specific inflow rate of working age immigrants into labour market r in year t that I use as an instrument for the change in the relative factor share is then given by

$$SP_{jrt} = \frac{\theta_{jt}\omega_t \Delta I_{rt}}{P_{jrt-2}},$$

where SP_{jrt} stands for the skill-specific supply-push component of ethnic

[12]In the presence of a correlation in skills between immigrants and their family contacts already living in Germany, this assumption may not hold. However, since these families have typically been split up a long time ago and passed through significantly different educational systems, the correlation in skills is likely to be small. If the assumption of identical skill compositions of arriving ethnic Germans were invalid, this would be reflected in a weak first stage of the instrumental variable estimations.

German immigrant inflow ΔI_{rt}, and P_{jrt-2} is the overall labour force in skill group j in $t-2$. I use a lag of two years in the denominator in order to avoid any correlation with the skill-specific error terms Δv_{jrt} and Δu_{jrt} in Equations 3.1 and 3.2.[13]

Based on my data, the skill-specific labour force in a locality consists of all employed individuals plus all individuals receiving official unemployment compensation, either unemployment benefits (*Arbeitslosengeld*) or unemployment assistance (*Arbeitslosenhilfe*). During the period covered by this analysis, unemployed individuals receive unemployment benefits for the first 6 to 32 months dependent on the duration of their previous employment. Subsequently, they receive unemployment assistance which is means-tested and, in principle, indefinite. The data therefore provides a fairly good approximation of the actual labour force, in particular for men which are less likely to lose or quit their job without receiving some sort of unemployment compensation thereafter. A peculiarity arising from these data with respect to the empirical model, however, is that year to year changes in the local skill shares are driven by new individuals becoming employed in a given skill group. This is because in order to qualify for official unemployment compensation individuals first have to work for at least 12 months prior to becoming unemployed, so that new entrants into the labour force always "enter" my data set as employed individuals.[14] This has an important implication for the interpretation of the coefficients β_1 and β_2. These now measure how changes in the relative skill shares in a locality induced by additionally employed individuals affect average labour market outcomes. In the case of the employment/labour force rate, β_1 hence measures the direct displacement effect, that is, how many workers lose their job for every additional worker finding a job.

[13]Using the skill-specific labour force of the previous year instead would increase the first stage correlation of the instrument with the endogenous variable $\Delta \log f_{jrt}$ but, in the presence of unobserved productivity and demand shocks, introduce a positive correlation of the instrument with the first differenced error terms Δv_{jrt} and Δu_{jrt} which would render the instrument invalid. For the skill-specific labour force of the previous year to be valid for the construction of the instrument would require that the employment/labour force rate evolves as a random walk, a requirement unlikely to hold for Germany (see Pischke and Velling, 1997, for a discussion of this issue).

[14]In the data, the recorded locality for an unemployed individual always corresponds to the locality of the previous employment spell. The only way the relative skill share in a locality can then change by additions to the number of unemployed from one year to the next is when an already eligible worker moves into a job in a new locality but then becomes unemployed before the cut-off date at which I calculate the relative skill shares.

3.3.2 Source of Variation

An important issue in the context of this study is that, by design, the exogenous allocation of ethnic German immigrants over the entire German labour market ensures that the variation in the overall regional inflow rates is small. In fact, if the overall number of immigrants allocated to each county was strictly proportional to the resident population, there would be no variation in the overall ethnic German immigrant inflow rate and simply regressing local labour market outcomes on the *overall* inflow rate, as done in many impact analyses (for instance Altonji and Card, 1991 or Pischke and Velling, 1997), would have been impossible. Moreover, if the allocation decision is based, as in the present case, to an overwhelming extent on family ties, the skill distribution of the newly arriving ethnic German immigrants is also going to be homogeneous across different regions. However, even with the same inflow rate and skill composition of the arriving immigrants in each region, the effect on the labour market outcomes of the resident population of a particular skill group will still differ dependent on the existing pre-migration skill distribution in each region. In particular, the percentage change in local skill share f_{jrt} after an inflow of immigrants that is homogenous across regions r relative to the resident population, $\frac{\Delta I_{rt}}{P_{rt-1}} = i_t$, and of which a constant share across regions of $v_{jrt} = v_{jt}$ is of skill j is given by

$$\%\Delta f_{jrt} = \frac{f_{jrt-1} + v_{jt} i_t}{f_{jrt-1}(1+i_t)} - 1, \tag{3.3}$$

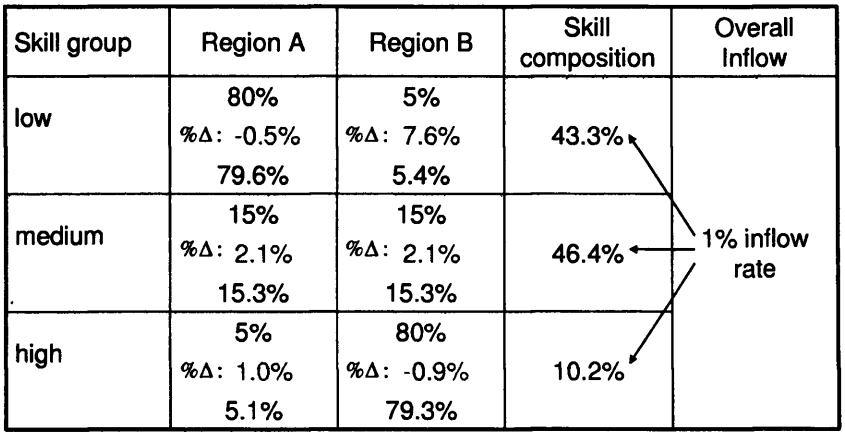
where, for simplicity, I assume that there is no growth in the local population for other reasons than immigration. The first derivative of this term with respect to the initial skill share f_{jrt-1} is then given by

$$-\frac{v_{jt} i_t}{f_{jrt-1}^2 (1+i_t)} < 0,$$

so the larger the initial skill share, the smaller will be the percentage change in the relative skill supply induced by the skill-homogenous inflow of immigrants.

Differences in the skill composition before the immigrant inflows occur thus lead to differences in the relative changes of the skill shares and hence to differences in the responses of labour market outcomes. The variation I exploit in my

Figure 3.2: Source of variation



estimations therefore arises mainly from variation in the pre-existing skill compositions across different labour market regions rather than from a differential composition of the immigrating population.[15]

Figure 3.2 illustrates this point. Suppose there are two regions, Region A and Region B, where Region A is a low skill region with 80% of the workforce being low-skilled, 15% medium-skilled, and 5% high-skilled while Region B is a high skill area with 5% low-, 15% medium-, and 80% high-skilled. Suppose skill is here measured by educational attainment. Now suppose there is a 1% inflow into each region of which 43% are low-skilled, 46% medium-skilled and 10% high-skilled. The values here reflect the corresponding skill shares in our immigrating population. Such an inflow will now lead to significantly different changes in relative skill shares in Regions A and B. While in Region A the share of low-skilled workers will decrease by -0.5%, it increases by 7.6% in Region B. Conversely, the inflow of high-skilled immigrants will lead to a 1% increase in the share of high-skilled individuals in Region A and a -0.9% reduction of the share

[15]Typically, studies that regress changes in skill-specific labour market outcomes on the overall rather than the skill-specific immigrant inflow rate in a locality implicitly assume a pre-migration skill distribution that is identical across local labour markets. As shown in Section 3.8.4 in the appendix to this chapter, a violation of this assumption of equal skill distributions will lead to biased estimates of the impact of overall immigrant inflows on labour market outcomes.

in Region B. Given our model, it is the percentage changes in relative skill shares that are driving labour market outcomes and which provide the variation we use to identify the labour market impact of immigration.

3.4 Data Sources

3.4.1 Data on Ethnic German Immigrants

At the end of every year, the Federal Administration Department in Germany (*Bundesverwaltungsamt*) publishes information on the recent cohort of ethnic German immigrants in their series "*Jahresstatistik für Aussiedler*". These publications contain information recorded upon the immigrants' arrival in Germany; specifically on their countries of origin, age structure, last occupation, last labour force participation status, and religious affiliation. They also include the absolute numbers allocated to each of Germany's sixteen federal states. All the information provided is on the national level, apart from the age structure and religious affiliation, which are detailed for each state separately. Of particular importance for this analysis is the information on the last occupation in the country of origin since it provides a measure of the immigrants' skill levels that is exogenous to local demand conditions in Germany. I use this occupational information to calculate the fraction θ_{jt} of ethnic German immigrants in each occupation group, which I require for the construction of my instrumental variable.

I augment the aggregate information from the annual publications with data on the regional inflows of ethnic German immigrants. Since there is no information on the country of birth of an individual in my main data source on local labour market characteristics, these immigrants are not distinguishable from those Germans who were born in Germany (and to which I will henceforth refer as "native Germans"). Tracking where they actually settled is therefore not possible from these data. For that reason, I approached the responsible federal admission centres for each state directly, which due to the decentralised allocation process are separately responsible for recording the actual inflows. I was able to obtain the relevant information for each county in West Germany's ten federal states with the exception of Bavaria, where records were not kept at the required re-

gional level.[16] The period I cover is from 1996 to 2001 during which the Assigned Place of Residence Act was in effect. I focus on West Germany (excluding Berlin) since data on ethnic German inflows to the territory of what was formerly known as the German Democratic Republic are very fragmentary. Furthermore, local labour markets in that area have experienced fundamental changes after German unification in 1990 in their transition to market economies which are difficult to control for and may contaminate the results of this study.

3.4.2 German Microcensus

While the last occupation in the country of origin is reported upon arrival in Germany and published in the annual reports of the Federal Administration Department, there is no information on the immigrants' educational attainment. I use the German Microcensuses of 1999, 2001, and 2002 to obtain this information. In each Microcensus I am able to identify ethnic German immigrants as individuals with German citizenship that arrived in Germany in any particular year between 1996 and 2001.[17] For any given year of arrival there were between 94 and 274 individuals aged 15 to 64 with valid educational information. From these observations I calculate the fraction θ_{jt} of ethnic German immigrants in each education group, which again is used for the construction of my instrumental variable in the regressions based on education groups. Since I am interested in the immigrants' educational level upon arrival, I use the available information closest to the actual year of arrival. The skill shares for 1996, 1997 and 1998 are therefore taken from the 1999 Microcensus, the shares for 1999 and 2000 from the 2001 Microcensus, and the shares for 2001 from the 2002 Microcensus.[18]

[16]The other nine federal states or Länder in West Germany are Schleswig-Holstein, Hamburg, Lower Saxony, Bremen, North Rhine-Westphalia, Hesse, Rhineland-Palatinate, Baden-Württemberg and Saarland.

[17]Unfortunately, there is no information in the Microcensuses on the country of origin so that some of the individuals I identify as ethnic Germans could in fact be German citizens immigrating from other, for instance Western European or North American countries. In an alternative data set, the European Social Survey 2003, which does include the necessary information, I am able to identify 33 individuals with German citizenship who were not born in Germany and who moved to Germany between 1993 and 2003. All 33 of these ethnic German immigrants came from typical source countries of Aussiedlers, mostly from Kazakhstan (14) and Russia (13). Although the sample is small, it indicates that the share of immigrating ethnic Germans from other regions is likely to be small.

[18]The 1999 Microcensus is the first Microcensus that asks German citizens for their year of arrival in Germany which is why I cannot use earlier Microcensuses for the years 1996 and 1997.

3.4.3 IAB Employment Subsample

I obtain data on the labour market outcomes of the resident population from the Employment Subsample 1975-2001 which is made available by the Institute for Employment Research (IAB). This administrative data set comprises a 2% subsample of all dependent employees subject to social security contributions in Germany. It includes all wage earners and salaried employees but excludes the self-employed, civil servants, and the military. It furthermore includes all unemployed who receive unemployment compensation.[19] The data is collected directly on the employer level by the Federal Institute of Employment and provides detailed employment histories of 460,000 individuals in West Germany and, after 1992, 110,000 in East Germany. For a detailed description of the data set see Bender et al. (2000). The basis of my analysis are all individuals aged 15 to 64. I construct the relative skill shares in the local labour force in each of West Germany's 204 labour market regions both by education level and occupation for each year between 1996 and 2001.

In the IAB data I am not able to distinguish ethnic German immigrants from native Germans so that part of the observed change in the employment/labour force rate and the log wages in a locality could be simply due to composition effects through newly entering immigrants. Section 3.8.5 in the appendix to this chapter shows that in this case the estimates of β_1 and β_2 would be biased and that this bias depends on the differential in employment and wages between the immigrants and the resident population. Since the ethnic German immigrants' labour market outcomes one year after arrival are substantially worse than they are for the resident population (Bauer and Zimmermann, 1997), their inclusion in the calculation of average labour market outcomes would lead to a downward bias of the true change in labour market outcomes for the resident population. For

Furthermore, the reference week in the German Microcensuses is usually the last week of April so that I cannot use the Microcensus in say 2001 to calculate the skill shares in 2001.

[19]In 2001, 77.2% of all workers in the German economy were covered by social security and 78% of unemployed individuals in West Germany received official unemployment compensation - mostly either unemployment benefits (Arbeitslosengeld) or unemployment assistance (Arbeitslosenhilfe) - and are hence recorded in the IAB data (Bundesagentur für Arbeit, 2004). The data set does not provide information on the out of labour force population and those individuals which are currently actively looking for a job but have not yet paid into the social security system.

that reason, I make use of the longitudinal dimension of my data set and restrict the sample to those individuals that were already observed in the data before 1996 when constructing the skill-group specific average employment/labour force rates and wages.[20]

These employment/labour force rates and wages are obtained by regressing separately for each year and skill group the individual level outcomes, either an employment indicator or log wages, on a set of observables, including a cubic of potential experience, a vector of region fixed effects, and a set of education (for the occupation-based regressions) and occupation (for the education-based regressions) group fixed effects. In addition, I include sixteen country/region of origin dummies as well as a gender dummy when I am pooling native Germans and resident foreign nationals as well as men and women to construct labour market outcomes for the overall population.[21] In each case, I use the estimated coefficients on the region dummies as the dependent variables in the regressions of Equations 3.1 and 3.2. They reflect the employment/labour force rate and average log wage in each locality, adjusted for observable differences in experience, gender, origin, and educational (occupational) composition within each occupation (education) group across local labour markets. All outcomes are constructed for the 31st of December of each year.[22]

For my analysis, the IAB sample has two major advantages compared to other data sources. First, since I am dealing with administrative data which is used to calculate health, pension and unemployment insurance contributions, the precision of the data is high. In particular the wage data are unlikely to suffer

[20] Although this procedure effectively excludes all newly immigrating ethnic Germans from the calculation of average labour market outcomes, it also excludes all those individuals who are starting their first job between 1996 and 2001 or who were self-employed before 1996 and are now entering an employment that is subject to social security contributions.

[21] The countries and regions I distinguish are Turkey, former Yugoslavia, Italy, Greece, Poland, the former Soviet Union, Portugal, Romania, Western Europe, Central & Eastern Europe, Africa, Central & South America, North America, Asia, Australia & Oceania and Others.

[22] I chose the 31st of December to conform with the available data on annual inflows of ethnic German immigrants as well as the reference date used in the official population data of the German Statistical Office which I merged with the IAB data.

from any measurement error or reporting bias typical in many survey data sets.[23] Second, the sample size is large and includes detailed regional identifiers. This is necessary because I look at different subgroups of individuals in Germany's local labour markets. Even with an annual sample size of 460,000 observations, cell sizes quickly become rather small when disaggregating the labour force by locality, gender, education levels and occupations.

3.4.4 Federal Statistical Office

Finally, I use county level population data provided by Germany's Federal Statistical Office to calculate overall ethnic German immigrant inflow rates into each county, which are needed in order to evaluate the effectiveness of the Assigned Place of Residence Act. From the population data, I also construct local growth rates of both the German and the foreign population, which I use to investigate whether there is evidence of out-migration in response to the inflow of ethnic German immigrants (see Section 3.5.5).

3.5 Descriptive Evidence

3.5.1 Definition of Skill Groups and Labour Market Regions

The theoretical model suggests that immigration affects relative labour market outcomes by changing the relative skill shares in the local economy. I differentiate skill groups in two ways. First, I use the reported educational attainment of an individual, distinguishing three different groups: low, intermediate and high. People with low education are individuals without an apprenticeship, people with intermediate education are individuals with an apprenticeship and people with high education are individuals with college education. Apprenticeships are a crucial component of Germany's educational system and more than two thirds of all Germans have completed one in 2001. Individuals usually enter apprenticeships immediately after leaving school. They typically consist of two to four years

[23] Wage records in the IAB data sample are top coded at the social security contribution ceiling. I impute those wages by first estimating a tobit model and then adding a random error term to the predicted value of each censored observation ensuring that the imputed wage lies above the threshold (see Gartner, 2004 for details).

on the job training with complementary class room teaching one day per week. In terms of future income, apprenticeships are a more important determinant than the actual number of years an individual went to school. For instance, the average daily wage of German individuals without an apprenticeship in West Germany in 2001 is €46.5 if they do not have A-levels, and only marginally higher at €47.1 if they do. For that reason, I choose them as the prime indicator of an individual's skill level in terms of educational attainment.

Second, as an alternative and to check the robustness of the empirical results, I define skill groups along five different occupation lines (see also Card, 2001): I. farmers, labourers and transport workers, II. operatives, craft workers, III. service workers, IV. managers, sales workers, and V. professional & technical workers. For the immigrant population these occupations refer to the last occupation in the country of origin. The motivation for this disaggregation by occupation is that the reported level of education an immigrant obtained in his or her country of origin often does not correspond well to the corresponding level of education in the host country.[24] Natives and immigrants in the same occupation group might therefore better reflect comparable skill levels. In the empirical estimations, I use occupation and education as alternative indicators for the skill level of the population.[25]

Table 3.1 provides some summary statistics for the labour force in each of these occupation groups. Occupation groups I to V are ordered according to the percentage of individuals with low education level. The largest occupation group is occupation group III where 36.3% of all workers work in the service

[24]However, because of their cultural links with Germany, ethnic German immigrants are presumably in a better position to appropriately respond to questions in the Microcensus on their educational attainment than, for instance, foreign nationals.

[25]Borjas (2003) defines skill groups in terms of education and work experience, arguing that individuals with similar education but different experience in the labour market are imperfect substitutes in the production process. Due to relatively small sample sizes in the German Microcensus from which I take the information on educational attainment and the unavailability of cross-tabulations of occupational attainment by age group, it is unfortunately not possible to extend my analysis in this direction and allow for imperfect substitutability across age groups. Similarly, since I cannot distinguish ethnic German immigrants from native Germans in my data, I am not able to allow for imperfect substitutability between natives and immigrants within the same skill group as suggested in two recent studies by Ottaviano and Peri (2006a) and Manacorda et al. (2006) for the U.S. and the UK, respectively.

Table 3.1: Occupational distribution of the labour force in West Germany in 2001

	Occupation Group				
	I	II	III	IV	V
Percentage female	14.8	18.9	70.8	54.2	25.6
Percentage foreign nationals	13.8	12.8	6.6	4.4	4.5
Percentage low education	37.1	33.2	21.3	14.9	7.3
Percentage intermediate education	62.1	66.4	72.1	74.5	49.9
Percentage high education	0.8	0.4	6.6	10.7	42.8
Mean wage (in Euros)	71.6	68.9	70.7	84.8	107.6
Mean wage men (in Euros)	73.8	71.7	86.2	101.4	113.0
Mean wage women (in Euros)	54.5	52.4	61.8	64.5	85.1
Employment/labour force rate (in %)	89.6	91.2	94.0	94.7	95.9
Employment/labour force rate (in %) men	89.2	92.0	92.3	94.8	96.2
Employment/labour force rate (in %) women	91.8	87.7	94.8	94.6	94.8
Percentage of workers	16.4	21.0	36.3	15.4	10.8
Percentage of labour force	17.0	21.4	35.9	15.2	10.5

Source: IAB sample
Notes: The occupation groups are I: farmers, labourers, transport workers; II: operatives, craft workers; III: service workers; IV: managers, sales workers; V: professional & technical workers. The aggregation has been performed on the basis of the IAB classification of occupations and was crosschecked with the American SF-3 Occupation Table.

sector. The smallest group is occupation group V, which comprises professional and technical workers, where only 10.8% work. More than one third of farmers, labourers and transport workers but only 7.3% of professional and technical workers have a low education level. Women work predominantly in the service sector (occupation group III) where they make up 70.8% of the labour force, while foreign nationals are particularly concentrated in the low skill occupation groups I and II with 13.8% and 12.8% of the labour force. Mean gross daily wages of full-time workers, measured in real 1995 Euros throughout this study, are lowest among operatives and craft workers at €68.9 and highest for professional and technical workers at €107.6. Men earn more than women in all occupation groups. Employment/labour force rates, defined as the number of employees divided by the sum of employees and registered unemployed, are lowest in occupation group I (89.6%) and highest in occupation group V (95.9%). Overall, men and women have similar employment/labour force rates with slightly higher rates for women in occupation groups I and III and lower rates in groups II and V.

Table 3.2 provides some descriptive statistics on the overall ethnic German

Table 3.2: Descriptive statistics of ethnic German immigrants, 1996 to 2001

population immigrating in each year between 1996 to 2001. In 1996, 177,751 ethnic German immigrants came to Germany. This number gradually declined to 95,615 in 2000 and then increased again slightly to 98,484 in 2001. Overall, over the period 1996 to 2001, 714,265 ethnic German immigrants came to Germany, which corresponds to an average inflow rate relative to the resident population of 0.84% using the 148 West German labour market regions for which I was able to obtain the relevant data. As expected from the design of the governmental allocation policy introduced in 1996, looking at the average inflow rates more closely shows relatively little variation across Germany's counties: for the period 1996 to 2001, the minimum inflow rate was 0.2% (area of *Mainz* and *Mainz-Bingen* in Rhineland-Palatinate) while the maximum inflow rate amounted to 2.4% (county *Waldeck-Frankenberg* in Hesse). Note that these extreme cases both occur in states that did not implement the Assigned Place of Residence Act. From the descriptives on the age and occupational composition of the ethnic German

immigrants we can see that the immigrant cohorts remain relatively homogenous over time. There is a slight increase in the labour force participation in the home country before immigration, which rises from 53.6% in 1996 to 57.3% in 2001. Furthermore, the immigrant cohorts became slightly older over time, with 22.6% being less than 15 years old, 71.1% of working-age 15 to 64, and 6.3% older than 64 in 2001. The structure of the occupational composition, which is reported upon arrival in Germany, did not change substantially over time. There is a slight decrease in the number of immigrants working in low skill occupation group I from 28.3% in 1996 to 26.1% in 2001 and a corresponding increase in occupation group II from 29.0% to 31.5%. There is, however, some variation in the educational attainment of the arriving immigrant cohorts. For instance the share of ethnic German immigrants with low education ranges from 34.4% in 2000 to 48.8% in 1997 and the share of those with high education from 8.3% in 1997 to 14.4% in 1998.

The primary regional unit in my analysis is the West German labour market region. These regions are aggregates of counties which are the original regional units at which I observe ethnic German inflows. The aggregations take account of commuter flows so that labour market regions better reflect separate local labour markets. They comprise on average around 320,000 individuals (compared to around 225,000 for counties), although this number varies substantially ranging from 64,000 to 2.7 million. Table 3.3 provides some descriptive statistics of the labour market outcomes and socioeconomic characteristics of the population in West Germany's 204 labour market regions. Due to the lack of data on ethnic German inflow rates for Bavaria, I only use 148 of these in my estimations.

3.5.2 Labour Market Competition of Resident Workers and Immigrants

The theoretical model predicts that ethnic German immigrants only affect relative labour market outcomes if their inflow leads to changes in the relative supply of different labour inputs. This would require the ethnic German immigrant population to differ from the resident population with respect to their skill distribution.

Comparing the educational attainment of the ethnic German immigrants

Table 3.3: Summary statistics for West German labour market regions. Means and standard deviations

	Year						Change
	1996	1997	1998	1999	2000	2001	1996 - 2001
Overall population	315,791	316,413	316,776	317,788	318,762	320,210	1.9%
	(382,216)	(382,306)	(382,297)	(383,852)	(386,969)	(388,474)	(2.6%)
Working-age pop. (15-64)	214,304	214,368	214,383	214,263	214,049	214,358	0.5%
	(266,845)	(266,338)	(265,945)	(265,956)	(266,289)	(266,984)	(2.9%)
Foreign immi. share (in %)	10.5	10.4	10.2	10.2	10.1	10.1	−0.3
	(4.2)	(4.0)	(4.0)	(4.0)	(4.0)	(3.9)	(1.1)
Labour market outcomes:							
Lf/pop rate	53.0	51.9	52.8	53.0	53.4	53.3	0.1
	(7.3)	(7.3)	(7.5)	(7.7)	(7.9)	(8.2)	(1.9)
Empl/pop rate	47.4	46.9	47.6	48.6	49.4	49.6	1.2
	(6.9)	(7.0)	(7.2)	(7.5)	(7.8)	(8.1)	(2.1)
Unempl/pop rate	5.6	5.0	5.2	4.3	4.1	3.8	−1.1
	(1.2)	(1.2)	(1.3)	(1.1)	(1.1)	(1.1)	(0.7)
Empl/lf rate	89.4	90.3	90.2	91.8	92.4	93.0	2.2
	(2.2)	(2.3)	(2.4)	(2.1)	(2.2)	(2.1)	(1.2)
Mean daily wage (in €)	75.1	74.7	75.3	76.1	76.1	76.7	1.7%
	(6.5)	(6.7)	(6.8)	(7.0)	(7.0)	(7.2)	(2.0%)
Socioeconomic characteristics:							
% Low education	25.1	24.9	24.7	24.6	24.4	24.0	−1.3
	(3.2)	(3.0)	(2.9)	(2.9)	(2.9)	(2.8)	(1.5)
% Intermediate education	67.8	68.0	67.5	67.2	67.2	67.2	−0.4
	(3.1)	(3.1)	(3.1)	(3.4)	(3.5)	(3.6)	(2.0)
% High education	7.1	7.0	7.9	8.2	8.4	8.8	1.7
	(3.1)	(3.2)	(3.4)	(3.6)	(3.7)	(3.9)	(1.0)
% Occupation I	18.8	18.5	18.2	17.9	17.6	17.0	−2.1
	(3.4)	(3.4)	(3.4)	(3.4)	(3.5)	(3.5)	(1.0)
% Occupation II	23.0	22.9	22.7	22.2	21.9	21.4	−1.8
	(4.9)	(5.0)	(5.1)	(5.2)	(5.3)	(5.4)	(1.2)
% Occupation III	33.4	34.0	33.9	34.5	35.1	35.9	3.0
	(3.7)	(3.8)	(3.8)	(3.8)	(3.9)	(4.0)	(1.4)
% Occupation IV	14.7	14.9	14.8	14.9	15.0	15.2	0.5
	(2.7)	(2.8)	(2.8)	(3.0)	(3.0)	(3.1)	(1.0)
% Occupation V	10.1	9.7	10.3	10.4	10.4	10.5	0.4
	(2.6)	(2.6)	(2.6)	(2.7)	(2.7)	(2.8)	(0.8)
% Female	51.2	51.2	51.2	51.2	51.2	51.1	−0.1
	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.1)
Mean age	38.2	38.3	38.4	38.5	38.6	38.7	0.7
	(0.9)	(0.9)	(0.8)	(0.8)	(0.8)	(0.7)	(0.5)

Source: IAB sample, Statistical Office
Notes: For the labour market outcomes and the socioeconomic characteristics I only consider the working-age population aged 15-64. Employment and unemployment refers to individuals subject to social security contributions. Basis of this table are West Germany's 204 labour market regions.

reported in Table 3.2 with the attainment of the resident population reported in Table 3.3 shows that more than 43% of the immigrants have a low education level, compared with only 25% of the resident population. On the other hand, 46% of the ethnic German immigrants have obtained an intermediate education,

compared with about 67% of the resident population. The shares with high education are similar for both groups at around 10% and 8% respectively.

With regard to the occupational distribution, the differences are similarly pronounced. Close to 60% of the immigrants worked in low skill occupation groups I and II before coming to Germany, compared with only about 40% of the resident population. While they are less likely to have worked in the service ($\sim 18\%$ vs. $\sim 34\%$) and, in particular, the commercial sector ($\sim 5\%$ vs. $\sim 15\%$), a relatively large fraction previously worked in high-skill occupation group V ($\sim 19\%$ vs. $\sim 10\%$), for instance as mathematicians, engineers, and teachers.

A more systematic way of measuring the degree of dissimilarity in the occupational distributions is to compute the following index of congruence for any two groups k and l (see Welch, 1999):

$$C_{kl} = \frac{\sum_c (q_{kc} - \bar{q}_c)(q_{lc} - \bar{q}_c)/\bar{q}_c}{\sqrt{(\sum_c (q_{kc} - \bar{q}_c)^2/\bar{q}_c)(\sum_c (q_{lc} - \bar{q}_c)^2/\bar{q}_c)}}$$

where q_{hc} gives the fraction of group $h(h = k,l)$ in occupation c, and $\bar{q}_c$ gives the fraction of the entire labour force in that occupation. The index C_{kl} equals one if the two groups have identical occupational distributions, and minus one if they are clustered in completely different occupations. An index close to one therefore implies a high degree of competition between the two groups under consideration, a value close to minus one little competition in the labour market. Table 3.4 displays the occupational distribution for different subgroups of the native German population as well as the foreign nationals that live in Germany in 2001.[26] In the bottom row, I report the occupational composition of the cohorts of ethnic German immigrants that arrived between 1996 and 2001 as reported upon arrival and shown in the last column of Table 3.2. The rightmost column

[26]Note that the corresponding fractions are computed using both employed and unemployed individuals, in the latter case using the last occupation they worked in which are imputed in the IAB data set. The implicit assumption is thus that individuals do not switch between occupations which is reasonable in the case of broadly defined occupation groups. Using both employed and unemployed individuals gives a better indication of the actual labour supply in each occupation group.

Table 3.4: Occupational distributions and index of congruence

2001	Fraction in occupation group					Index of
	I	II	III	IV	V	congruence
Native Germans						
Low education	24.7	27.8	33.3	10.5	3.6	0.32
Intermediate education	15.3	20.7	38.8	17.2	8.0	-0.95
High education	1.5	1.0	26.9	18.8	51.9	0.21
All	16.1	20.4	36.7	15.9	11.0	-0.63
Foreign Nationals						
Low education	33.1	37.0	24.0	4.6	13.3	0.57
Intermediate education	25.2	29.6	28.8	11.3	5.1	0.51
High education	2.9	2.3	26.5	16.1	52.3	0.26
All	27.4	31.9	27.3	7.8	5.5	0.63
Ethnic German immigrants	27.9	30.0	18.3	4.9	18.9	1.00

Source: IAB sample, Bundesverwaltungsamt
Notes: The occupation groups are I: farmers, labourers, transport workers; II: operatives, craft workers; III: service workers; IV: managers, sales workers; V: professional & technical workers. The occupational composition refers to last activity in country of origin of all ethnic German immigrants that arrived between 1996 and 2001.

presents the corresponding values of the index of congruence C_{kl} between recent ethnic German immigrants and the various subgroups of the native German and foreign population.

The results show that ethnic German immigrants are most similar in their occupational distribution to native Germans with low education with a calculated index of 0.32. This index drops to -0.95 for Germans with intermediate education but increases again for highly educated Germans to 0.21. The index of congruence with respect to the overall native German population is -0.63, indicating the substantially different occupational composition compared to the immigrating ethnic Germans. The corresponding index for the resident foreign nationals in Germany is 0.63, which in turn means that these are quite similar in their occupational composition to the newly arriving ethnic German immigrants. Within the group of foreign nationals those with low and intermediate education levels are most similar with indices of 0.57 and 0.51 respectively. Based on these calculations, the immigrant inflows between 1996 and 2001 are likely to have exerted supply pressure on the labour markets of particularly the foreign

nationals in Germany as well as the less educated native Germans. There is also some indication of increased supply pressure for the highly skilled native labour force. Due to initial occupational downgrading of the more highly skilled ethnic German immigrants, however, some of this pressure may have been shifted away towards the lesser skilled resident labour force (Bauer and Zimmermann, 1999).

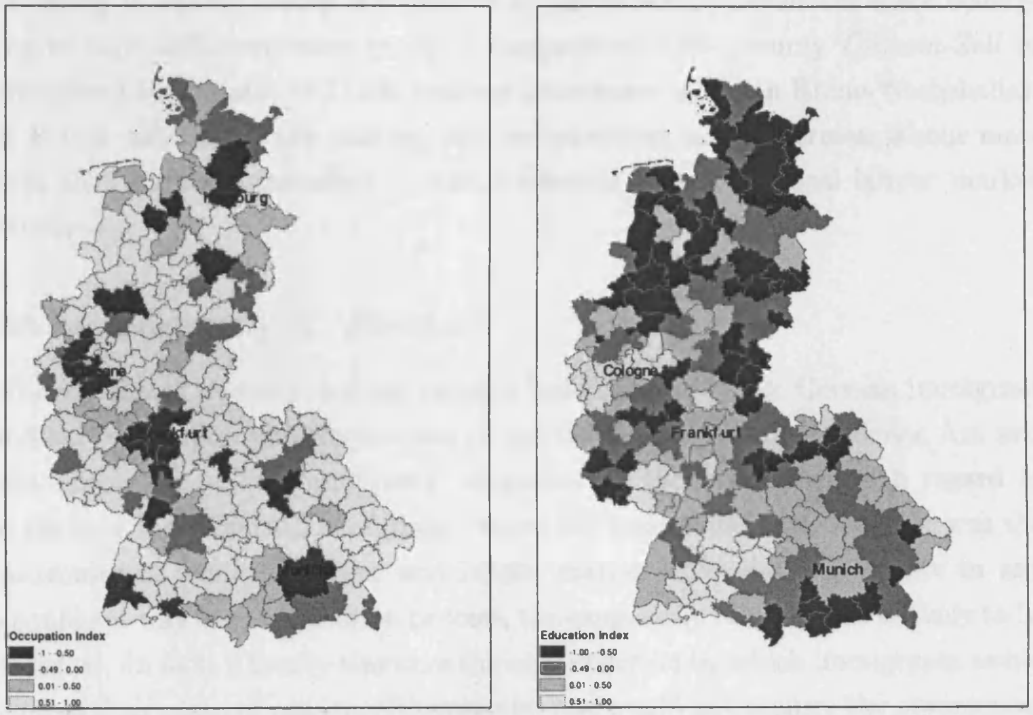
To conclude, both the educational and occupational composition of the newly arriving ethnic German immigrants differs substantially from the existing skill composition of, in particular, the native German population and will therefore have affected the relative factor supplies in the economy.

3.5.3 Variation in Existing Skill Compositions

As described in Section 3.3.2, the primary source of variation in my empirical analysis arises from differences in the existing skill composition of the labour force across local labour markets. As the summary statistics for West Germany's 204 labour market regions in Table 3.3 indicate, there is considerable variation in skill shares both in terms of occupations and educational attainment. To illustrate this point, I calculate the index of congruence as defined in the previous section between the existing skill composition in each locality at the end of 1995 and the skill attainment of the ethnic German immigrants. The map on the left of Figure 3.3 shows this index of congruence with respect to occupations for all West German labour market regions while the map on the right shows the corresponding index with respect to educational attainment. As before, the index ranges between minus one and plus one, the former signifying that the local labour force and the immigrants have entirely different skill compositions and the latter indicating identical skill compositions. Both maps underline the substantial variation in existing local skill compositions across West Germany and the consequential variation in differences relative to the skills of the arriving ethnic German immigrants. These differences across regions give rise to different labour market effects even if all regions are exposed to homogenous immigrant inflows in terms of relative size and skill composition.

To give an example, the lowest share of individuals with low education in a locality is 18.3% (county *Nordfriesland* in Schleswig-Holstein) while the highest

Figure 3.3: Index of congruence across West German labour markets



share is 41.5% (county *Zollernalbkreis* in Baden-Württemberg). Using Equation 3.3 and given an average overall ethnic German inflow rate between 1996 and 2001 of $i = 0.84\%$ of which v=43.3% had only low education (compare Table 3.2), the corresponding percentage change in the share of individuals with low education is then 0.04% for the region with the highest initial share, and 1.1% for the region with the lowest initial share. Similarly, for high skill individuals, the lowest share in my labour market regions is 1.9% (county *Cochem-Zell* in Rhineland-Palatinate) while the highest is 12.9% (area of *Darmstadt* and *Darmstadt-Dieburg* in Hesse). With 10.2% of the ethnic German immigrants being college educated, this leads to a percentage change in the corresponding skill share of -0.17% for the initially high-skill, and 3.6% for the initially low-skill local labour market.

The variation in existing skill shares with respect to occupation groups is similarly pronounced. For instance at the end of 1995, the share of individuals

belonging to occupation group I ranges from 13.6% (county *Calw* in Baden-Württemberg) to 29.1% (county *Holzminden* in Lower Saxony) while the share belonging to high-skill occupation group V ranges from 3.0% (county *Cochem-Zell* in Rhineland-Palatinate) to 17.9% (county *Leverkusen* in North Rhine-Westphalia). It is this variation in the existing skill compositions across German labour markets that identifies the effect of ethnic German inflows on local labour market outcomes.

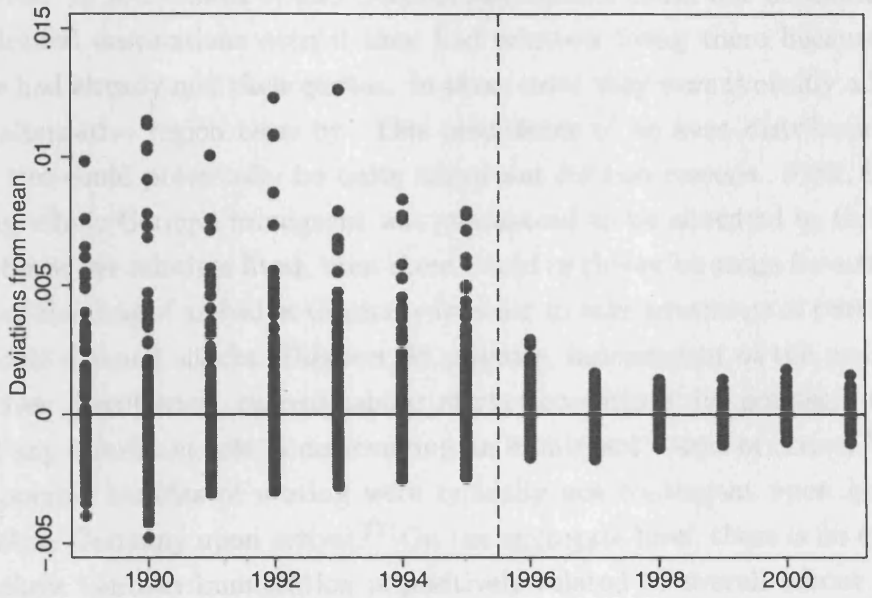
3.5.4 Exogeneity of Allocation

The validity of my instrumental variable based on the ethnic German immigrant inflows relies upon the effectiveness of the Assigned Place of Residence Act and the exogeneity of the immigrants' allocation by the authorities with regard to transitory local demand conditions. Since the main allocation criterion was the proximity of family members and labour market skills did not feature in any significant way in the allocation process, the exogeneity requirement is likely to be satisfied. In fact, if family ties were the only criterion by which immigrants would choose their place of residence themselves, one would not require the government allocation policy in order to maintain the exogeneity assumption with regard to local labour demand shocks. However, local labour market conditions are likely to have played a role in the choice of place of residence before the introduction of the new legislation in 1996, as suggested by Figure 3.4.

Figure 3.4 shows the variation of ethnic German immigrant inflow rates in all West German counties before the introduction of the new legislation in 1996 and for the counties where the law was implemented thereafter. There is a significant reduction in the variation of the regional inflow rates after the introduction of the new legislation. This reduction indicates that the new allocation policy has indeed been effective in altering the direction of ethnic German immigrant inflows and ensuring a more even distribution across Germany. It also points towards the existence of a few particularly attractive destinations before 1996.

There are several potential reasons for the remaining variation after 1996 shown in Figure 3.4. First, the quotas for each federal state and a large number of counties have not been adjusted to changes in their corresponding populations

Figure 3.4: Variation in the ethnic German immigrant inflow rate, 1989 to 2001



Notes: Values depicted are deviations from the mean ethnic German inflow rate in each year. The inflow rates are calculated as the number of allocated ethnic German immigrants divided by the overall population in the county at the end of the previous year. The sample size is, 85 for 1989, 145 for 1990/1991, 204 in 1992-1994, 230 in 1995, 122 in 1996 and 168 in 1997-2001. From 1996 onwards only counties in states that implemented the Assigned Place of Residence Act are depicted.

after they were originally set. In addition, when the state quotas were set in 1993, they were not exclusively based on the resident population but also on the strength of the economy of each state so that some states (and thus the counties they comprise) might receive higher relative inflows than others. I control for these differences in my empirical estimations by the inclusion of region fixed effects. Another reason for the observed differences in relative inflows are different allocation procedures. For instance, in North Rhine-Westphalia the geographical area of each county features as an additional factor in determining the number of immigrants allocated and in Lower Saxony some counties which received a disproportionate number of ethnic Germans in the early 1990s were exempted from additional allocations for some years after 1996.

Trying to achieve an even distribution while giving as much consideration

as possible to the proximity of family members are two not always reconcilable objectives. In some cases ethnic German immigrants could not be allocated to their desired destinations even if they had relatives living there because those regions had already met their quotas. In these cases they were typically allocated to an alternative region close by. This precedence of an even distribution over family ties could potentially be quite important for two reasons. First, if every arriving ethnic German immigrant was guaranteed to be allocated to the region where his or her relatives lived, then there would in theory be scope for a selective choice of the time of arrival in Germany in order to take advantage of particularly good local demand shocks. However, in practice, independent of the precedence of an even distribution, current labour market conditions did not seem to have played any significant role in determining an immigrant's time of arrival because the economic benefits of moving were typically not contingent upon getting a paid job in Germany upon arrival.[27] On the aggregate level, there is no evidence that ethnic German immigration is positively related to overall labour market conditions. On the contrary, as Tables 3.2 and 3.3 show, while both employment and wage rates in Germany increased steadily between 1996 and 2001, ethnic German inflows gradually decreased. To investigate this issue in more detail, I regress the annual inflow rates into each region on the employment/labour force rate and the wage level at the beginning of each year, including both year and region fixed effects. In the absence of county quotas, and if immigrants were certain about which area they would be allocated to and were timing their arrival based on the labour market situation in that area at the beginning of each year, one would expect to find a positive correlation between initial labour market conditions and immigrant inflows. Both coefficient estimates of these regressions are virtually zero and statistically not significant with t statistics of -0.03 and 0.58 respectively.[28] Whether the absence of any correlation is due to government authorities strictly adhering to the set quotas and not allowing relatively more immigrants to move into regions with particularly good current labour market conditions, or immigrants not timing their arrival accordingly cannot be directly

[27] According the government authorities it seemed to be predominantly factors in the country of origin that determined the actual timing of immigration to Germany.

[28] The point estimate on the employment/labour force rate is -0.71×10^{-4} with a robust standard error of 24.4×10^{-4} while the estimate on the average wage level is 0.19×10^{-4} with a standard error of 0.33×10^{-4}.

deduced from these results. To answer that question I would require information on the number of immigrants that arrived in Germany each year but were not allocated to their preferred destination. If these numbers were positively related to current labour market conditions, this would point towards a selective timing of immigration. What the results show, however, is that local labour market conditions at the beginning of a year did not affect the size of relative inflows into each area.[29] The second potential problem that could arise if there was no precedence of quotas over family ties is that, theoretically, relatives could move to those areas that are particularly attractive before the immigration of the ethnic German occurs and through this channel allow an endogenous self-selection of the immigrant. However, even in that case, as long as the selective migration of relatives is based on permanent rather than transitory features of the selected labour market region, I am able to control for such behaviour by including region fixed effects in the empirical estimations.

One way to investigate whether the allocation decision has indeed been exogenous with respect to individual skill characteristics as suggested by the overwhelming importance of family ties for the allocation decision is to compare the age distribution of the ethnic German immigrants that were allocated to each federal state. These distributions are recorded at the central admission centre and reported in Table 3.5. If immigrants were exogenously allocated with respect to their individual characteristics, one would not expect there to be significant differences in their age distribution across states. As shown in Table 3.5, the age distributions across states are indeed very similar. As a reference point, I show the standard deviation of each age group's share of the overall resident population across the same states at the end of 1995 in the last column. Apart from the 15 to 24 year-olds, the standard deviation of the age group shares of the allocated ethnic German immigrants is substantially lower than the corresponding standard deviation in the overall population in all age groups. In particular the

[29] If relative labour market conditions for different skill groups lead to selective relative timing of arrival by these skill groups, then this could potentially be problematic. For example, if there are good conditions for low-skill workers in a locality relative to those for high-skill workers, this could lead to an advancement of immigration by low-skill workers and a postponement by high-skill workers, thus changing the composition (rather than the size) of the arriving immigrant labour force. For the construction of my instrumental variable I assume that the skill composition of the arriving ethnic German immigrants in each locality is identical.

Table 3.5: Age distribution of allocated ethnic German immigrants, 1996 to 2001

Age group	SH	HA	LS	BR	NW	HE	RP	BW	BA	SA	STDEV	STDEV all
0 - 14	25.9	24.2	26.4	26.1	25.9	25.8	25.6	25.0	25.0	24.8	0.7	1.2
15 - 24	18.7	19.7	19.2	18.9	19.3	18.6	19.1	18.9	19.0	18.9	0.3	0.3
25 - 34	15.3	15.0	14.9	15.3	14.9	15.3	15.0	14.8	14.9	15.3	0.2	0.7
35 - 44	18.2	17.8	18.0	17.5	17.7	17.8	17.4	17.8	17.7	17.9	0.2	0.5
45 - 55	9.1	10.1	8.8	9.2	9.0	8.9	9.7	9.5	9.5	9.8	0.4	0.6
55 - 64	6.4	7.1	6.6	6.8	6.6	6.7	6.6	7.0	7.2	7.0	0.3	0.4
> 64	6.4	6.2	6.2	6.3	6.6	6.8	6.6	7.1	6.7	6.3	0.3	0.8

Notes: West Germany's 10 federal states are: Schleswig-Holstein (SH), Hamburg (HA), Lower Saxony (LS), Bremen (BR), North Rhine-Westphalia (NW), Hesse (HE), Rhineland-Palatinate (RP), Baden-Württemberg (BW), Bavaria (BA) and Saarland (SA).

shares of the groups aged 25 to 34 and 35 to 44, which represent a large part of the working population and are therefore most relevant for this analysis, are very similar across states. A regression of the age group shares of the immigrant population allocated to each state between 1996 and 2001 on the existing share at the end of 1995 and a set of age group fixed effects gives an estimate of -0.03 with a robust standard error of 0.12.[30] Hence there is no evidence that for instance young ethnic German immigrants have been allocated to states that are generally more attractive to young people. Overall the figures suggest that there has been an exogenous allocation of ethnic German immigrants to each federal state with respect to their individual characteristics. Since the allocation to each state follows similar administrative processes and decision criteria as the subsequent allocation to different counties, the results in Table 3.5 can be regarded as indicative of an exogenous allocation within states to different counties.

[30]Similarly, regressing annual age group shares on existing age group shares of the resident population as well as interactions of age group and year fixed effects gives a statistically not significant estimate of -0.01 with a robust standard error of 0.07.

3.5.5 Migratory Responses

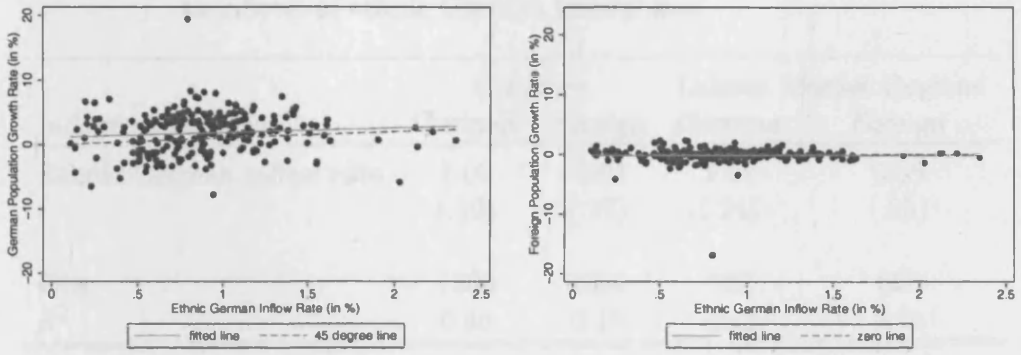
Before presenting the empirical results for the impact of immigration on local labour market outcomes, I first investigate whether there is evidence for migratory responses of the resident population to the inflows of ethnic German immigrants. By dissipating the effect of immigration across the entire economy, one would in that case underestimate the magnitude of the parameters of interest β_1 and β_2. Due to Germany's relatively inflexible labour market, one would a priori not expect large migration flows in response to increased immigration and previous results seem to confirm this claim (e.g. Pischke and Velling, 1997). The comparatively generous social security system, with particularly high and long-lasting unemployment benefits, typically counteracts the incentive to move to a different location in the face of adverse labour market conditions.[31]

This perception is supported by Figure 3.5 which plots the growth rates of the German and foreign population in the 230 West German counties between 1996 and 2001 against the corresponding ethnic German inflow rates. In the absence of out-migration of the resident population in response to the immigrant inflows, every additional ethnic German immigrant moving into a particular county should increase the overall German population (which includes the ethnic German immigrants) of that county by one while the number of foreign nationals should remain unchanged. A simple OLS regression of the German population growth rate on the ethnic German immigrant inflow rate yields a coefficient of 0.73 with a robust standard error 0.53, while the same regression for the group of foreign nationals yields a coefficient of -0.01 with a standard error of 0.17 so the hypotheses that these coefficients are one and zero, respectively, cannot be rejected. As apparent in the graph, there is substantial variation particularly in the German population growth rates across counties, ranging from minus to plus 10% but these changes are not systematically related to the ethnic German immigrant inflows.

To investigate this issue further, I regress the annual growth rate of the German population on the annual immigrant inflow rates, including both year

[31] During the 1980s, for instance, the regional disparities of unemployment rates in West Germany widened substantially while internal migration decreased (see Bauer et al., 2005).

Figure 3.5: Population growth vs. ethnic German inflow rate, 1996 to 2001



Source: Statistical Office and own collection.
Notes: Sample are 230 West German counties for which ethnic German inflows are observable. Rates are calculated as the overall German or foreign population change, respectively the overall number of ethnic German immigrants, between 1996 and 2001 divided by the county population on 31 December 1995.

and region fixed effects, the latter to allow for region-specific population growth trends. I estimate at the county as well as the labour market region level. The results are shown in Table 3.6. As before, in the absence of migratory responses of the native German population, every immigrating ethnic German should increase the overall German population by one. Native out-migration, on the other hand, would be reflected by a coefficient estimate of less than one. As we can see in columns (1) and (3) of Table 3.6, there is no evidence of native out-migration that could dissipate any labour market effects across the economy. Both estimates are very close to one. Moreover, there is also no evidence that the immigrants move to areas that are particularly attractive destinations for native Germans, in which case the coefficient estimate would be greater than one.[32] This finding supports the claim that because of their exogenous allocation to particular counties ethnic German immigrants did not self-select into booming local labour markets.

Columns (2) and (4) of Table 3.6 report the results when I regress the annual growth rate of foreign nationals in a locality on the ethnic German immigrant inflow rate. As before, there is no evidence of out-migration of foreign nationals

[32]Particularly attractive destinations are in this context regions that experience annual increases in their German population that go beyond their long-term trends.

Table 3.6: Migratory response of native Germans and foreign nationals to inflows of ethnic German immigrants

	Counties		Labour Market Regions	
Independent variable	German	Foreign	German	Foreign
Ethnic German inflow rate	1.05	-0.01	1.01	0.08
	(.19)	(.17)	(.24)	(.25)
Obs.	1380	1380	888	888
R^2	0.48	0.19	0.42	0.18

Notes: Entries are the estimated coefficients on the ethnic German immigrant inflow rate in models where the dependent variable is either the annual growth rate of the German or the foreign local population in either West Germany's 230 counties or 148 labour market regions for which I have information on the annual ethnic German inflows between 1996 and 2001. All estimations include a full set of region and year fixed effects.

in response to these inflows which would be reflected by a negative coefficient estimate. Equally important, both for counties and labour market regions, there is also no indication of a positive relationship between the flows of ethnic German immigrants and foreign nationals. Both coefficients are close to zero. Given that foreign nationals are to a large extent free to choose their place of residence and likely to move to those areas where labour market conditions are best, one could expect a similar settlement pattern from ethnic German immigrants if they did indeed choose their places of residence endogenously. In that case the estimates in Table 3.6 should show a positive correlation.

Since in the empirical model on which this analysis is based, changes in relative factor shares are determining the relative wage structure, it is instructive to investigate whether there is evidence of skill-specific out-migration in response to the inflow of ethnic German immigrants. Following Card and DiNardo (2000), I relate the annual change in the overall log skill share of a specific skill group in a locality to the predicted relative immigrant inflow rate for that skill group:

$$\Delta \log(P_{jr}/P_r) = a + b(\Delta I_{jr}/P_{jr_{-1}} - \Delta I_r/P_{r_{-1}}) + u_{jr},$$

where $\Delta I_{jr}/P_{jr_{-1}}$ is the predicted skill-specific inflow rate of ethnic German immigrants with skill j in region r and $\Delta I_r/P_{r_{-1}}$ is the overall inflow rate. If the

Table 3.7: Skill-specific migratory response to inflows of ethnic German immigrants

	Counties		Labour Market Regions	
Independent variable	Occupation	Education	Occupation	Education
Relative inflow rate	1.30	1.65*	1.17	1.74*
	(.34)	(.39)	(.42)	(.45)
Obs.	6900	4140	4440	2664
R^2	0.21	0.29	0.30	0.40

Notes: Entries are the estimated coefficients on the relative skill-specific ethnic German immigrant inflow rate. The dependent variable is the annual change in the log skill share in either West Germany's 230 counties or 148 labour market regions for which I have information on the annual ethnic German inflows between 1996 and 2001. All estimations include five occupation and three education groups respectively. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Robust standard errors are reported in parentheses and are clustered at the skill-specific regional level. Regressions are weighted by the overall skill-specific labour force in each region. A (*) denotes that the parameter is statistically different from 1 at the 10%, a (**) at the 5% and a (***) at the 1% significance level.

migratory response of the resident population fully offsets the skill-specific inflow of immigrants, then the relative inflow rate will have no effect on the overall skill share and the coefficient b will be zero. By contrast, in the absence of a differential migratory response of the resident population in a specific skill group to inflows of ethnic German immigrants into the same group, the coefficient b will be one. Table 3.7 shows the results for the parameter b for both the specification based on occupation groups and the specification based on education groups. As before, I estimate at the county as well as the labour market region level. The results show that there is no indication for any selective out-migration of the resident population that could offset the changes in relative factor shares induced by the immigrant arrival. All parameter estimates are larger than 1, with point estimates of 1.30 and 1.17 for the occupation-based regressions and 1.65 and 1.74 for the education-based regressions. If at all, there is some evidence that the skill-specific inflow of immigrants leads to an increase in the relative growth of the corresponding resident population, although only in the education-based regressions is b statistically different from 1 and that only at the 10% level.

To sum up, overall the results in Table 3.6 and Table 3.7 show that there

is little evidence of any out-migration of the resident population, both overall and skill-specific, in response to ethnic German immigrant inflows. It is therefore unlikely that out-migration has mitigated the effect the immigrant inflow has had on the regional wage structure and relative employment rates.

3.6 Empirical Results

Turning to the estimation results, Table 3.8 presents estimates of the effect of changes in skill-specific local labour force shares on the employment/labour force rate of the resident population. I estimate the empirical model in Equation 3.1 first by OLS and then using the predicted skill-specific ethnic German inflow rate as described in Section 3.3.1 to instrument the potentially endogenous change of the skill shares in a locality. I report results for skill groups based on occupations in the upper panel and for skill groups based on educational attainment in the lower panel. The dependent variable in each regression is the regression-adjusted employment/labour force rate of the local labour force, thus controlling for differences in individual characteristics across labour markets. The estimates in columns (1) and (2) are based on all 148 West German labour market regions for which data on ethnic German inflows are available while in columns (3) and (4) the sample is restricted to those 112 regions that formally implemented the Assigned Place of Residence Act. The reason why the inclusion of labour market regions in states that have not formally implemented the legislation could be of interest is that even in those states the main criterion for the actual allocations were family ties, in which case the immigrant inflows would also be exogenous to unobserved labour demand shocks and provide additional observations for the estimations. However, endogenous allocations by the authorities as well as self-selection by immigrants within these states continues to be a possibility, so that the results from this specification are likely to remain upward biased.

Looking at the OLS results for all individuals reported in the first row in columns (1) and (3) of the upper panel first, we see a significant negative effect of an increase in the relative occupation share in a locality on the overall employment/labour force rate. The estimated coefficients of -0.125 and -0.126 imply that a 10% increase in the relative occupation share induced by additionally

Table 3.8: Impact of changes in relative factor shares on the employment/labour force rate

	All regions		Restricted regions	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Occupation groups				
All	-0.125***	-0.026	-0.126***	-0.353**
	(.011)	(.306)	(.013)	(.168)
		[1.44]		[3.13]
All unweighted	-0.120***	0.127	-0.121***	-0.374**
	(.012)	(.451)	(.012)	(.189)
		[1.38]		[2.98]
All aged 25-54	-0.118***	0.109	-0.122***	-0.211
	(.011)	(.264)	(.012)	(.150)
		[1.80]		[3.17]
Germans only	-0.125***	-0.090	-0.122***	-0.327**
	(.011)	(.222)	(.012)	(.155)
		[1.84]		[3.40]
Observations	4440	4440	3185	3185
Education groups				
All	-0.069***	-0.381*	-0.074***	-0.482*
	(.017)	(.198)	(.019)	(.288)
		[2.94]		[2.66]
All unweighted	-0.070***	-0.348	-0.065***	-0.248*
	(.015)	(.212)	(.018)	(.132)
		[2.95]		[3.21]
All aged 25-54	-0.065***	-0.234	-0.067***	-0.416
	(.020)	(.235)	(.020)	(.258)
		[2.49]		[2.74]
Germans only	-0.079***	-0.313*	-0.083***	-0.425
	(.018)	(.181)	(.019)	(.267)
		[3.24]		[2.58]
Observations	2664	2664	1911	1911

Notes: Entries are the estimated coefficients on the change in the log factor shares $\Delta \log f_{jrt}$. The dependent variable is the annual change in the skill-specific employment/labour force rate. All estimations include five occupation and three education groups respectively. Columns 1 and 2 use all 148 West German labour market regions for which data is available, columns 3 and 4 only those 112 that actually implemented the law (see Table 3.11 in Section 3.8.2). Employment/labour force rates are based on individuals already in the data at the end of 1995. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Employment/labour force rates are adjusted for differences in individual specific characteristics across labour markets. Robust standard errors are reported in parentheses and are clustered at the skill-specific regional level. For the IV estimates, the t-stat of the instrument from the first stage regression is reported in square brackets. Regressions are weighted by the inverse of the standard errors of the region fixed effects taken from the regressions to obtain adjusted outcomes. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

employed individuals reduces the employment/labour force rate of the resident population by 1.25 and 1.26 percentage points respectively.[33]

In the presence of unobserved transitory local demand shocks, the OLS estimates of Equation 3.1 will be upward biased since such shocks attract workers into a particular skill group while at the same time improving employment opportunities. I therefore instrument the changes in the relative skill shares with the occupation-specific ethnic German inflow rate. The corresponding estimates are reported in column (2) and (4). While the coefficient for the specification based on all labour market regions is small and statistically not significant due to a weak first stage with a t statistic for the instrument of only 1.44, restricting the sample to those regions that did formally implement the legislation increases the strength of the instrument and reduces the estimate to -0.353, which is significant at the 5% level (column 4). Since, as explained in Section 3.3.1, ethnic German immigrants can only appear in the data and hence enter the numerator of the relative local skill share by becoming employed, the estimated coefficients can be directly interpreted as a displacement effect: for every 10 ethnic German immigrants finding employment, 3.5 resident workers accordingly lose their job (or do not find one when they otherwise would have). The increase in magnitude of this estimate by a factor of around 3 compared to the OLS results points towards the existence of unobserved skill-specific local demand shocks that attract workers into the labour force as well as lead to favourable changes in local labour market outcomes.

The first row of the lower panel of Table 3.8 reports results for the same regression but this time after defining skill groups according to the educational attainment of an individual. While the OLS results in columns (1) and (3) suggest that an increase in the relative skill share through additionally employed individuals by 10% reduces the employment/labour force rate of the resident labour force by 0.69 and 0.74 percentage points respectively, this effect increases

[33]Note that in order to facilitate the calculation of regression-adjusted employment/labour force rates I use the employment/labour force rate in levels in my estimations rather than in logs as suggested by the theoretical model in Section 3.3.1. One can translate the coefficients in my tables for the effects on the employment/labour force rate into estimates of β_1 by dividing them by the average employment/labour force rates of all individuals (0.91).

by a factor of 5.5 and 6.5 respectively, to 3.81 and 4.82 percentage points once I instrument for the potentially endogenous change in the relative skill shares. Although only marginally significant at the 10% level, the point estimates of the IV regressions in column (2) and (4) suggest a similar magnitude as the one found when distinguishing between different occupation groups. Moreover, the fact that the IV estimates increase in magnitude when moving from all 148 regions to the restricted sample of 112 regions indicates that, in the former case, there may be some positive correlation remaining between the ethnic German inflows and unobserved demand shocks in those areas where the law has not been implemented so that the estimated coefficient continues to be upward biased. The implied displacement effects of 3.81 and 4.82 workers for every 10 ethnic Germans finding employment seem relatively large. However, since, based on information from the German Microcensus, only between 30% and 40% of working age ethnic German immigrants find a job in the first year after arrival, and absolute inflows on the local level have been relatively moderate, the actual number of displaced native German and foreign workers has been quite small.[34]

The remaining rows of Table 3.8 show estimates of β_1 for a number of alternative specifications in order to test the robustness of the results. In the second row of each panel, I report the unweighted regression results for both the OLS and IV estimations. All estimates are similar in magnitude to their counterparts in the weighted regressions apart from the IV result based on education groups for the restricted set of regions reported in column (4) which is somewhat smaller with a point estimate of -0.248. Since the data have some shortcomings in terms of capturing movements into and out of the labour force, I estimate my model separately for individuals aged 25 to 54 for which these movements are less of an option to adjust to changing labour market conditions. The corresponding results are reported in the third row of each panel. Although statistically not significant, the point estimates indicate a slightly smaller magnitude than the one found when using all individuals as reported in the first row of each panel. Finally, I investigate whether there are different effects for the native German

[34]Multiplying the estimated coefficients by the share of immigrants that find employment within the first year of arrival will provide an estimate of how a general inflow of immigrants into the labour force, whether employed or unemployed, affects labour market outcomes.

population compared to foreign nationals living in Germany which make up about 10% of the labour force. Due to the limited sample size for the latter group in my region/skill cells, estimating separately for them is not viable. However, I can estimate separately for native Germans and compare the results with those obtained when using all individuals to get at least an indication of whether the effect on foreign nationals is likely to be larger or smaller than the one on Germans. The last row of each panel in Table 3.8 reports the results for the effect on the employment/labour force rate of the native German population only. Compared to the estimates for the overall population reported in the first row, the estimated effects tend to be smaller both in the regressions based on occupations and the ones based on educational attainment. In the first case, using the restricted set of labour market regions leads to a significant estimate of -0.327 (column 4) compared to -0.353 when using the entire population, both Germans and foreign immigrants. Similarly, the estimate based on education groups decreases from -0.482 for the overall population to -0.425 for the German population, although this estimate is not statistically significant at conventional levels.

Turning towards the impact of changes in relative skill shares on wages, the upper panel in Table 3.9 reports the results for the coefficient β_2 in Equation 3.2 when, as before, skill groups are defined by occupation, whereas the lower panel reports the results when they are defined by education. The OLS estimates of β_2 for the wages of all individuals reported in the first row of Table 3.9 in column (1) are -0.049 for the occupation and -0.058 for the education regressions. These imply that a 10% increase in the relative skill share in a locality through additionally employed individuals decreases relative wages by 0.49% and 0.58% respectively. The IV results on the other hand do not show any negative effect of ethnic German immigrant inflows on the average wage rate both in the specification based on all 148 labour market regions and the one using only those 112 regions that implemented the Assigned Place of Residence Act. All estimates are statistically not significant and in most cases close to zero. The point estimates in the preferred specification in column (4) are -0.120 with a standard error of 0.188 in the occupation regression and 0.301 with a standard error of 0.316 in the education regression.

Table 3.9: Impact of changes in relative factor shares on log daily wages

	All regions		Restricted regions	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Occupation groups				
All	-0.049***	-0.174	-0.068***	-0.120
	(.014)	(.562)	(.015)	(.188)
		[1.14]		[2.69]
All unweighted	-0.042***	0.457	-0.061***	-0.028
	(.015)	(.637)	(.015)	(.182)
		[1.38]		[2.98]
All aged 25-54	-0.053***	-0.641	-0.069***	-0.277
	(.016)	(.584)	(.016)	(.214)
		[1.62]		[2.71]
Germans only	-0.048***	-0.143	-0.066***	-0.197
	(.014)	(.474)	(.015)	(.192)
		[1.33]		[2.85]
Observations	4440	4440	3185	3185
Education groups				
All	-0.058**	0.198	-0.060***	0.301
	(.026)	(.133)	(.022)	(.316)
		[3.53]		[2.08]
All unweighted	-0.043**	0.380*	-0.071***	0.084
	(.021)	(.209)	(.021)	(.130)
		[2.95]		[3.21]
All aged 25-54	-0.045	-0.019	-0.054**	0.151
	(.028)	(.244)	(.022)	(.254)
		[2.59]		[2.33]
Germans only	-0.046*	0.298**	-0.059***	0.350
	(.025)	(.115)	(.021)	(.329)
		[4.54]		[2.03]
Observations	2664	2664	1911	1911

Notes: Entries are the estimated coefficients on the change in the log factor shares $\Delta \log f_{jrt}$. The dependent variable is the annual change in the skill-specific average log daily wage of all full-time employees. All estimations include five occupation and three education groups respectively. Columns 1 and 2 use all 148 West German labour market regions for which data is available, columns 3 and 4 only those 112 that actually implemented the law (see Table 3.11 in Section 3.8.2). Average log wages are based on individuals already in the data at the end of 1995. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Average log wages are adjusted for differences in individual specific characteristics across labour markets. Robust standard errors are reported in parentheses and are clustered at the skill-specific regional level. For the IV estimates, the t-stat of the instrument from the first stage regression is reported in square brackets. Regressions are weighted by the inverse of the standard errors of the city fixed effects taken from the regressions to obtain adjusted outcomes. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

The IV estimates of most of the additional specifications that I estimate and report in Table 3.9 are not precisely estimated and inconclusive regarding the effect of ethnic German immigrant inflows on relative wages. While the point estimates tend to be negative in the regressions based on occupation groups, they tend to be positive in the education based regressions. However, the only cases in which they are statistically significant are the unweighted specification and the specification for native Germans only based on all 148 regions available (column 2) with estimates of 0.380 and 0.298 respectively. These positive effects are driven by a large positive impact on wages of German women whereas the effect on men is very small in magnitude and not significant (see separate tables for men and women in Section 3.8.6 in the appendix to this chapter). As I pointed out before, there remains scope for endogenous self-selection of immigrants in those regions in which the Assigned Place of Residence Act was not implemented, which could in principle also lead to a positive coefficient. When I restrict the sample to the preferred set of 112 regions, the estimates for the education based regressions remain positive but become statistically not significant.

The fact that I do not find any evidence of negative wage effects may be explained by Germany's relatively inflexible labour market and, in particular, strong unions and strict labour market regulations. Although in decline, union coverage is still high at 68% in 2000 (OECD, 2004).[35] In addition, wages in Germany are to a large extent set by sector-level collective wage agreements, leaving little room for wage adjustments on the regional level. The overall scope for short-term adjustments in the wage structure in Germany in response to immigrant inflows is therefore limited. This may also explain why I find relatively large adjustments in relative employment levels in my estimations: with rigid wages and at least some degree of substitutability between the resident workforce and newly arriving immigrants in the production process, an increase in labour supply through immigration leads to an increase in unemployment of the resident population unless it induces a sufficiently large increase in labour demand. However, as Pischke and Krueger (1998) point out, constraints and rigidities on the product market are relatively pronounced in Germany, impacting precisely this demand side of the labour market. For instance, it is much more

[35]For comparison, the corresponding figure for the U.S. is 14%.

difficult to start up a new business in Germany than it is in the U.S. which contributes to the economy's sluggishness in creating additional jobs when its population expands. In fact, total employment in Germany increased by only 1.4% between 1991 and 2001 while the working age population increased by 4.7% (of which around 46% was due to ethnic German immigrants and 45% due to immigration of foreign nationals).[36] This explanation is also supported by the results of a cross-country study carried out by Angrist and Kugler (2003). Analysing the impact of immigrants on native employment rates in eighteen European countries, the authors not only find evidence of a substantial displacement of native workers by immigrants, ranging from 35 to 83 native job losses for every 100 immigrants in the labour force, but also some clear indication that this effect is exacerbated by rigidities on the product market, such as high business entry costs, and reduced flexibility on the labour market, for instance through employment protection, union coverage, and minimum wages.

As pointed out in Section 3.3.2, the main source of variation I exploit in the empirical estimations are differences in the existing skill compositions across local labour markets. One concern in this context is that my results may be driven by unobserved trends in skill region specific labour market outcomes that are correlated with the initial skill share in a locality. For instance, if for some reason regions with a small initial share of a particular skill group tend to experience faster declining employment and wage rates than regions with a large initial share, then even if there was no effect of an immigrant inflow on labour market outcomes, the empirical estimates would still show a negative effect. This is because, as described in Section 3.3.2, the lower the initial share of a particular skill group in a locality, the larger will be the percentage change in this share induced by the inflow of ethnic German immigrants. The observed negative correlation between the percentage change in the relative skill share and changes in labour market outcomes will in this case, however, be entirely driven by the underlying correlation between the initial skill share and future changes in labour market outcomes.

To investigate this issue, I estimate a model relating changes in labour market outcomes directly to the initial skill shares f_{jrt-2} in a locality. I use the skill

[36]Source: Statistical Office and own calculation.

Table 3.10: Impact of initial skill shares on labour market outcomes, 1985 to 1987

	$\Delta(N_{jrt}/P_{jrt})$		$\Delta \log w_{jrt}$	
Independent variable	Occupation	Education	Occupation	Education
Initial skill share	0.011	-0.003	-0.005	-0.014
	(.011)	(.016)	(.016)	(.020)
Obs.	1480	888	1480	888
R^2	0.81	0.76	0.70	0.82

Notes: Entries are the estimated coefficients on the local skill share lagged by two periods, f_{jrt-2}. The dependent variable is either the annual change in the employment/labour force rate or the annual change in log daily wages for the period 1985 to 1987. All estimations include five occupation and three education groups, respectively, and are estimated using West Germany's 148 labour market regions. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Standard errors are robust and clustered at the skill-specific regional level. Employment and wage rates are adjusted for differences in individual specific characteristics across labour markets (see text). Regressions are weighted by the inverse of the standard errors of the region fixed effects taken from the regressions to obtain adjusted outcomes. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

share lagged by two periods to mimic as closely as possible my previous estimations in which I also used the skill-specific labour force lagged by two periods to construct the instrumental variable. The two models for the change in the employment/labour force and wage rate, respectively, are then given by

$$\Delta(N_{jrt}/P_{jrt}) = a_{jt} + a_{rt} + \delta_1 f_{jrt-2} + a_{jrt}$$

$$\Delta \log w_{jrt} = b_{jt} + b_{rt} + \delta_2 f_{jrt-2} + b_{jrt},$$

where a_{jt}, b_{jt}, a_{rt}, and b_{rt} are, as in the regression models in Equations 3.1 and 3.2, interactions of skill group and year fixed effects and region and year fixed effects respectively.

To minimise the influence of any other compounding factors and isolate the effect of initial skill shares, I estimate these models for the period 1985 to 1987. This is a period of little immigration to Germany which, at the same time, is sufficiently long after the strong recession of 1981/82. A significant

correlation between the initial skill share f_{jrt-2} and changes in labour market outcomes would point towards unobserved skill region specific trends that are not accounted for in the model set out in Section 3.3.1.

Table 3.10 reports the estimates for δ_1 and δ_2 separately for the regressions based on occupation (columns 1 and 3) and education groups (column 2 and 4). All of the estimated coefficients on the initial skill share are statistically not significant and close to zero, indicating that the initial skill share is not systematically related to future changes in these labour market outcomes. For the corresponding results for men and women see Table 3.16 in Section 3.8.6 of the appendix. Apart from the effect on women's wages in the occupation regression, all estimated gender-specific coefficients are also not significant. Based on these results, I conclude that unobserved trends correlated with the initial skill shares in a locality are unlikely to be driving the results of the empirical estimations.

3.7 Conclusion

The arrival of ethnic German immigrants and their distribution across local labour markets by the administration offers a unique natural experiment to investigate the impact of immigration on labour market outcomes. In this chapter, I analyse how these inflows have affected the employment/labour force rates and average wages of the resident population in Germany between 1996 and 2001.

The empirical results show that shifts in the relative supply of different skill groups in a locality systematically affect the employment/labour force rate of the resident population. Like previous studies, I find evidence that unobserved skill-specific demand shocks lead to biased OLS estimates of the effect of these relative supply shifts. Instrumenting them with the ethnic German inflow rate leads to substantially larger estimates by a factor of 3 to 7. The estimated short-run effects on the overall employment/labour force rate are relatively stable for both skill definitions, occupations and educational attainment, pointing towards a displacement effect of around 0.4 or 4 unemployed resident workers for every 10 immigrants that find a job. I do not find conclusive evidence of any detrimental effect on relative wages. When estimating the empirical model for

the native German population alone, excluding resident foreign nationals from the sample, the estimates for the effect on the employment/labour force rate become smaller in magnitude, suggesting that resident foreign nationals are more affected by ethnic German immigrant inflows than the native German population.

While the absence of significant wage effects of immigration is consistent with most of the existing evidence for Germany, the conclusion that immigrant inflows into a local labour market have a detrimental effect on the employment/labour force rate stands in contrast to a number of other studies for Germany, for instance Pischke and Velling (1997) or Bonin (2005). Both these studies, however, cover a different period, the former the years 1985 to 1989, and the latter the years 1975 to 1997, so that the results are not necessarily comparable. In addition, and in contrast to my analysis, the study by Pischke and Velling, related in that it also uses spatial correlations to identify the immigrant impact, identifies a medium-run effect of immigration by looking at changes over a four-year period. The longer time period allows more scope for labour market adjustments through compensatory population flows as well as changes in the industry structure and output mix of the local economy, both channels which would tend to reduce the effect on relative local labour market outcomes. The fact that German labour markets adjust to immigrant inflows through changes in employment rather than wages is potentially due to Germany's institutional setting in which strong unions allow relatively little wage flexibility, at least at the regional level and in the short run. The relatively large magnitude of the displacement effect in turn points towards constraints on the product market that do not allow for sufficiently large labour demand responses to absorb the additional labour supply.

Because of the importance of the resident labour force's skill composition as a source of variation, I investigate whether initial relative skill shares have an independent effect on future changes in labour market outcomes that could be driving the results but do not find any indication for this. I also do not find evidence of any correlation between the population growth rates of native Germans or foreign nationals and ethnic German immigration. While the absence of a positive correlation can be seen as evidence for the effectiveness of the allocation policy in preventing ethnic German immigrants to move to

particularly attractive labour markets, the absence of a negative correlation suggests that there is no systematic out-migration of either native Germans or foreign nationals in response to the immigrant inflows. This last result also holds when I look at skill-specific out-migration. My estimates of the labour market impacts of immigration are therefore unlikely to be underestimated as a result of unaccounted compensating migration flows.

Apart from estimating the short-run labour market effects of immigration in Germany, this study also emphasises the importance of the existing structure of a labour market in determining the effect of an immigrant inflow using spatial correlations. An identical relative inflow of immigrants into two regions will have substantially different impacts on local labour market outcomes if these regions differ in terms of their existing skill mix. In the context of a governmental allocation policy such as the one described in this chapter, an even distribution in terms of numbers of immigrants relative to the existing population does therefore not necessarily lead to an even distribution of their labour market effects across regions.

While this study has focussed on the impact of an exogenous inflow of immigrants on relative labour market outcomes, an interesting avenue to pursue in the future could be to look at changes in absolute terms. The arrival of new immigrants will typically lead to a redistribution in an economy with a net positive effect on national income accruing to the resident population, the immigrant surplus, as long as the immigrants differ from the resident population in terms of their skills and lower their wages (Borjas, 1995b). In theory, the more different the immigrants are from the existing workforce, the larger should be the immigrant surplus they give rise to in a region. The allocation policy described in this chapter offers a good framework for studying this theory due to the substantial variation in the differences of skill levels between immigrants and local workforces. As opposed to cross-country studies, the major advantage of the German context is that both the actual immigrant inflows and the existing institutional settings are homogenous across regions, making it easier to isolate the mechanism by which immigrant inflows lead to immigrant surpluses.

3.8 Appendix

3.8.1 Sample Description

All data on the local labour force is based on the IAB Employment Subsample 1975-2001. This data set contains complete employment histories of 2% of all employees subject to social security contributions in Germany, which translates into approximately 460,000 observations per year for West Germany. For each year, I collect the relevant information at the cut-off date of 31 December. I delete all individuals that are marginally employed (*geringfügig beschäftigt*, *pers_gr*=109, 209, 110, 202, 210) from the sample since these are only recorded from 1999 onwards. I also delete observations that indicate a parallel employment spell (*level2*$\neq$0). I include only men and women aged 15 to 64. I impute missing or unknown values for occupation, educational attainment and location of an individual with the most recent information from previous spells of the same individual, if available. Occupations are aggregated to five groups based on the American SF-3 Occupation Table. The aggregation key can be obtained upon request. Education levels are aggregated to three groups: "low" for individuals "without completed education" (*bild*=0), "without A-levels and without vocational training" (*bild*=1), or "with A-levels but without vocational training" (*bild*=3); "intermediate" for individuals "without A-levels but with vocational training" (*bild*=2) or "with A-levels and with vocational training" (*bild*=4); and "high" for individuals "with (technical) college degree" (*bild*=5, 6). Potential experience, which is used in the regressions to obtain adjusted labour market outcomes, is calculated as current year minus year of birth minus age at the end of educational/vocational training. The average age for each education level is set at 15 for individuals "without completed education", 16 for those "without A-levels and without vocational training", 19 for those "without A-levels but with vocational training" or "with A-levels but without vocational training", 22 for those "with A-levels and with vocational training", and 25 for those "with (technical) college degree" or unknown or missing values (which, based on their average wage rate, seem most similar to college educated individuals). Foreign nationals are aggregated to sixteen groups according to their countries or regions of citizenship: Turkey, former Yugoslavia, Italy, Greece, Poland, the former Soviet Union, Portugal, Romania, Western Europe, Central & Eastern Europe, Africa, Central & South America,

North America, Asia, Australia & Oceania, and Others. Individuals are considered unemployed if they are benefit receivers ($typ1$=6). For the construction of average wages I only consider individuals that are working full-time ($stib$<5). All wages are converted into real wages in Euros at constant 1995 prices using the German CPI for all private households. Wage records that are right censored at the social security contribution ceiling are imputed using a method developed by Gartner (2004). I aggregate the 326 West German counties (excluding Berlin) to 204 labour market regions using an aggregation key provided by the IAB.

3.8.2 Institutional Background

Table 3.11: West Germany's states and their implementation of the Assigned Place of Residence Act

	No. of counties	No. of labour market regions	State quota in %	Actual quota 1996-2001	Law implemented	Date of implementation	In unrestricted sample	In restricted sample
Schleswig-Holstein	15	7	3.3	3.4	yes	1.3.1996	yes	yes
Hamburg	1	1	2.1	2.1	yes	1.3.1996	yes	yes
Lower Saxony	46	35	9.2	8.2	yes	7.4.1997	yes	yes, from 1997
Bremen	2	0	0.9	0.9	yes	1.3.1996	yes	yes
North Rhine-Westphalia	54	36	21.8	21.6	yes	1.3.1996	yes	yes
Hesse	26	16	7.2	7.2	yes	1.1.2002	yes	no
Rhineland Palatinate	36	21	4.7	4.6	no	-	yes	no
Baden-Württemberg	44	29	12.3	12.1	yes	1.3.1996	yes	yes
Bavaria	96	55	14.4	14.3	no	-	no	no
Saarland	6	4	1.4	1.4	yes	11.3.1996	yes	yes
Overall	**326**	**204**	**77.3**	**75.8**	8/10	-	9/10	7/10

Notes: The labour market region in Hamburg also comprises three counties that are situated in Schleswig-Holstein and one county that is situated in Lower Saxony. Because of the dominance of Hamburg's and Schleswig-Holstein's counties, this labour market region is already used from 1996 onwards when these two states adopted the Assigned Place of Residence Act. There are two labour market regions in Lower Saxony that each comprise one of Bremen's counties. Because each labour market region here consists of one county from Lower Saxony and one county from Bremen, I conservatively include these labour market regions only from 1997 onwards when Lower Saxony implemented the new legislation. Finally, there is one labour market region in Baden-Württemberg that comprises one of Bavaria's counties. Because this labour market region consists of two counties from Baden-Württemberg and only one from Bavaria, I include it from 1996 onwards.

3.8.3 The Empirical Model

The empirical analysis in this chapter is based on a theoretical model derived by Card (2001) in which immigration impacts local labour markets by changing the relative supplies of different skill groups. Suppose that a single output good Y is produced in labour market region r in a given year t with a production function

$$Y_{rt} = F(K_{rt}, L_{rt}),$$

where K_{rt} are non-labour inputs and L_{rt} is a nested CES production function of different skill groups j that are imperfect substitutes:

$$L_{rt} = \left(\sum_j (e_{jrt} N_{jrt})^{(\sigma-1)/\sigma}\right)^{\sigma/(\sigma-1)}.$$

Here N_{jrt} is the number of individuals with skill level j employed in region r at time t and σ is the elasticity of substitution between the different skill groups. e_{jrt} reflect region- and skill-specific productivity levels. If the wage rate of skill group j in region r at time t is now given by w_{jrt} and the selling price of output from region r in year t by q_{rt}, equating the marginal product of a skill group with its real product wage will lead to the following expression:

$$\log N_{jrt} = \theta_{rt} + (\sigma - 1)\log e_{jrt} - \sigma \log w_{jrt}, \tag{3.4}$$

where $\theta_{rt} = \sigma \log [q_{rt} F_L(K_{rt}, L_{rt}) L_{rt}^{1/\sigma}]$ is a region- and time-specific component shared by all skill groups. Let P_{jrt} be the labour force of individuals in skill group j in labour market region r in year t and assume a log-linear labour supply function

$$\log (N_{jrt}/P_{jrt}) = \varepsilon \log w_{jrt} \tag{3.5}$$

with $\varepsilon > 0$. Then using Equations 3.4 and 3.5, I can obtain the following expressions for the employment/labour force and average wage rate of skill group j in region r at time t:

$$\log (N_{jrt}/P_{jrt}) = \varepsilon/(\varepsilon + \sigma)\{(\theta_{rt} - \log P_{rt}) + (\sigma - 1)\log e_{jrt} - \log (P_{jrt}/P_{rt})\},$$

$$\log w_{jrt} = 1/(\varepsilon+\sigma)\{(\theta_{rt} - \log P_{rt}) + (\sigma - 1)\log e_{jrt} - \log(P_{jrt}/P_{rt})\},$$

where P_{rt} is the overall labour force in labour market region r at time t.[37] Both local wages and employment rates are determined by three factors: a common region- and time-specific component, a skill-, region- and time-specific productivity component, and the relative labour force shares of the different skill groups. If I decompose the unobserved productivity component into four parts

$$\log e_{jrt} = e_{jr} + e_{jt} + e_{rt} + e'_{jrt},$$

where e_{jr} represents skill- and region-specific effects, e_{jt} is a skill- and time-specific effect, e_{rt} is a region- and time-specific effect, and e'_{jrt} is a skill-, region- and time-specific effect, I can obtain two regression models for the employment and wage rates:

$$\log(N_{jrt}/P_{jrt}) = v_{jr} + v_{jt} + v_{rt} + \beta_1 \log f_{jrt} + v_{jrt},$$

$$\log w_{jrt} = u_{jr} + u_{jt} + u_{rt} + \beta_2 \log f_{jrt} + u_{jrt},$$

where $f_{jrt} = P_{jrt}/P_{rt}$ denotes the fraction of the overall labour force in labour market r at time t that falls into skill group j. Finally, taking first differences provides the set of equations that are the basis of the empirical analysis in this chapter:

$$\Delta\log(N_{jrt}/P_{jrt}) = v'_{jt} + v'_{rt} + \beta_1 \Delta\log f_{jrt} + \Delta v_{jrt},$$

$$\Delta\log w_{jrt} = u'_{jt} + u'_{rt} + \beta_2 \Delta\log f_{jrt} + \Delta u_{jrt},$$

where v'_{jt}, u'_{jt}, v'_{rt}, and u'_{rt} are interactions of skill and year fixed effects and region and year fixed effects, respectively, and Δv_{jrt} and Δu_{jrt} are unobserved error components that depend on the productivity terms e'_{jrt} and e'_{jrt-1}.

[37] I use the labour force rather than the working age population for P_{jrt} and P_{rt}. I am therefore not able to capture responses through entries to or exits from the labour force which, while less an issue for men, may be problematic when looking at female labour market outcomes.

3.8.4 Regional Skill Mix Variation

Most empirical specifications in studies that regress changes in skill-specific labour market outcomes on the overall rather than the skill-specific immigrant inflow rate in a locality are based on the theoretical model derived by Altonji and Card (1991). In the simplest version, changes in the wage rate of unskilled workers are related to the overall immigrant inflow rate as follows:

$$\Delta \log w_u = \frac{-\lambda_u}{\varepsilon_u - \eta_{uu}} (\alpha/a) \Delta I/P,$$

where α is the share of unskilled workers in the newly arriving immigrant population and a is the share of unskilled workers in the resident local population. The fraction (α/a) is then an indicator for the relative skill differences between these two groups. Now, in Altonji and Card's study as well as many others, (α/a) is assumed to be constant across labour markets. Clearly this is a very strong assumption which in most cases is unlikely to hold. Suppose the relative skill difference between the new group of immigrants and the resident population (α/a) varies across labour markets r. Then the Altonji and Card model can be seen as a random coefficients model of the form

$$\begin{aligned} y_r &= \beta_r (\frac{\Delta I_r}{P_r}) + u_r \\ &= \overline{\beta} (\frac{\Delta I_r}{P_r}) + (\beta_r - \overline{\beta}) (\frac{\Delta I_r}{P_r}) + u_r, \end{aligned}$$

where $\beta_r = \frac{-\lambda_u}{\varepsilon_u - \eta_{uu}} \frac{\alpha_r}{a_r}$.

To obtain an unbiased estimate of $\overline{\beta}$, the effect of immigration on the average local labour market, requires

$$E[(\frac{\Delta I_r}{P_r})^2 (\beta_r - \overline{\beta})] = 0,$$

which holds if the immigrant inflow rate $(\frac{\Delta I_r}{P_r})$ and the local skill differences $(\frac{\alpha_r}{a_r})$ are independent or if there is no variation in the skill composition of either the resident or the arriving immigrant population across labour markets so that $\beta_r = \overline{\beta}$ for all regions r. However, if for instance immigrants predominantly settle in regions where the existing share of unskilled workers is particularly low ("a_r"

is small), then this will induce a positive correlation between $(\frac{\Delta I_r}{P_r})^2$ and $(\beta_r - \overline{\beta})$. Since the term $(\beta_r - \overline{\beta})(\frac{\Delta I_r}{P_r})$, which measures the impact of the skill-specific part of the local immigrant inflow that goes beyond the impact on the average labour market, carries a negative sign this will then lead to a downward biased estimate of $\overline{\beta}$. Importantly, this bias does not necessarily disappear when the immigrant inflow rate is instrumented with the lagged immigrant concentration since the latter is in many cases correlated with $(\beta_r - \overline{\beta})$, for example when immigrants traditionally live in areas with a relatively small unskilled population. Hence, a violation of the assumption of equal skill distributions across local labour markets can potentially lead to biased estimates of the impact of immigration on labour market outcomes if the estimation only uses overall immigrant inflow rates.

3.8.5 Composition Issues

The fact that I do not observe the employment/labour force and wage rates of native Germans alone but only a composite outcome for both native and ethnic Germans, poses the question, to what extent this affects my estimates of β_1 and β_2. Assuming for simplicity that there are no foreign nationals in the economy, suppose my dependent variable were the first difference of the overall observed German outcome. I start off by looking at the case for the employment/labour force rate. Let r_t denote this composite outcome variable. Suppose further that in the initial period $t-1$, the total labour force in a local labour market consists exclusively of native Germans, N_{t-1}. Then the change in the employment/labour force rate of all Germans after an inflow of ethnic Germans of ΔG in period t can be written as

$$\Delta r_t = \frac{r_t^N N_t + r^G \Delta G}{N_t + \Delta G} - r_{t-1}^N,$$

where r_t^N and r^G are the employment/labour force rates of natives and ethnic German immigrants in period t, respectively, N_t represents the native German labour force in period t and ΔG the number of new ethnic German immigrants who participate in the labour force. Remember that in $t-1$, before the inflow occurred, the labour force consisted exclusively of native Germans, so that the second term also coincides with the overall German employment/labour force rate in that period. Let $\alpha = \frac{\Delta G}{N_{t-1}}$ be the ethnic German immigrant inflow rate

and suppose that the percentage change in the native labour force is given by $\nu = \frac{N_t}{N_{t-1}} - 1$, which could be either due to natural population growth or internal migration of native Germans, then the previous equation can be rewritten as

$$\Delta r_t = \Delta r_t^N + (r^G - r_t^N)\frac{\alpha}{1+\nu+\alpha}. \tag{3.6}$$

This equation shows how the observed change in the overall German employment/labour force rate Δr_t is related to changes in the native German employment/labour force rate Δr_t^N, which is the true parameter of interest in the empirical analysis. Clearly, if

$$r^G > r_t^N,$$

then

$$\Delta r_t > \Delta r_t^N.$$

This only reflects the intuitive result that if the employment/labour force rate of the incoming ethnic German immigrants is higher than the native German employment/labour force rate in period t, then the observed change in the overall German employment/labour force rate will always be larger than the change in the native German employment/labour force rate.

In the empirical model of this chapter, changes in labour market outcomes are related to changes in the log of the relative skill shares which in turn are affected by the inflows of new groups of workers. For instance, a 10% inflow rate α into a particular skill group will increase the respective log skill share by approximately 10%. For ease of exposition, I will, in what follows, focus on the reduced form of this model.

Suppose the empirical model of interest is then given by

$$\Delta r_t^N = \delta\alpha + \varepsilon_t,$$

but I only observe the composite outcome Δr_t. Then, using Equation 3.6, the estimation equation is given by

$$\Delta r_t = \delta\alpha + (r^G - r^N_{t-1} - \delta\alpha - \varepsilon_t)\frac{\alpha}{1+\nu+\alpha} + \varepsilon_t.$$

Taking the partial derivative of this expression with respect to α yields

$$\frac{\partial \Delta r_t}{\partial \alpha} = \delta\left(1 - \frac{\alpha}{1+\nu+\alpha} - \frac{\alpha(1+\nu)}{(1+\nu+\alpha)^2}\right) + (r^G - r^N_{t-1} - \varepsilon_t)\frac{1+\nu}{(1+\nu+\alpha)^2}$$

$$= \delta\left(\frac{(1+\nu)^2}{(1+\nu+\alpha)^2}\right) + (r^G - r^N_{t-1} - \varepsilon_t)\frac{1+\nu}{(1+\nu+\alpha)^2}.$$

Taking expectations and assuming that there is no endogenous self-selection of immigrants into localities so that $E(\varepsilon_t \alpha) = 0$ gives

$$E\left(\frac{\partial \Delta r_t}{\partial \alpha}\right) = \delta\left(\frac{(1+\nu)^2}{(1+\nu+\alpha)^2}\right) + (r^G - r^N_{t-1})\frac{1+\nu}{(1+\nu+\alpha)^2}.$$

This expression tells us how an inflow of ethnic German immigrants affects on average the composite employment/labour force rate r_t. It also shows that this estimate will be a biased estimate of the parameter of interest δ. If the ethnic German immigrants have a sufficiently lower employment/labour force rate than the native German population had in period $t-1$, specifically if

$$r^G - r^N_{t-1} < \delta\left(\frac{\alpha(2+2\nu+\alpha)}{(1+\nu)}\right),$$

then my estimate will underestimate the true effect of ethnic German immigrant inflows on the native German employment/labour force rate. However, if I could get a measure for the difference in the respective employment/labour force rates of ethnic German immigrants and native Germans, $r^G - r^N_{t-1}$, and if I assumed that this difference is constant over time and across labour markets, then it would be possible to adjust my estimated coefficient accordingly.

Note that even if the ethnic German immigrants' employment/labour force rate equals the native German one in period $t-1$, that is $r^G - r^N_{t-1} = 0$, there still

remains an attenuation bias since

$$0 < \frac{(1+v)^2}{(1+v+\alpha)^2} < 1.$$

Finally, even if there is no causal effect on the native employment/labour force rate, $\delta = 0$, the simple change in composition of the labour force will still lead to a biased estimate, different from zero, unless immigrants and natives have the same employment/labour force rates.

A similar adjustment is required to translate the estimated effect of the ethnic German inflow rate on the overall wage rate into the effect on the native wage rate. The only difference to the previous derivation is that N now represents the number of native Germans who are employed (and thus earn positive wages) and ΔG the number of newly arriving ethnic German immigrants who have found employment. The parameter v, which in the previous case reflected the percentage change in the native labour force, then becomes the percentage change in the native German labour force in employment.[38] Let r_t^N and r^G denote the average wage of native Germans and ethnic German immigrants, respectively. If I estimate in logs, then the empirical model of interest will be given by

$$\Delta \ln r_t^N \approx \frac{\Delta r_t^N}{r_{t-1}^N} = \delta\alpha + \varepsilon_t.$$

As before, I can only observe the composite outcome and estimate

$$\Delta \ln r_t = \delta\alpha + \left(\frac{r^G - r_{t-1}^N}{r_{t-1}^N} - \delta\alpha - \varepsilon_t \right) \frac{\alpha}{1+v+\alpha} + \varepsilon_t,$$

where I take advantage of the fact that $r_{t-1}^N = r_{t-1}$. The expectation of the

[38] In this derivation, I am assuming that the inflow of immigrants affects different subgroups of the native working population in the same way rather than, for instance, only those at the bottom of the wage distribution. The change of the native German population in employment in itself, potentially caused by the immigration of ethnic Germans, does therefore not affect the average wage rate paid to them. There is no selectivity bias.

partial derivative with respect to α then gives

$$E\left(\frac{\partial \Delta r_t}{\partial \alpha}\right) = \delta\left(\frac{(1+v)^2}{(1+v+\alpha)^2}\right) + \left(\frac{r^G - r^N_{t-1}}{r^N_{t-1}}\right)\frac{1+v}{(1+v+\alpha)^2}.$$

As before, my estimate will hence be a biased estimate of the parameter of interest δ. If the ethnic German immigrants have a sufficiently lower wage rate than the native German population had in period $t-1$, so that

$$\frac{r^G - r^N_{t-1}}{r^N_{t-1}} < \delta\left(\frac{\alpha(2+2v+\alpha)}{(1+v)}\right),$$

I will underestimate the true effect of ethnic German immigrant inflows on the average wage rate of the native German population. If I could find a measure of the relative wage differential between ethnic German immigrants and natives, $(\frac{r^G - r^N_{t-1}}{r^N_{t-1}})$, and if I assumed that this wage differential is constant over time and local labour markets, then I would again be able to adjust the obtained regression of the relative wage differential between ethnic German immigrants and natives, co, $r^G - r^N$

Finally, as in the case for the employment/labour force rate, the attenuation bias persists even if immigrants and natives earn the same wages, while the composition bias remains even if there is no causal effect on the native wage rate unless immigrants and natives earn the same wages.

Generally, I conclude, that the lower the employment/labour force and wage rates of the incoming ethnic German immigrants are relative to the resident native German population, the more are the estimates of β_1 and β_2 downward biased estimates of the true effects of immigration on the labour market outcomes of the native German population.

3.8.6 Tables

Table 3.12: Impact of changes in relative factor shares on the employment/labour force rate: men

	All regions		Restricted regions	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Occupation groups				
All	-0.117***	-0.281	-0.121***	-0.369*
	(.014)	(.862)	(.017)	(.218)
		[0.76]		[2.90]
All unweighted	-0.120***	0.118	-0.130***	-0.370*
	(.014)	(.463)	(.017)	(.200)
		[1.38]		[2.98]
All aged 25-54	-0.108***	-0.317	-0.119***	-0.305*
	(.014)	(.396)	(.016)	(.158)
		[1.70]		[3.69]
Germans only	-0.127***	-0.083	-0.131***	-0.375*
	(.014)	(.400)	(.017)	(.206)
		[1.41]		[3.29]
Observations	4440	4440	3185	3185
Education groups				
All	-0.035**	-0.262**	-0.043*	-0.395
	(.014)	(.119)	(.022)	(.251)
		[4.61]		[2.24]
All unweighted	-0.030**	-0.233	-0.036*	-0.224
	(.012)	(.163)	(.019)	(.144)
		[2.95]		[3.21]
All aged 25-54	-0.026*	-0.135*	-0.026	-0.405
	(.014)	(.075)	(.021)	(.262)
		[4.77]		[2.15]
Germans only	-0.039***	-0.209	-0.036*	-0.224
	(.015)	(.136)	(.019)	(.144)
		[3.99]		[3.21]
Observations	2664	2664	1911	1911

Notes: Entries are the estimated coefficients on the change in the log factor shares $\Delta \log f_{jrt}$. The dependent variable is the annual change in the skill-specific employment/labour force rate of men. All estimations include five occupation and three education groups respectively. Columns 1 and 2 use all 148 West German labour market regions for which data is available, columns 3 and 4 only those 112 that actually implemented the law (see Table 3.11 in Section 3.8.2). Employment/labour force rates are based on individuals already in the data at the end of 1995. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Employment/labour force rates are adjusted for differences in individual specific characteristics across labour markets. Robust standard errors are reported in parentheses and are clustered at the skill-specific regional level. For the IV estimates, the t-stat of the instrument from the first stage regression is reported in square brackets. Regressions are weighted by the inverse of the standard errors of the region fixed effects taken from the regressions to obtain adjusted outcomes. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

Table 3.13: Impact of changes in relative factor shares on log daily wages: men

	All regions		Restricted regions	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Occupation groups				
All	-0.041***	-0.754	-0.042**	0.100
	(.015)	(1.216)	(.017)	(.265)
		[0.73]		[2.11]
All unweighted	-0.029*	-0.235	-0.032**	0.045
	(.016)	(.424)	(.016)	(.217)
		[1.38]		[2.98]
All aged 25-54	-0.031**	-1.033	-0.029*	-0.231
	(.015)	(1.054)	(.016)	(.222)
		[1.21]		[2.78]
Germans only	-0.029*	-0.445	-0.029*	-0.024
	(.015)	(.545)	(.017)	(.233)
		[1.25]		[2.51]
Observations	4440	4440	3185	3185
Education groups				
All	-0.031	0.026	-0.040	0.137
	(.030)	(.092)	(.027)	(.278)
		[4.94]		[2.35]
All unweighted	-0.032	0.064	-0.055**	0.032
	(.024)	(.133)	(.026)	(.150)
		[2.95]		[3.21]
All aged 25-54	-0.018	0.007	-0.028	0.033
	(.033)	(.109)	(.027)	(.308)
		[4.26]		[2.29]
Germans only	-0.035	0.066	-0.055**	0.032
	(.029)	(.101)	(.026)	(.150)
		[4.75]		[3.21]
Observations	2664	2664	1911	1911

Notes: Entries are the estimated coefficients on the change in the log factor shares $\Delta \log f_{jrt}$. The dependent variable is the annual change in the skill-specific average log daily wage of all male full-time employees. All estimations include five occupation and three education groups, respectively. Columns 1 and 2 use all 148 West German labour market regions for which data is available, columns 3 and 4 only those 112 that actually implemented the law (see Table 3.11 in Section 3.8.2). Average log wages are based on individuals already in the data at the end of 1995. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Average log wages are adjusted for differences in individual specific characteristics across labour markets. Robust standard errors are reported in parentheses and are clustered at the skill-specific regional level. For the IV estimates, the t-stat of the instrument from the first stage regression is reported in square brackets. Regressions are weighted by the inverse of the standard errors of the region fixed effects taken from the regressions to obtain adjusted outcomes. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

Table 3.14: Impact of changes in relative factor shares on the employment/labour force rate: women

	All regions		Restricted regions	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Occupation groups				
All	-0.130***	0.186	-0.121***	-0.283
	(.020)	(.314)	(.023)	(.324)
		[3.43]		[2.94]
All unweighted	-0.137***	0.782	-0.109***	-0.072
	(.030)	(1.711)	(.025)	(.388)
		[1.33]		[2.98]
All aged 25-54	-0.128***	0.282	-0.116***	-0.315
	(.022)	(.441)	(.023)	(.413)
		[2.98]		[2.53]
Germans only	-0.118***	-0.129	-0.109***	-0.169
	(.021)	(.322)	(.022)	(.298)
		[3.31]		[3.56]
Observations	4436	4439	3185	3185
Education groups				
All	-0.130***	-0.283	-0.137***	-0.630
	(.039)	(.737)	(.036)	(.652)
		[1.78]		[2.31]
All unweighted	-0.158***	-0.750	-0.114***	-0.241
	(.051)	(.605)	(.036)	(.292)
		[2.52]		[3.21]
All aged 25-54	-0.126***	-0.274	-0.141***	-0.601
	(.046)	(.740)	(.037)	(.554)
		[1.86]		[2.75]
Germans only	-0.161***	0.429	-0.114***	-0.241
	(.048)	(1.547)	(.036)	(.292)
		[1.33]		[3.21]
Observations	2660	2660	1911	1911

Notes: Entries are the estimated coefficients on the change in the log factor shares $\Delta \log f_{jrt}$. The dependent variable is the annual change in the skill-specific employment/labour force rate of women. All estimations include five occupation and three education groups respectively. Columns 1 and 2 use all 148 West German labour market regions for which data is available, columns 3 and 4 only those 112 that actually implemented the law (see Table 3.11 in Section 3.8.2). Employment/labour force rates are based on individuals already in the data at the end of 1995. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Employment/labour force rates are adjusted for differences in individual specific characteristics across labour markets. Robust standard errors are reported in parentheses and are clustered at the skill-specific regional level. For the IV estimates, the t-stat of the instrument from the first stage regression is reported in square brackets. Regressions are weighted by the inverse of the standard errors of the region fixed effects taken from the regressions to obtain adjusted outcomes. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

Table 3.15: Impact of changes in relative factor shares on log daily wages: women

	All regions		Restricted regions	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Occupation groups				
All	-0.096**	-0.165	-0.153***	-0.883
	(.037)	(.649)	(.038)	(.652)
		[3.09]		[2.85]
All unweighted	-0.108**	-0.776	-0.164***	-1.289*
	(.049)	(3.055)	(.051)	(.767)
		[1.43]		[2.98]
All aged 25-54	-0.134***	-0.837	-0.188***	-0.968
	(.041)	(.655)	(.041)	(.707)
		[2.71]		[2.62]
Germans only	-0.091**	-0.595	-0.145***	-1.365*
	(.039)	(.907)	(.041)	(.729)
		[2.49]		[2.92]
Observations	4431	4431	3185	3185
Education groups				
All	-0.065	1.585	-0.047	0.539
	(.046)	(1.273)	(.060)	(.662)
		[2.02]		[2.13]
All unweighted	-0.087*	1.704**	-0.076	0.368
	(.048)	(.803)	(.055)	(.327)
		[2.57]		[3.23]
All aged 25-54	-0.035	0.010	-0.075	0.267
	(.056)	(.892)	(.072)	(.789)
		[1.51]		[2.14]
Germans only	-0.061	1.318**	-0.076	0.368
	(.049)	(.639)	(.055)	(.327)
		[2.77]		[3.23]
Observations	2646	2653	1907	1907

Notes: Entries are the estimated coefficients on the change in the log factor shares $\Delta \log f_{jrt}$. The dependent variable is the annual change in the skill-specific average log daily wage of all female full-time employees. All estimations include five occupation and three education groups respectively. Columns 1 and 2 use all 148 West German labour market regions for which data is available, columns 3 and 4 only those 112 that actually implemented the law (see Table 3.11 in Section 3.8.2). Average log wages are based on individuals already in the data at the end of 1995. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Average log wages are adjusted for differences in individual specific characteristics across labour markets. Robust standard errors are reported in parentheses and are clustered at the skill-specific regional level. For the IV estimates, the t-stat of the instrument from the first stage regression is reported in square brackets. Regressions are weighted by the inverse of the standard errors of the region fixed effects taken from the regressions to obtain adjusted outcomes. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

Table 3.16: Impact of initial skill shares on labour market outcomes by gender, 1985 to 1987

	$\Delta(N_{jrt}/P_{jrt})$		$\Delta \log w_{jrt}$	
Independent variable	Occupation	Education	Occupation	Education
Men				
Initial skill share	0.017	-0.014	0.017	0.010
	(.015)	(.021)	(.020)	(.020)
Observations	1480	888	1480	888
R^2	0.68	0.64	0.72	0.84
Women				
Initial skill share	0.021	0.008	-0.082**	-0.100
	(.024)	(.023)	(.039)	(.061)
Observations	1478	886	1476	876
R^2	0.86	0.68	0.68	0.99

Notes: Entries are the estimated coefficients on the local skill share lagged by two periods, f_{jrt-2}. The dependent variable is either the annual change in the employment/labour force rate or the annual change in log daily wages of full-time employees for the period 1985 to 1987. All estimations include five occupation and three education groups, respectively, and are estimated using West Germany's 148 labour market regions. Additional covariates are a full set of interactions of skill and year fixed effects as well as region and year fixed effects. Standard errors are robust and clustered at the skill-specific regional level. Employment and wage rates are adjusted for differences in individual specific characteristics across labour markets. Regressions are weighted by the inverse of the standard errors of the region fixed effects taken from the regressions to obtain adjusted outcomes. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

Chapter 4

How Do Industries and Firms Respond to Changes in Local Labour Supply?*

4.1 Introduction

One of the main consequences of immigrant inflows into a labour market is the alteration of the relative supply of workers of different skill levels and the induced change in equilibrium wage and employment rates. A large number of empirical studies have tried to quantify these impacts of immigration on the labour market outcomes of the resident population in a variety of countries using regional variation in immigrant inflows (see Chapter 2 for an overview). The majority of these studies have failed to find any significant negative effect of immigration on both relative wages and employment rates. This result is somewhat at odds with the common notion that the labour demand curve is downward sloping and that therefore an increase in labour supply should, in a competitive market, lead to a decrease in wages and, with elastic labour supply, an increase in unemployment. One possible explanation for the apparent insensitivity of local wages to immigration that has been put forward is based on standard trade theory and in particular on the Factor Price Insensitivity Theorem (Leamer and Levinsohn, 1995). Accordingly, as long as there are a number of output

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goods being produced in a region with different relative factor intensities and as long as these goods are tradable across regions, a change in local relative factor endowments through immigration will not lead to changes in relative factor prices but rather to an adjustment in the output mix of the immigrant-receiving region.[1]

Although some impact studies have pointed towards changes in output mix as a potential adjustment channel to regional immigration (e.g. Card, 1990, 2001, and Friedberg and Hunt, 1995), the actual empirical evidence is scarce. In a recent paper, Ethan Lewis (2004b) has for the first time specifically analysed the extent to which the industry mix in U.S. metropolitan areas adjusts to changes in local factor supplies caused by immigration.[2] In his analysis, he decomposes the change in local factor supplies into a part that is absorbed by changes in the scale of industries and a part that is absorbed by changes in the relative factor intensities within industries. His findings suggest that only a small fraction of the changes in local labour supply is accommodated through changes in the industry mix and that most of the adjustment happens through within-industry changes in worker mix. Since there is no evidence of significant changes in relative wages, he concludes that industries are changing their production technologies to complement the changes in local factor supplies, a conclusion also supported by a case study of the industry adjustments in the Miami labour market in the aftermath of the Mariel boatlift (Lewis, 2004a).

The observation that production technologies may change in response to local factor supply conditions has recently been theoretically modeled and empirically tested in the literature. One way such adjustment could come about is through an endogenous choice of the direction of research by profit-maximising innovators so that new technological innovations available to firms are complementary to

[1]Recent work by Hanson and Slaughter (2002) and Quispe-Agnoli and Zavodny (2002) for the U.S., Davis et al. (1997) for Japan, and Bernhard et al. (2002) for the UK evaluates the validity of the Heckscher-Ohlin-Samuelson theory within countries which underlies this adjustment mechanism.

[2]Gandal et al. (2004) provide a related analysis by investigating how national changes in output mix and global changes in production techniques in the form of skill-biased technological change have helped Israel to absorb the large number of Russian immigrants who arrived in the early 1990s. Similar to Lewis (2004b), their results suggest that output mix adjustments did not play a significant role and that changes in production techniques were sufficient to offset the substantial changes in relative factor supplies induced by the immigrant inflows.

particular factor supply conditions (see for instance Acemoglu, 1998, 2002). As an alternative to this technology supply explanation, it could be that the demand for technologies is endogenous so that firms optimally decide which technology out of a given pool of available technologies to adopt given the factor supplies they are facing (see Atkinson and Stiglitz, 1969; Basu and Weil, 1998; Beaudry and Green, 2003, 2005; Caselli, 1999; Caselli and Coleman, 2006). Recent empirical evidence that on the job computer use as well as automation expand most rapidly in those areas where the relative supply of skilled labour grows fastest points towards the importance of this demand-side explanation (Beaudry et al., 2006; Doms and Lewis, 2006; Lewis, 2005).

In this chapter, we first re-assess the importance of industry mix adjustments in absorbing changes in local factor endowments and compare our findings for Germany with the results found by Lewis (2004b). We distinguish between tradable and non-tradable industries and show which channel, between industry scale or within industry factor intensity adjustments, is dominant in each of these industry types. We then decompose the observed adjustments on the industry level into scale and intensity adjustments on the firm level taking advantage of a unique data set that comprises the entirety of firms that operated in West Germany between 1985 and 1995. We show that an analysis on the industry level does not accurately reflect the changes in employment and factor intensities that take place on the firm level and that conclusions about the importance of endogenous technology changes in response to changes in factor supplies derived from an industry-level analysis have to be drawn with care.

Our empirical results show that adjustments in the output mix as predicted by trade theoretic models do not play a large role in accommodating changes in local factor endowments, even on the firm level. Adjustments in within firm relative factor intensities, by contrast, are important and, given relatively small wage adjustments, point towards the endogenous adoption of new production technologies. However, a large part of what is considered as within industry changes in worker mix stems from the net creation of new firms and cannot necessarily be interpreted as technological change as previously suggested.

The remainder of this chapter is structured as follows. In the next section we describe the data we are using for this analysis and provide some descriptive evidence on the industry and firm structure in West Germany between 1985 and 1995. In Section 4.3 we show the extent to which local relative wage and employment rates have responded to the changes in local factor supplies induced by the immigrant inflows to Germany between 1985 and 1995. In Section 4.4 we then explain our analytical framework and present our empirical results, first for the industry and then for the firm level analysis. Section 4.5 analyses to what extent relative wages within firms have responded to changes in firm-specific factor intensities. Section 4.6 concludes.

4.2 Data

The data base we are using for our analysis is the entirety of the German social security records which are provided by the Institute for Employment Research (IAB). The data comprises the employment histories of all dependent employees subject to social security contributions in Germany. It includes all wage earners and salaried employees but excludes the self-employed, civil servants, and the military.[3] What is crucial to our analysis is that the social security records for each working individual include an identifier for the firm he or she is working in. We use this identifier to construct a yearly panel of all firms in Germany that includes information about their skill-specific employment and wages, the industry they belong to, and the region they operate in.[4]

The major advantage of using the entirety of individuals in Germany is that we are able to capture all firms in Germany and not only a particular subset thereof. Most firm level datasets such as the Annual Survey of Manufactures for

[3]In 2001, 77.2% of all workers in the German economy were covered by the social security system (Bundesagentur für Arbeit, 2004).

[4]The wage records in the IAB data sample are top coded at the social security contribution ceiling which is particularly severe for individuals in the highest skill group. Across regions, the mean fraction of individuals with censored wage observations is 0.6% for the low-skilled, 5.0% for the medium-skilled, and 41.6% for the high-skilled. Throughout the analysis we therefore use median wages and indicate whenever the median wage remains subject to censoring, i.e. when more than 50% of the observations within skill group are censored. All wages are gross daily wages in real 1995 Euro terms based on the consumer price index for all private households.

the U.S. are biased towards large establishments. The IABS, a 2% subsample of our data that is publicly available to researchers, also includes a firm identifier variable as well as a set of variables that show the overall employment by skill group for each firm. Based on this data set, it is therefore possible to construct a panel of firms similar to the one we use in this analysis. However, because individuals from large firms are more likely to be included in the IABS, such a firm panel over-represents large firms relative to small firms. In fact, while only 1.9% of firms in Germany had more than 100 employees in 1995, this share of large firms based on the IABS subsample is 14.8%. Since the aim of this chapter is to analyse changes in aggregate industry and firm growth as well as firm-level technology adjustments, and the vast majority of firms in Germany is small with 13 employees on average, it would be potentially misleading to only focus on large establishments. Our analysis will show that it is in small firms where most of the adjustments, in particular in relative factor intensities, take place.

The basis of our analysis are all individuals aged 15 to 64 that work full-time. We differentiate skill groups by their educational attainment, distinguishing three groups: low, intermediate and high. People with low education are individuals without an apprenticeship, people with intermediate education are individuals with an apprenticeship and people with high education are individuals with college education. As discussed in Chapter 3, apprenticeships are a crucial component of Germany's educational system and more than 70% of all Germans in the data have completed one in 1995.

Throughout the analysis we focus on the period 1985 to 1995 during which substantial immigration to Germany took place which led to significant changes in local factor supplies. Basis of our estimations on the industry level are 79 industries in 204 labour market regions in West Germany.[5] We distinguish between 44 industries that produce tradable goods (=tradable industries) and 35 industries that produce non-tradable goods (=non-tradable industries). Follow-

[5]West Germany's unification with East Germany took place on the 3rd of October 1990 but data on East Germany is only included in the IAB data from 1992 onwards. Therefore we focus exclusively on labour market regions in West Germany. Labour market regions are aggregates of West Germany's 326 counties that take commuter flows into account so that they better reflect separate local labour markets. They comprise around 320,000 individuals on average.

ing Hanson and Slaughter (2002), we include the following sectors in the group of tradable industries: manufacturing, agriculture, mining, finance, real estate, business services and legal services. For a detailed overview of the individual industries, their classification as tradable and non-tradable and a number of key indicators see Table 4.12 in the appendix to this chapter. The biggest tradable industry in 1995 was *Manufacturing of electrical equipment* with around 790,000 employees, which corresponded to 4.7% of the overall full-time employment in West Germany in that year. The biggest non-tradable industry was *Retail* with around 2.2 million employees or 13% of the overall employment. Overall full-time employment declined by 4.2% to around 7.8 million in tradable industries and grew by 7.5% to around 8.9 million in non-tradable industries. However, variation in employment growth was substantial, ranging from a decrease of 51.6% in the tradable industry *Manufacture of apparel* to an increase of 103.8% in the non-tradable industry *Other services.* Employment in tradable industries comprised relatively more low-skilled as well as high-skilled workers (24.1% and 8.5% respectively) than employment in non-tradable industries (21.5% and 6.8% respectively). In both tradable and non-tradable industries the use of low-skilled workers declined significantly between 1985 and 1995 by 28.1% and 22.0%, respectively, whereas the use of high-skilled workers increased by 64.3% and 41.8% respectively. Firms were larger in tradable industries with on average 20.5 employees compared to only 9.9 employees in firms operating in non-tradable industries.

Table 4.1 provides some detailed information on firms in West Germany. Overall there were 1,383,591 firms in West Germany's 204 labour market regions in 1995, 402,452 of those in tradable and 981,139 in non-tradable industries. Roughly half of these firms were permanent firms, that is firms that had already existed in 1985, and half were firms that had been newly established in the ten years between 1985 and 1995.[6] The vast majority of firms, 98.3%, were small

[6]There is some concern in the IAB data with regard to the interpretation of newly occurring firm identifiers. If a firm changes its legal status from say a limited company to a stock corporation, then often this firm would receive a new identifier and would thus appear in our data as a new firm, leading to a higher observed firm turnover. However, it is known that plant turnover is substantial so that the roughly equal numbers of permanent and new firms are not too surprising. For example, Dunne et al. (1989a,b) find that 40% of firms in manufacturing in the U.S. disappear over a five year period and are replaced by new entrants.

Table 4.1: Firm characteristics

	1995			% Change 1985 - 1995		
	all	tradable	non-trad.	all	tradable	non-trad.
No. of firms	1,383,591	402,452	981,139	9.4	10.4	9.0
No. permanent firms	685,666	210,680	474,986	.	.	.
No. new firms	697,925	191,772	506,153	.	.	.
No. old firms †	579,241	153,938	425,303	.	.	.
Average size	13.0	20.5	9.9	-5.2	-12.3	1.3
% low skill	22.7	24.1	21.5	-25.6	-28.1	-22.0
% medium skill	69.7	67.4	71.7	8.0	9.9	6.0
% high skill	7.6	8.5	6.8	52.4	64.3	41.7
Wage low skill	57.9	63.9	49.2	16.1	16.7	22.9
Wage medium skill	76.9	83.2	72.5	15.3	14.8	16.4
Wage high skill	128.4	131.1*	118.0	14.0*	15.8*	9.8
No. of small firms	1,359,857	390,428	969,429	9.5	10.8	9.0
No. permanent firms	666,139	200,782	465,357	.	.	.
No. new firms	693,718	189,646	504,072	.	.	.
Average size	7.3	8.9	6.7	7.4	5.6	8.2
% low skill	21.8	21.7	21.9	-24.5	-29.0	-21.7
% medium skill	72.9	71.7	73.6	7.2	8.3	6.5
% high skill	5.3	6.6	4.5	71.8	104.0	52.3
Wage low skill	46.0	50.7	42.3	34.5	31.0	39.6
Wage medium skill	70.2	73.8	68.3	16.1	15.4	16.4
Wage high skill	109.5	115.0	106.0	10.3	7.3	11.5
No. of large firms	23,734	12,024	11,710	1.7	-2.1	5.9
No. permanent firms	19,527	9,898	9,629	.	.	.
No. new firms	4,207	2,126	2,081	.	.	.
Average size	337.5	395.8	277.5	-11.1	-12.2	-7.6
% low skill	23.7	25.8	20.6	-25.9	-26.5	-23.0
% medium skill	65.9	64.4	68.2	7.7	9.6	4.4
% high skill	10.4	9.8	11.2	52.0	58.3	42.3
Wage low skill	66.6	69.6	59.9	16.5	16.7	17.2
Wage medium skill	85.3	89.6	80.1	16.8	16.6	18.3
Wage high skill	131.1*	131.1*	127.7	15.8*	15.8*	13.5*

Notes: Wages are median wages of each skill group. A (*) indicates that the median wage suffers from right censoring, that is that more than 50% of the individuals in that group had wages above the taxable base so that the table entry is simply the value of the censoring limit in 1995. For the wage changes, a (*) indicates that in at least one of the years 1985 and 1995, the median wage lay above the taxable base so that the percentage change is not accurate. Large firms are firms with more than 100 full-time employees in 1985.

† The number of old firms refers to the number of firms that existed in 1985 but do not exist anymore in 1995.

with overall full-time employment of less than 100 workers and an average size of 7.3 workers. The average size of the 23,734 firms that had more than 100

employees was 337.5, with significantly larger firms in tradable industries with on average 395.8 workers compared to only 277.5 in non-tradable industries. While the average size of firms in tradable industries declined by 12.3% between 1985 and 1995, it increased slightly by 1.3% for firms in non-tradable industries. In terms of relative factor inputs, there was hardly any difference between small firms in tradable and those in non-tradable industries. Around 22% of workers were low-skilled, 72% medium-skilled and 6% high-skilled. In large firms by contrast, those in tradable industries were more low-skill intensive with a worker share of 25.8% than those in non-tradable industries with a share of only 20.6%. Between 1985 and 1995, small firms increased their input of high-skilled workers by 71.8% whereas large firms only increased it by 52.0%. The shift from low- to high-skill employment was particularly pronounced in small firms in tradable industries, where the former decreased by 29.0% and the latter increased by 104%.

There were substantial differences in the wage level between small and large firms across all skill groups. While the median wage for low-, medium- and high-skilled workers in small firms was €46.0, €70.2 and €109.5, respectively, it was €66.6, €85.3 and above the censoring limit of €131.1 in large firms in 1995. Wage growth for low-skilled workers was particularly high in small firms with 34.5% compared to only 16.5% in large firms. Wages grew similarly in large firms in tradable and non-tradable industries but tended to grow faster in small firms in non-tradable industries than in small firms in tradable industries. Overall, wage growth between 1985 and 1995 was quite similar across skill groups with a rate of 16.1% for low-skilled workers and 15.3% for medium-skilled workers.[7] In particular, relative wages in tradable industries did not change much between 1985 and 1995 despite significant changes in relative factor inputs while in non-tradable industries the wages of low-skilled workers grew the most with 22.9% compared to 16.4% for medium-skilled workers and only 9.8% for high-skilled workers.

[7]Because of the censoring of high-skill wages, their growth of 14.0% reflects the increase in the social security contribution ceiling rather than the real increase in wages paid to high-skilled workers.

4.3 Wage and Employment Responses

Before we show how industries and firms have absorbed changes in local labour supply, we first investigate how these changes have affected skill-specific wages and employment rates in West Germany's 204 labour market regions. To do this, we estimate the following models:

$$\%\Delta w_{ir} \quad \text{or} \quad \Delta\left(\frac{N_{ir}}{P_{ir}}\right) = \eta_i + \delta_r + \gamma \%\Delta L_{ir} + \varepsilon_{ir}, \tag{4.1}$$

where $\%\Delta w_{ir}$ is the percentage change in gross daily wages, $\Delta(N_{ir}/P_{ir})$ the change in the employment/labour force rate, and $\%\Delta L_{ir}$ the percentage growth in the labour supply of education group i in region r. η_i and δ_r are full sets of education and region fixed effects.

We start off by estimating both models by OLS. A well known problem in these estimations is that unobserved skill-specific local labour demand shocks may attract workers of that skill group into a particular region while at the same time increasing that group's wages and employment rates. In that case the OLS results of the parameter γ would be upward biased. To address this endogeneity problem we follow an approach similar to Card's (2001) and use the supply-push component of foreign immigration as an instrument for the relative factor supply changes in a locality.

The supply-push component of immigrant inflows refers to the exogenous part of the actual inflow to a local labour market that is attributable to existing ethnic concentrations. The underlying idea is that immigrants tend to settle in those areas where other immigrants of the same country of origin or cultural background have already settled before (Bartel, 1989). Suppose ΔI_c is the net overall number of immigrants with nationality c entering Germany during a given period.[8] In the absence of any local labour demand shocks, these new immigrants are likely

[8]In the IAB data we only observe an individual's nationality not the country of birth. This means that some foreign nationals we observe in the data are actually born in Germany but have kept their parents' nationality. According to figures from the German Statistical Office, the share of second generation immigrants in the immigrant working-age population in 1995 is around 10%.

to distribute themselves across Germany according to the existing distribution of their fellow countrymen. Let λ_{cr} represent the share of all immigrants of nationality c in Germany that reside in labour market r at the beginning of the period and let θ_{ci} be the nationwide fraction of the newly arriving immigrants of nationality c that fall into skill group i. Then the number of new immigrants of nationality c with skill i that is expected to move to labour market region r is given by $\lambda_{cr} \times \theta_{ci} \times \Delta I_c$. Summing across source countries then gives an estimate of the expected overall skill-specific immigrant inflow into local labour market r:

$$SP_{ir} = \sum_c \lambda_{cr} \theta_{ci} \Delta I_c.$$

This supply-push component of recent immigration will be exogenous as long as λ_{cr} is uncorrelated with local demand shocks. Since older immigrant cohorts already living in Germany are also likely to relocate to labour market r in the presence of positive economic shocks, contemporary λ_{cr} will violate this condition. For that reason we use past immigrant distributions, using a lag of five years. So for the period 1985 to 1995 we use the existing distributions in 1980. Finally, since we instrument the percentage change in the skill-specific labour force $\%\Delta L_{ir}$, we divide SP_{ir} by the overall skill-specific labour force in region r at the beginning of the immigration period. The supply-push rate we use as our instrument is then given by:

$$SPR_{ir} = \frac{\sum_c \lambda_{cr} \theta_{ci} \Delta I_c}{L_{ir_0}}. \tag{4.2}$$

In contrast to previous studies that have used the overall lagged foreign immigrant concentration as an instrument for current changes (for instance, Altonji and Card, 1991; Dustmann et al., 2005), this approach is more elaborate in that we distinguish between fifteen nationality-specific immigrant distributions in Germany. This is particularly important when analysing a period during which the country of origin composition of immigrant inflows has changed significantly relative to the existing immigrant stock. For a new immigrant from Asia or Yugoslavia, the two largest groups of recent immigrants to Germany, the existence of a large, say Turkish community, the largest existing immigrant group in Germany, is presumably irrelevant for his or her location decision.

Table 4.2: Summary statistics of immigrant inflow, 1985 to 1995

Table 4.2 provides an overview of the size and composition of the net immigrant inflow to Germany between 1985 and 1995. Overall, nearly 3 million new immigrants arrived in Germany during that period, which corresponds to an inflow rate of 4.8%. Of these immigrants, more than a quarter originated from the territory of Former Yugoslavia as a result of the civil wars in the first half of the 1990s. The next biggest groups of immigrants came from Asia (15.9%), Poland (12.9%) and Turkey (11.0%). Overall, the newly arriving immigrants were relatively low-skilled compared to the existing population in Germany in 1985: 48.6% with low educational attainment (compared with 33.5% in the existing population), 37.4% with intermediate educational attainment (61.7%), and 14% with high educational attainment (4.8%), although there is substantial variation across countries of origin.

Table 4.3 now shows estimates of the parameter γ in our two regression models in Equation 4.1. The OLS results for the percentage change in daily wages for all workers, those in tradable industries and those in non-tradable

Table 4.3: Impact of changes in local labour supply

1985-1995	Median wages						Employment/LF	
	all		tradable		non-tradable		all	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Education groups 1 - 3							
$\hat{\gamma}$	-0.03	-0.13*	-0.04	-0.10	-0.14*	-0.48**	0.01	0.04
	(.03)	(.08)	(.03)	(.08)	(.07)	(.21)	(.02)	(.06)
1^{st} stage t-stat		5.9		4.8		5.9		7.2
R^2	0.64	0.62	0.71	0.69	0.59	0.55	0.60	0.60
Observations	540	540	476	476	602	602	612	612
	Education groups 1 & 2							
$\hat{\gamma}$	-0.09	-0.12	-0.01	-0.05	-0.59***	-0.63***	0.03	0.04
	(.07)	(.09)	(.05)	(.14)	(.13)	(.19)	(.04)	(.04)
1^{st} stage t-stat		13.2		5.9		14.3		13.2
R^2	0.62	0.62	0.74	0.74	0.64	0.64	0.83	0.83
Observations	408	408	408	408	408	408	408	408

Notes: All regressions include a full set of skill and region fixed effects. For the wage regressions with all education groups, some observations drop out due to right censoring. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_r^{85} + 1/N_r^{95})^{-1/2}$ where N_r^t represents the overall labour force in region r in year t. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

industries are shown in columns 1, 3 and 5, respectively. Columns 2, 4 and 6 show the corresponding IV results where we use the supply-push component of recent immigration as an instrument for the percentage change in skill-specific local labour supply. The first stage regression is strong in all estimations with t-statistics for the instrument between 4.8 and 14.3. The OLS results for all workers in column 1 show that changes in local labour supply have little impact on relative wages. The wage elasticity is estimated at -0.03. The IV result for the wage regression of -0.13 is more negative than the OLS result and statistically significant at the 10% level, pointing towards demand-driven labour flows. There are large differences in the wage response between tradable and non-tradable industries. While in tradable industries relative wages change relatively little in response to local labour supply shifts with an insignificant IV estimate of -0.10,

wages in non-tradable industries are far more responsive with a wage elasticity of -0.48. As the results in columns 7 and 8 show, there is no evidence of a significant effect of labour supply changes on the employment/labour force rate in a region. In the bottom panel of Table 4.3 we repeat the same estimation but restrict our sample to the low and medium skill groups in each region. The parameter estimates are similar in magnitude to the case with all three education groups with somewhat larger estimates for wages in non-tradable industries. Overall, the results in Table 4.3 show that changes in local labour supply have relatively little impact on relative wages and employment in West Germany. All wage adjustments take place in non-tradable industries whereas wages in tradable industries remain unaffected by local labour supply conditions.[9] Employers in these industries seem to substitute different education groups elastically in their production process. In fact, the estimates from the OLS and IV regressions in columns 1 and 2 of the upper panel would imply an elasticity of substitution between skill groups of 33 and 8, respectively, which is significantly higher than estimates found in the related literature. For instance, Fitzenberger and Kohn (2006) estimate an elasticity of substitution of between 4.9 and 6.9 while Fitzenberger and Franz (2001) estimate an elasticity between medium- and low-skilled workers of 0.6-1.4 for manufacturing and 3.0-3.6 for non-manufacturing industries in Germany. For the U.S. the typical estimate ranges between 1.5 and 2.5 (see, for instance, Bound and Johnson, 1992; Card and Lemieux, 2001; Ciccone and Peri, 2007; Katz and Murphy, 1992; Krusell et al., 2000). The question thus arises how these changes in local factor supplies are absorbed, in particular in tradable industries, without going through the mechanism of factor price adjustments.

[9]The observation that relative wages respond to changes in local labour supply in non-tradable industries but not in tradable industries is somewhat puzzling under the assumption of free labour mobility across these sectors. In principle, a decline in relative wages in non-tradable industries should, in a competitive market, induce workers to move into better paying tradable industries until the wage rates in the two sectors are equalised.

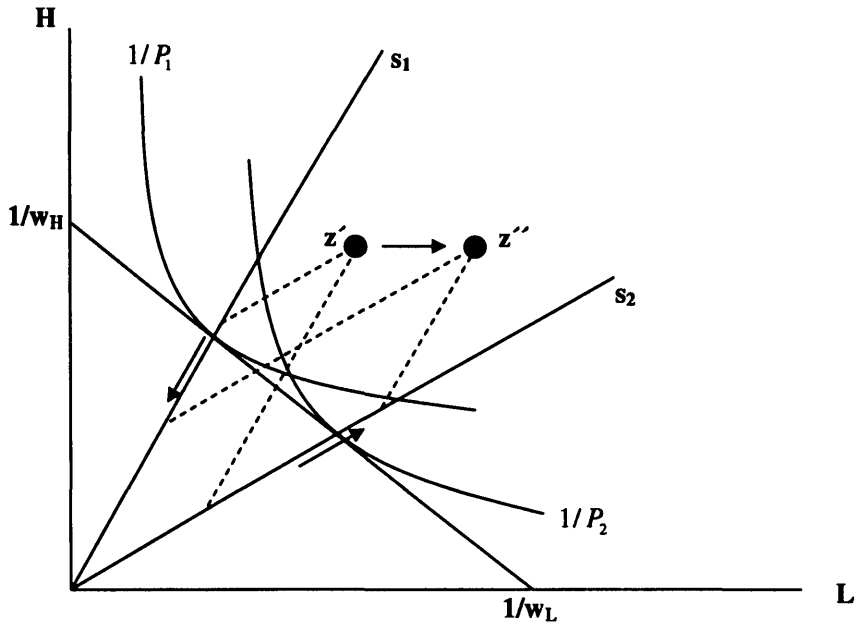
4.4 Analytical Framework

4.4.1 Industry Decomposition

In the following, we explain and graphically illustrate how changes in factor endowments in an economy can be absorbed by between and within industry changes and how these changes at the industry level can themselves be decomposed into changes between and within firms (see also Leamer, 1995, and Gaston and Nelson, 2000). We show that only at the level of the firm are we able to accurately distinguish scale and technology adjustments.

Suppose we have an economy in which there are two industries which each produce a particular tradable output good whose price is fixed on the world market with a constant returns to scale production technology using only two inputs, low-skilled workers and high-skilled workers. Let the initial endowment of the economy with both types of workers be denoted by z'. Figure 4.1 shows this initial situation where the number of low-skilled workers L is shown on the x-axis and the number of high-skilled workers H is shown on the y-axis. With the available technology, each industry can produce a given amount of its output good with a variety of combinations of the two labour inputs L and H. Normalising the value of each output good to 1, these combinations are depicted by the unit-value isoquants $1/P_1$ for industry 1 and $1/P_2$ for industry 2. Now, given there is perfect competition in all markets and labour is mobile across industries, wages have to be identical in both industries in equilibrium. Assuming full employment and cost minimisation by firms, the relative wage rate will then be uniquely determined by the slope of the isocost curve that is tangent to both unit isoquants. Denote this initial relative wage rate as w_L/w_H. The rays s_1 and s_2 from the origin through the tangency points of the isocost function and the unit isoquants then represent the equilibrium input ratio in each industry. The cone defined by s_1 and s_2 represents the so-called *cone of diversification.* Any combination of factor endowments that lies within this cone will result in both output goods being produced. In our case, both industries are active with industry 1 using high-skilled workers more intensively than industry 2. With full employment, the scale of each industry is determined by the intersection of the production rays s_1 and s_2 and the dashed lines through the initial factor

Figure 4.1: Between industry adjustments



endowment z'.

Suppose immigration increases the supply of low-skilled workers in the economy, thus shifting z' to z''. If output good prices are fixed and the technologies available remain unchanged, then the unit-value isoquants cannot change. Therefore, relative wages cannot change either in response to the change in relative factor endowments, unless the economy specialises its production.[10] This is what Leamer and Levinsohn (1995) call the Factor Price Insensitivity Theorem. In order to absorb the additional workers all that happens is a change in the scale of each industry with industry 1, the skill-intensive industry, decreasing its output and industry 2 increasing it as illustrated by the arrows along the production rays s_1 and s_2.[11] This *between industry* effect is subject of the Rybczynski Theorem

[10]For a formal derivation of these results see, for example, Dustmann et al. (2005). In general, an economy's ability to absorb changes in relative labour supply without changing its relative wage structure depends on the number of traded goods produced relatively to the number of distinct labour inputs. Derived from trade theory models, Woodland (1982) and Ethier (1984a) show the relevant algebra, also allowing for the existence of non-traded goods (see also Komiya, 1967, and Ethier, 1972).

[11]It should be pointed out that this has to be considered as a long-run effect. In the short

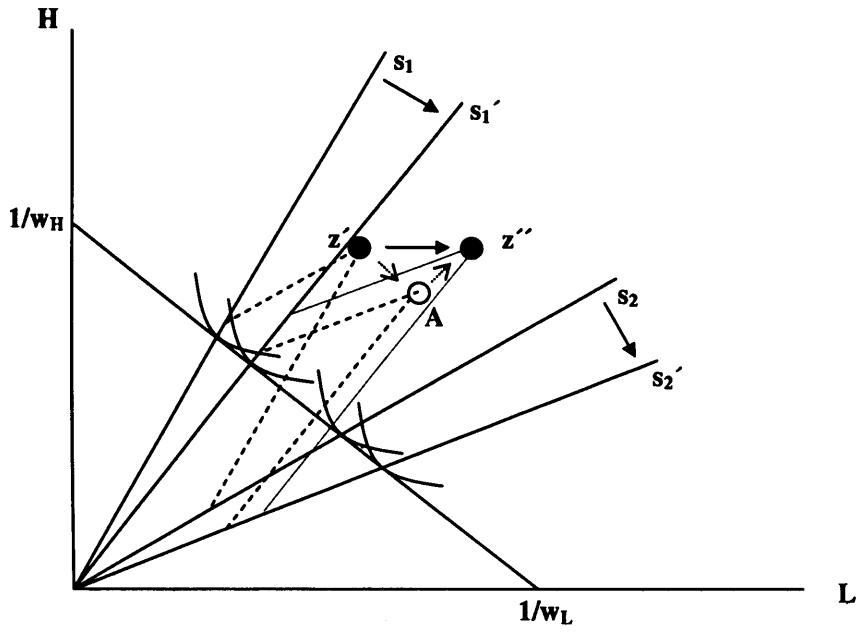
(Rybczynski, 1955). The basic proposition of the Rybczynski Theorem is that with given output prices and technology, the only way an economy can react to a change in factor endowment is to change its output mix by increasing production in the industry that uses the now more abundant labour input more extensively and decreasing it elsewhere. In the context of the Heckscher-Ohlin-Samuelson model illustrated here, the only way a change in relative factor prices could be generated is through a change in the prices of output goods.

Now, we continue to assume that output prices are fixed on the international market but that industries can respond to changes in relative labour supply by changing their production technology. This situation is depicted in Figure 4.2. Suppose both industries change their technology towards a more low-skill intensive technology in response to the shift in labour supply. One can think of this endogenous technology change as a clockwise rotation of the cone of diversification around the origin as shown in the graph. The deviation of the new isocost curve from the initial one could in that case be small. To avoid cluttering the diagram, we illustrate the case, in principle feasible, in which the isocost curve remains unchanged, so that relative wages do not respond to changes in technology. Suppose the scale of an industry is given by the distance between the origin and the intersection of the dashed line with the corresponding production ray. A suitable rotation of the cone of diversification (illustrated by the move from z' to A) and a subsequent proportional increase in scale in both industries in order to ensure full employment (illustrated by the move from A to z'') will leave the relative scale of each industry unchanged.[12] Endogenous changes in production technology hence offer an alternative explanation of how industries can adjust to changes in relative labour supply. Such *within industry* technology adjustments could be identified from observing a change in relative factor inputs within industries with constant relative scales of the industries and the absence of

run, the increase in low-skill labour supply will lead to a decrease in relative wages. This change in relative wages in turn leads to a relatively larger decrease in unit production costs for the low-skill intensive industry than for the skill intensive industry. When output prices are fixed, there will be positive profits in the low-skill intensive industry. In a perfectly competitive market these profits then induce new firms to enter the industry (or firms to move from the skill intensive to the more profitable low-skill intensive industry), increasing relative demand for low-skilled workers and driving relative wages back to the original level.

[12] Analytically, this is not accurate but helps to visualise the underlying process.

Figure 4.2: Within industry adjustments



changes in relative wages.[13] Of course, it is likely that both between and within industry adjustments take place simultaneously. We will start off by quantifying which of the two has been dominant in Germany over the period 1985 to 1995.

Following Lewis (2004b), we decompose the relative growth in labour supply of skill group i in a locality into four components: a scale effect capturing growth in the size of industries j holding relative factor inputs constant, an intensity effect capturing how industries change their relative factor inputs holding overall size constant, a residual term consisting of the interaction of both these effects, and relative growth in skill-specific unemployment in the locality. This decomposition is given by

[13]If relative wages do change, then it is not clear whether changes in relative output prices have shifted the unit-value isoquants and the industries continue to produce with their original technology, or whether there is a set of new technologies that leads to a new relative wage equilibrium.

$$
\begin{aligned}
\frac{\Delta L_i}{L_{i_0}} &= \sum_j s_{ij_0} \%\Delta M_j && \text{industry scale effect} \\
&+ \sum_j s_{ij_0} \%\Delta\left(\frac{N_{ij}}{M_j}\right) && \text{industry intensity effect} \\
&+ \sum_j s_{ij_0} \%\Delta M_j \cdot \%\Delta\left(\frac{N_{ij}}{M_j}\right) && \text{industry residual term} \\
&+ s_{iu_0} \%\Delta U_i && \text{unemployment growth,}
\end{aligned}
\tag{4.3}
$$

where L_i is the labour supply of skill i, M_j is the overall employment in industry j, N_{ij} is the overall employment of skill i in industry j, and U_i is the overall number of unemployed individuals of skill i (for details see Appendix 4.7.2).[14] The subscript 0 denotes the base year 1985. With this notation, we have

$\frac{\Delta L_i}{L_{i_0}}$: percentage change in supply of type i workers

$s_{ij_0} = \frac{N_{ij_0}}{L_{i_0}}$: initial share of type i workers employed in industry j

$\%\Delta M_j$: percentage change in overall employment in industry j

$\%\Delta(\frac{N_{ij}}{M_j})$: percentage change in relative intensity of type i workers in industry j

$s_{iu_0} = \frac{U_{i_0}}{L_{i_0}}$: initial unemployment rate of type i workers

$\%\Delta U_i$: percentage change in number of unemployed type i workers.

To estimate the relative contribution of adjustments in scale, intensity, residual and unemployment in absorbing changes in local labour supply, we regress each of the four components in Equation 4.3 on the percentage change in labour supply in a region plus a full vector of region fixed effects θ_r, which account for scale effects common to all industries in each region, and skill group fixed effects λ_i, which account for exogenous changes in production technology that alter the relative

[14] An alternative to overall employment as a measure of the size of an industry would be industry-specific output. That information, however, is difficult to obtain for all industries and, in particular, for the entirety of firms once we move the analysis to the firm level. Lewis (2004b) shows that for manufacturing industries in the U.S., the results for the between industry scale effect do not depend on whether the size of an industry is measured by output or total employment.

Table 4.4: Decomposition of changes in labour supply on the industry level

1985-1995	Between Industries	Within Industries	Net New Industries	Ambi-guous	Unem-ployment
			OLS		
Labour Supply Growth	0.128*** (.019)	0.541*** (.027)	0.002 (.001)	0.201*** (.020)	0.128*** (.020)
			IV		
Labour Supply Growth	0.201*** (.070)	0.620*** (.070)	0.007** (.003)	0.135** (.054)	0.039 (.049)

Notes: All regressions use 612 observations and include a full set of skill and region fixed effects. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_r^{85} + 1/N_r^{95})^{-1/2}$ where N_r^t represents the overall labour force in region r in year t. The first stage t-stat is 6.0. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

usage of different labour types in all industries and regions. For the scale effect, for instance, our estimation equation is then given by

$$\sum_j s_{ijr_0} \%\Delta M_{jr} = y_{ir} = \lambda_i + \theta_r + \beta \%\Delta L_{ir} + \varepsilon_{ir}, \tag{4.4}$$

where r denotes the labour market region. We estimate these models both by OLS and IV, using the supply-push component of recent immigrant inflows (compare Section 4.3) as an instrument for the potentially endogenous labour supply growth in a locality. Table 4.4 shows the results for the parameter β for each of these four regressions. Each estimate represents the corresponding share of the change in local labour supply that is absorbed.[15]

Focussing on the estimates of the IV regressions, we see that 62% of the changes in local labour supply are absorbed within industries while only around 20% are absorbed between industries. Qualitatively, this result accords with Lewis's findings for the period 1980 to 1990 in the U.S., although his estimates show a quantitatively larger adjustment within industries of 74% and a smaller adjustment of only 4% between industries.

[15]Since in some regions not all industries existed in the base year of the regression so that $s_{ij_0} = 0$ and in others industries ceased to exist so that $\%\Delta M_j = 0$ and $\%\Delta(N_{ij}/M_j) = 0$, we add an additional component Net New Industries given by $\sum_{j_{old,new}}(\Delta N_{ij}/L_{i_0})$, which captures the contribution from these few new and old industries.

Table 4.5: Decomposition of changes in labour supply on the industry level, by industry type

1985-1995	Between Industries		Within Industries		Net New	Ambi-	Unem-
	tradable	non-trad.	tradable	non-trad.	Industries	guous	ployment
			OLS				
Labour Supply Growth	0.128*** (.019)		0.541*** (.027)		0.002 (.001)	0.201*** (.020)	0.128*** (.020)
	0.080*** (.016)	0.048*** (.010)	0.337*** (.042)	0.205*** (.025)			
			IV				
Labour Supply Growth	0.201*** (.070)		0.620*** (.070)		0.007** (.003)	0.135** (.054)	0.039 (.049)
	0.048 (.053)	0.152*** (.035)	0.449*** (.101)	0.171** (.070)			

Notes: All regressions use 612 observations and include a full set of skill and region fixed effects. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_r^{85} + 1/N_r^{95})^{-1/2}$ where N_r^t represents the overall labour force in region r in year t. Overall employment in 1985 was 8,513,067 (49.1%) in firms in tradable industries and 8,828,637 (50.9%) in firms in non-tradable industries. The first stage t-stat in the IV regressions is 6.0. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

Table 4.5 now further decomposes these relative contributions into those coming from industries that produce tradable goods and those coming from industries that produce non-tradable goods. In principle, industries in the tradable sector face output good prices that are fixed on the international market, ruling out output price adjustments in response to changes in factor supplies. Interestingly, for the period 1985 to 1995, the estimates show that in tradable industries the within adjustments are particularly pronounced (44.9% compared with only 17.1% in non-tradable industries) while the opposite is true for the between industry adjustments (15.2% in non-tradable industries compared with only 4.8% in tradable ones). Given that the overall scale of the tradable and non-tradable industry sectors are approximately the same in the base year 1985 (49.1% and 50.9% of overall employment, respectively), one would expect both types of industries to contribute equally to the overall between and within industry effects if they reacted in the same way to changes in local factor supplies. This result is somewhat surprising in the context of the Heckscher-Ohlin-Samuelson model

if we rule out endogenous changes in technology since in the non-tradable sector there is more scope for relative wage adjustments due to more output price flexibility and thus for more adjustments in the relative use of different labour inputs.

Overall, the results suggest that only a relatively small fraction of the changes in labour supply are absorbed by an expansion of those industries that use the more abundant factor more intensively as predicted by the traditional Heckscher-Ohlin-Samuelson model. The majority of adjustment happens through changes in the skill intensity within industry, particularly so in tradable industries while non-tradable industries show a relatively large adjustment in scale. Under the assumption of fixed output good prices, a possible explanation for this finding could be endogenous changes in production technologies. However, since changes in technology are implemented within firms rather than industries, it is crucial to take the analysis to the firm level. As we will see, only an analysis at that level will allow us to unambiguously attribute the large observed changes in skill intensity within industries to actual technological changes within firms.

4.4.2 Firm Contributions to Industry Effects

With firm level data available, a natural first step would be to decompose the terms capturing the scale and intensity effects on the industry level in Equation 4.3 and distinguish between the contributions of permanent firms f^p, new firms f^n and old firms f^o. Permanent firms are defined as firms that exist in both periods, 1985 and 1995, new firms are firms that do not exist in the base year 1985 but exist in 1995, and old firms are firms that exist in 1985 but do not exist anymore in 1995.

The scale effect on the industry level can then be written as:

$$\begin{aligned}
\sum_j s_{ij_0} * \%\Delta M_j = & \sum_j \sum_{f^p} s_{ij_0} \left(\frac{M_{jf^p} - M_{jf_0^p}}{M_{j_0}}\right) && \text{permanent firms scale contribution} \\
& + \sum_j \sum_{f^n} s_{ij_0} \left(\frac{M_{jf^n}}{M_{j_0}}\right) && \text{new firms scale contribution} \\
& - \sum_j \sum_{f^o} s_{ij_0} \left(\frac{M_{jf_0^o}}{M_{j_0}}\right) && \text{old firms scale contribution,}
\end{aligned} \tag{4.5}$$

where M_{jf^x} is total employment in a firm of type $x = (p,n,o)$.[16]

The industry intensity effect of Equation 4.3 can be decomposed as follows:

$$\begin{aligned}
\sum_j s_{ij_0} * \%\Delta\left(\frac{N_{ij}}{M_j}\right) = &\sum_j \sum_{f^p} s_{ij_0}\left(\frac{\frac{N_{ijf^p}}{M_j} - \frac{N_{ijf^p_0}}{M_{j_0}}}{\frac{N_{ij_0}}{M_{j_0}}}\right) && \text{permanent firms intensity contribution} \\
&+ \sum_j \sum_{f^n} s_{ij_0}\left(\frac{\frac{N_{ijf^n}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}}\right) && \text{new firms intensity contribution} \qquad (4.6) \\
&- \sum_j \sum_{f^o} s_{ij_0}\left(\frac{\frac{N_{ijf^o_0}}{M_{j_0}}}{\frac{N_{ij_0}}{M_{j_0}}}\right), && \text{old firms intensity contribution,}
\end{aligned}$$

where N_{ijf^x} is the number of type i workers employed in a firm of type x.

These are simple decompositions which allow us to assess the contributions made by permanent, new and old firms to the overall scale and intensity effects found on the industry level. For clarity we summarise the joint effect of new and old firms in a category called *Net New Firms*. Table 4.6 reports the results for each of the four components, two for the scale effect and two for the intensity effect, together with the original estimates from the industry level estimations as reported in Table 4.4.

Focussing on the second row for the IV estimations, we can see that of the 20.1% of changes in labour supply that are absorbed by between industry adjustments, 9.5 percentage points are absorbed by permanent firms and 10.8 by the net creation of new firms. By contrast, of the within industry component of 62%, 47.1 percentage points are absorbed by permanent firms and 15.2 percentage points by new firms.

Decomposing these contributions further, the last row in Table 4.6 shows the relative contributions of firms operating in the tradable and non-tradable sector. Given that the two types of sectors are of roughly the same size in the base

[16]Total employment in every new firm in 1985 is zero, so $M_{jf^n_0} = 0$, and total employment in every old firm in 1995 is zero, so $M_{jf^o} = 0$, which gives the second and third term.

Table 4.6: Decomposition of changes in labour supply - from industry to firm level, by industry type

1985-1995	Between Industries				Within Industries			
	Permanent		Net New		Permanent		Net New	
Level	tradable	non-trad.	tradable	non-trad.	tradable	non-trad.	tradable	non-trad.
				OLS				
Industry		0.128*** (.019)				0.541*** (.027)		
Firm	0.091*** (.014)		0.038*** (.013)		0.436*** (.034)		0.106*** (.025)	
Firm/ tradability	0.061*** (.013)	0.029*** (.006)	0.020* (.011)	0.019** (.009)	0.292*** (.044)	0.144*** (.021)	0.045* (.024)	0.061*** (.010)
				IV				
Industry		0.201*** (.070)				0.620*** (.070)		
Firm	0.095** (.043)		0.108*** (.042)		0.471*** (.075)		0.152*** (.047)	
Firm/ tradability	0.042 (.028)	0.052* (.027)	0.008 (.036)	0.101*** (.022)	0.372*** (.101)	0.099 (.060)	0.079* (.046)	0.073** (.032)

Notes: All regressions use 612 observations and include a full set of skill and region fixed effects. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_r^{85} + 1/N_r^{95})^{-1/2}$ where N_r^t represents the overall labour force in region r in year t. Overall employment in 1985 was 8,513,067 (49.1%) in firms in tradable industries and 8,828,637 (50.9%) in firms in non-tradable industries. The first stage t-stat in the IV regressions is 6.0. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

year 1985 and the share of permanent firms is similar (compare Table 4.1), it is particularly interesting to see that the majority of within industry adjustments contributed by permanent firms comes from firms in the tradable sector with 37.2% compared to only 9.9% for non-tradable firms.

Table 4.7 has the same structure as Table 4.6 but this time distinguishes contributions by small and large firms. A firm is defined as large if it has more than 100 full-time employees in 1985 or, for a new firm, if it has more than 100 full-time employees in 1995. Focussing again on the IV results in the bottom row, we can see that large firms contribute substantially to the between industry adjustment component with 9.9% compared to only -0.4% for small firms, while small firms contribute disproportionately to the within industry component with 47.4% compared to only -0.3% for large firms.

Table 4.7: Decomposition of changes in labour supply - from industry to firm level, by firm size

1985-1995	Between Industries				Within Industries			
	Permanent		Net New		Permanent		Net New	
Level	small	large	small	large	small	large	small	large
				OLS				
Industry		0.128*** (.019)				0.541*** (.027)		
Firm	0.091*** (.014)		0.038*** (.013)		0.436*** (.034)		0.106*** (.025)	
Firm/ size	0.023*** (.007)	0.067*** (.014)	0.049*** (.008)	-0.011 (.009)	0.192*** (.018)	0.244*** (.042)	0.110*** (.012)	-0.004 (.022)
				IV				
Industry		0.201*** (.070)				0.620*** (.070)		
Firm	0.095** (.043)		0.108*** (.042)		0.471*** (.075)		0.152*** (.047)	
Firm/ size	-0.004 (.018)	0.099*** (.034)	0.081*** (.018)	0.027 (.032)	0.474*** (.054)	-0.003 (.087)	0.235*** (.030)	-0.084** (.041)

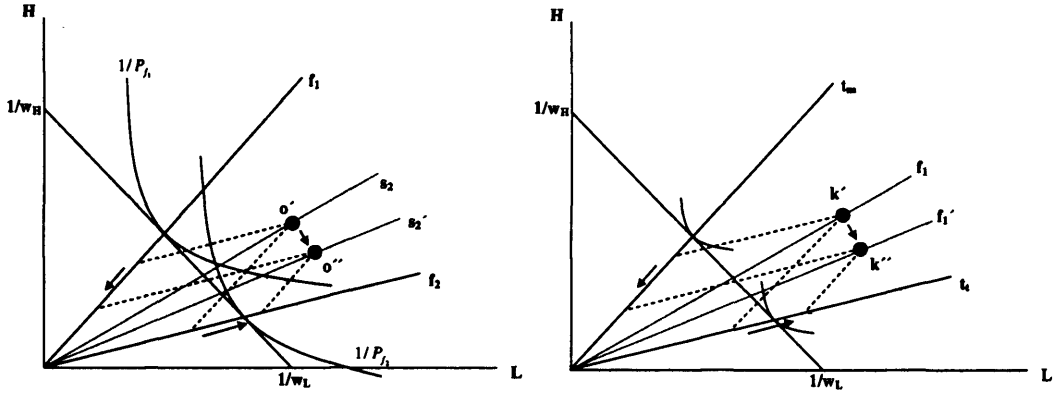
Notes: All regressions use 612 observations and include a full set of skill and region fixed effects. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_r^{85} + 1/N_r^{95})^{-1/2}$ where N_r^t represents the overall labour force in region r in year t. Overall employment in 1985 was 8,482,928 (48.9%) in small firms and 8,858,776 (51.1%) in large firms. The first stage t-stat in the IV regressions is 6.0. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

4.4.3 A New Firm Level Decomposition

Despite offering a good insight into the relative contributions of permanent, new and old firms to the measured between and within industry effects, the decompositions in Equations 4.5 and 4.6 cannot directly be interpreted as scale and intensity effects on the firm level.

To see this, assume that all the adjustments happen within industries as suggested by the findings of Lewis (2004b). Focussing on industry 2 for the moment, the left graph in Figure 4.3 depicts this change in technology by the move from the optimal labour input ratio s_2 to the new optimal ratio s_2'. Now suppose this industry consists of two firms, firm 1 and firm 2, and that both these firms produce a different output good with technologies f_1 and f_2, where firm 1 is using a skill-intensive technology relative to firm 2. The unit-value isoquants for firm 1 and firm 2 are given by $1/P_{f_1}$ and $1/P_{f_2}$, where P_{f_1} and P_{f_2} are the prices of the output goods produced by firm 1 and firm 2. Similar to the line of argument

Figure 4.3: Between and within firm adjustments



that explains the between industry adjustment mechanism, when output prices are fixed, the observed within industry intensity effect could be fully explained by a *within industry between firm* scale effect, which we simply call the *between firm* effect, with the skill-intensive firm 1 decreasing its output and the low-skill intensive firm 2 increasing it as illustrated by the arrows along the production rays f_1 and f_2.[17] This suggests that there are potential pitfalls from aggregating to the industry level and that one potentially misinterprets evidence of changes in relative factor inputs within industries as endogenous technology adjustments.

Such endogenous technology adjustments could in turn be represented by a clockwise rotation of the within industry cone of diversification similar to the way described in Section 4.4.1. Suppose in every firm there exist two competing modes of technology (or organisation), a traditional t_t and a modern one t_m, that are simultaneously in use as suggested by Beaudry and Green (2003, 2005).[18] This situation is depicted for firm 1 in the right graph of Figure 4.3. A possible explanation of how a firm endogenously adjusts to changes in relative factor

[17]Presumably, labour mobility between firms of the same industry is easier than between industries so that the assumption of constant relative wages across firms within the same industry is more likely to hold than across industries.

[18]In their model of endogenous technological adoption, Beaudry and Green (2003, 2005) emphasise the importance of physical capital in determining changes in the wage-education relationship. Unfortunately, there is no data available on the stock of physical capital in each of the firms in our data, so that we cannot investigate the role capital movements play in firms' adjustment processes in response to local labour supply changes.

supplies without changing its relative wage structure is by changing its relative usage of the two technologies. In the example of low-skilled immigration, the firm increases its use of the low-skill intensive technology while decreasing the use of the high-skill intensive technology as illustrated by the arrows along the technology-specific production rays t_t and t_m. As a consequence of this technology adjustment, the equilibrium factor input ratio of firm 1 will change as depicted by the shift from f_1 to f_1'. We call this effect the *within industry within firm* intensity effect, or simply the *within firm* effect.

We now show under which conditions industry and firm level analyses lead to the same conclusions with regard to the relative magnitude of between and within effects and quantify the actual discrepancies resulting from the aggregation to the industry level.

In order to identify between and within firm effects, a useful decomposition would be to start off by writing the change in the labour supply of skill group i in a locality as the sum of changes in employment of workers with skill level i in each industry j and the change in the number of unemployed workers with skill level i:

$$\Delta L_i = \sum_j \Delta N_{ij} + \Delta U_i.$$

In each industry j there are now a number of firms operating. Let us divide these firms as before into three groups:

f^p: *permanent* firms that appear in both periods
f^n: *new* firms that were established between 1985 and 1995
f^o: *old* firms that went out of business between 1985 and 1995

The percentage change in labour supply can then be decomposed in the following way (for details see Appendix 4.7.3):

$$\frac{\Delta L_i}{L_{i_0}} = \sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} (\%\Delta N_{ijf^p}) + \sum_j \sum_{f^n} \frac{\Delta N_{ijf^n}}{L_{i_0}} - \sum_j \sum_{f^o} s_{ij_0} s_{ijf_0^o} + s_{iu_0} \%\Delta U_i, \quad (4.7)$$

where N_{ijf} is the overall employment of skill i in firm f that operates in industry j, so that

$s_{ij_0} = \frac{N_{ij_0}}{L_{i_0}}$: initial share of type i workers employed in industry j

$s_{ijf_0^x} = \frac{N_{ijf_0^x}}{N_{ij_0}}$: initial share of type i workers in industry j employed in firm f^x

$\%\Delta N_{ijf^p}$: percentage change in number of type i workers employed in *permanent* firm f^p

$\frac{\%\Delta N_{ijf^n}}{L_{i_0}}$: percentage change in number of type i workers employed in *new* firm f^n relative to initial labour force of type i

$s_{iu_0} = \frac{U_{i_0}}{L_{i_0}}$: initial unemployment rate of type i workers

$\%\Delta U_i$: percentage change in number of unemployed type i workers

Now let M_{jf} be a measure of the size of a firm f in industry j, in our case total employment. Then we can decompose the firm-specific percentage change in employment of type i workers for all permanent firms (and only for these firms) into three terms (again, for details see Appendix 4.7.3):

$$\%\Delta N_{ijf} = \%\Delta M_{jf^p} + \%\Delta\left(\frac{N_{ijf^p}}{M_{jf^p}}\right) + \%\Delta M_{jf^p} \cdot \%\Delta\left(\frac{N_{ijf^p}}{M_{jf^p}}\right), \tag{4.8}$$

where

$\%\Delta M_{jf^p}$: percentage change in total employment of firm f^p in industry j

$\%\Delta\left(\frac{N_{ijf^p}}{M_{jf^p}}\right)$: percentage change in type i labour intensity in firm f^p in industry j.

The first term thus represents a firm-specific scale effect while the second term represents changes in the firm-specific relative factor intensity. The interaction of both effects is captured in the third term. Substituting Equation 4.8 into

Equation 4.7, we then obtain an expression that decomposes the change in skill-specific labour supply into six distinct components:[19]

$$
\begin{aligned}
\frac{\Delta L_i}{L_{i_0}} = & \sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} \cdot \%\Delta M_{jf^p} && \text{permanent firms scale effect} \\
& + \sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} \cdot \%\Delta\left(\frac{N_{ijf^p}}{M_{jf^p}}\right) && \text{permanent firms intensity effect} \\
& + \sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} \cdot \%\Delta M_{jf^p} \cdot \%\Delta\left(\frac{N_{ijf^p}}{M_{jf^p}}\right) && \text{residual term permanent firms} \\
& + \sum_j \sum_{f^n} \frac{\Delta N_{ijf^n}}{L_{i_0}} && \text{new firms contribution} \\
& - \sum_j \sum_{f^o} s_{ij_0} s_{ijf_0^o} && \text{old firms contribution} \\
& + s_{iu_0} \%\Delta U_i && \text{unemployment growth.}
\end{aligned}
\tag{4.9}
$$

We regress each of these components on the percentage change in skill-specific labour supply in a region. The model is the same as in Section 4.4.1:

$$y_{ir} = \lambda_i + \theta_r + \beta \%\Delta L_{ir} + \varepsilon_{ir}$$

where y_{ir} is one of our outcome variables, and λ_i and θ_r are education group and region fixed effects respectively. Table 4.8 reports the corresponding results. As before, we estimate both by OLS and IV, using the predicted immigrant inflow to instrument the potentially endogenous labour supply growth in a locality. Focussing on the IV results for the period 1985 to 1995, we can see that 13.4% of the change in labour supply is absorbed by an increase in scale of permanent firms while 31.1% is absorbed by changes in relative factor intensities. This contribution is what could be considered as arising from endogenous changes in production technology as suggested by Lewis's work. However, the corresponding estimate on the industry level in Table 4.4 gave a share of 62.0%. An analysis on the industry level thus clearly misrepresents the importance of technology adjustments in absorbing changes in local labour supply. The main difference

[19]There are some regions where the number of unemployed workers with college education in the sample in the initial period is zero so that it is not possible to obtain the growth rate $\%\Delta U_i$. In these few cases we calculate $\Delta U_i / L_{i_0}$ rather than $s_{iu_0} \%\Delta U_i$ which is, of course, equivalent.

Table 4.8: Decomposition of changes in labour supply on the firm level

1985-1995	Permanent scale	Permanent intensity	Net New firms	Ambi-guous	Unem-ployment
			OLS		
Labour Supply Growth	0.191*** (.036)	0.293*** (.050)	0.217*** (.026)	0.171*** (.044)	0.128*** (.020)
			IV		
Labour Supply Growth	0.134** (.068)	0.311** (.128)	0.232*** (.044)	0.285** (.120)	0.039 (.049)

Notes: All regressions use 612 observations and include a full set of skill and region fixed effects. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_r^{85} + 1/N_r^{95})^{-1/2}$ where N_r^t represents the overall labour force in region r in year t. First stage t-stat is 6.0. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

between the results on the industry and firm level arises from the (net) creation of firms which contributes a significant 23.2%. Interestingly, even compared to the *within* results that we obtained after breaking down the industry effects into the contributions by permanent and net new firms (compare Table 4.6) our estimates in Table 4.8 show a smaller *within* effect, 31.1% vs 47.1%, and a larger *between* effect, 13.4% vs 9.5% in permanent firms. The reason for these discrepancies is that in the former decomposition, we are not holding each individual firm's relative factor inputs and scales constant as necessary to accurately distinguish between and within effects.

In particular, the contribution to the industry scale effect coming from permanent firms in Equation 4.5 equals the firm scale effect given in Equation 4.9 plus a residual term:[20]

$$\underbrace{\sum_j \sum_{f^p} s_{ij_0}\left(\frac{M_{jf^p} - M_{jf_0^p}}{M_{j_0}}\right)}_{\substack{\text{permanent firm contribution} \\ \text{industry scale effect}}} = \underbrace{\sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} * \%\Delta M_{jf^p}}_{\substack{\text{permanent firm} \\ \text{scale effect}}} + \underbrace{\sum_j \sum_{f^p} s_{ij_0}\left(\frac{M_{jf_0^p}}{M_{j_0}} - \frac{N_{ijf_0^p}}{N_{ij_0}}\right)\%\Delta M_{jf^p}}_{\text{residual term}}$$

[20]See Appendix 4.7.4 for details as well as the remaining decompositions of the terms for new and old firms, and an overview.

As long as the second term is different from zero, the two scale effects will not be identical. If all firms in the same industry j produce with the same relative factor inputs in the base year, then $(\frac{M_{jf_0^p}}{M_{j_0}} - \frac{N_{ijf_0^p}}{N_{ij_0}}) = 0$, and the industry based scale effect of permanent firms will be identical to the firm based scale effect.

Similarly, the contribution to the industry intensity effect coming from permanent firms in Equation 4.6 equals the firm intensity effect in Equation 4.9 plus a residual term:

$$\underbrace{\sum_j \sum_{f^p} s_{ij_0} \left(\frac{\frac{N_{ijf^p}}{M_j} - \frac{N_{ijf_0^p}}{M_{j_0}}}{\frac{N_{ij_0}}{M_{j_0}}} \right)}_{\text{permanent firm contribution industry intensity effect}} = \underbrace{\sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} * \%\Delta \left(\frac{N_{ijf^p}}{M_{jf^p}} \right)}_{\text{permanent firm intensity effect}} + \underbrace{\sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} \left(\frac{\frac{N_{ijf^p}}{N_{ijf_0^p}} * (\frac{M_{jf^p}}{M_{jf_0^p}} - \frac{M_j}{M_{j_0}})}{\frac{M_j}{M_{j_0}} \frac{M_{jf^p}}{M_{jf_0^p}}} \right)}_{\text{residual term}}$$

As before, as long as the second term is different from zero, the two intensity effects will not be identical. If all firms in the same industry j grow at the same rate (so there is no "between" effect within industry), then the second term of the right hand side of the last equation will be zero for all firms since $(\frac{M_{jf^p}}{M_{jf_0^p}} - \frac{M_j}{M_{j_0}}) = 0$ and the industry based intensity effect of permanent firms will be identical to the firright hand side of the last equation will be zero for all firms since $(\frac{M_{jf^p}}{M_{jf_0^p}} - \frac{M_j}{M_{j_0}}) = 0$ bias that results from aggregating firms to industries.

Comparing the results for permanent firms from the industry analysis in Table 4.6 and those on the firm level in Table 4.8, we see that the relative magnitude of the residual terms arising from the aggregation to the industry level is substantial. In our case, they amount to minus 29% of the true firm scale effect ($\frac{0.095-0.134}{0.134}$), and 51% of the true firm intensity effect ($\frac{0.471-0.311}{0.311}$). These discrepancies reflect a typical aggregation problem. Given the large degree of heterogeneity of firms and their products within industries (see, for instance, Bernard and Jensen, 2002), such an aggregation is potentially very problematic, especially in the context of technology adjustments, which, in the end, take place on the firm level.

Given the importance of the net creation of new firms in absorbing changes in local labour supply, it is of particular interest to try to characterise its contribution as either a scale or an intensity contribution. Because these firms did not exist in the base year or have ceased to operate since, one cannot use the firm-specific growth rates in scale and skill-specific factor intensities as we have for permanent firms. However, a natural benchmark for the production technology of new and old firms in an industry is the average production technology (in terms of relative factor inputs) in that industry in the base year. Specifically, one can re-write the contribution of both new and old firms given in Equation 4.9 as the sum of two terms

$$\underbrace{\sum_j \sum_{f^n} \frac{N_{ijf^n}}{L_{i_0}}}_{\substack{\text{new firms} \\ \text{contribution}}} = \underbrace{\sum_j \sum_{f^n} s_{ij_0} \left(\frac{M_{jf^n}}{M_{j_0}}\right)}_{\substack{\text{new firms} \\ \text{scale effect}}} + \underbrace{\sum_j \sum_{f^n} s_{ij_0} \left(\frac{M_{jf^n}}{M_{j_0}}\right) \left(\frac{\frac{N_{ijf^n}}{M_{jf^n}} - \frac{N_{ij_0}}{M_{j_0}}}{\frac{N_{ij_0}}{M_{j_0}}} \right)}_{\substack{\text{new firms} \\ \text{intensity effect}}},$$

$$\underbrace{-\sum_j \sum_{f^o} \frac{N_{ijf^o}}{L_{i_0}}}_{\substack{\text{old firms} \\ \text{contribution}}} = \underbrace{-\sum_j \sum_{f^o} s_{ij_0} \left(\frac{M_{jf_0^o}}{M_{j_0}}\right)}_{\substack{\text{old firms} \\ \text{scale effect}}} \underbrace{-\sum_j \sum_{f^o} s_{ij_0} \left(\frac{M_{jf_0^o}}{M_{j_0}}\right) \left(\frac{\frac{N_{ijf_0^o}}{M_{jf_0^o}} - \frac{N_{ij_0}}{M_{j_0}}}{\frac{N_{ij_0}}{M_{j_0}}} \right)}_{\substack{\text{old firms} \\ \text{intensity effect}}},$$

where the fraction N_{ij_0}/M_{j_0} in the second term on the right hand side of each equation is the average factor share of skill type i in industry j in the base year 1985. While the first term in each equation can be interpreted as the contribution of new and old firms to the scale of the industry, the second term captures the factor intensity contribution that goes beyond the average industry-wide factor intensity in the base year. If a new firm produces with exactly the same factor intensity as the industry average used to, then $(\frac{N_{ijf^n}}{M_{jf^n}} - \frac{N_{ij_0}}{M_{j_0}}) = 0$ and the second term in the first equation is zero so that the creation of this new firm can be exclusively interpreted as a contribution to the scale effect. Similarly, if an old firm produced with exactly the same factor intensity as the industry average in 1985, then $(\frac{N_{ijf_0^o}}{M_{jf_0^o}} - \frac{N_{ij_0}}{M_{j_0}}) = 0$ and its destruction can again be interpreted as solely a contribution to the scale effect. Note that each leading term on the right hand side of the previous equations is identical to the contribution of new and old firms, respectively, to the industry scale effect in Equation 4.5. With an IV

estimate of 0.108 for the net contribution of these terms (compare Table 4.6) and an IV estimate of the overall net new firms contribution of 0.232 (compare Table 4.8), the overall intensity contribution of new and old firms is given by 0.232-0.108=0.124. So roughly half of what the net creation of new firms contributes to the absorption of local labour supply changes can be considered as a scale effect and about half as an intensity adjustment. Overall, the analysis on the firm level thus reveals that 43.5% of changes in local labour supply are absorbed by changes in relative factor intensities (31.1% by permanent and 12.4% by new firms) and 24.2% by a differential growth in the scale of firms (13.4% by permanent and 10.8% by new firms). Compared to the corresponding intensity and scale contributions estimated on the industry level of 62.0% and 20.1% respectively (compare Table 4.4), these figures imply that the contribution of changes in production technology may have been overestimated on the industry level relative to the contribution of changes in scale but that intensity adjustments are nonetheless the more important channel through which local firms adjust to changes in relative factor supplies.

Table 4.9 shows the firm contributions if we distinguish between firms in tradable industries and those in non-tradable industries. The IV results show that the bulk of the overall scale effect of 13.4% comes from firms in non-tradable industries (10.5%), while pretty much all of the intensity effect arises from firms in tradable industries (34.6%). About two thirds of the contribution from new firms comes from new firms in non-tradable industries and one third from firms in tradable industries. This difference reflects the differential growth in overall employment of the non-tradable and tradable sector with the former growing by 7.5% and the latter shrinking by 4.2% between 1985 and 1995.

With regard to the size of the firms, Table 4.10 shows that most of the scale effect of permanent firms comes from large firms with more than 100 employees (12.8%) whereas the intensity effect is exclusively driven by labour input adjustments in small firms (51.9%). This could point towards more flexibility in the production methods available to small firms compared to large firms. All of the new firms that contribute to the absorption of the changes in relative factor supplies are small firms which is to be expected since there are only around 4,200

Table 4.9: Decomposition of changes in labour supply on the firm level, by industry type

1985-1995	Permanent scale		Permanent intensity		Net New firms		Ambi-	Unem-
	tradable	non-trad.	tradable	non-trad.	tradable	non-trad.	guous	ployment
				OLS				
Labour Supply Growth	0.191*** (.036)		0.293*** (.050)		0.217*** (.026)		0.171*** (.044)	0.128*** (.020)
	0.130*** (.025)	0.061*** (.020)	0.170*** (.053)	0.123*** (.023)	0.116*** (.024)	0.101*** (.013)		
				IV				
Labour Supply Growth	0.134** (.068)		0.311** (.128)		0.232*** (.044)		0.285** (.120)	0.039 (.049)
	0.028 (.052)	0.105** (.043)	0.346*** (.131)	-0.035 (.085)	0.073* (.044)	0.159*** (.037)		

Notes: All regressions use 612 observations and include a full set of skill and region fixed effects. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_r^{85} + 1/N_r^{95})^{-1/2}$ where N_r^t represents the overall labour force in region r in year t. Overall employment in 1985 was 8,513,067 (49.1%) in firms in tradable industries and 8,828,637 (50.9%) in firms in non-tradable industries. The first stage t-stat is 6.0. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

newly established firms that have more than 100 employees in 1995 compared to around 700,000 newly established small firms (compare Table 4.1). The differential adjustment behaviour of small and large firms is of particular relevance in connection with the typical data sample selection in favour of large firms we discussed earlier. In an economy with predominantly small firms, focussing on large establishments may conceal some of the most important adjustment processes that locally take place in response to changes in relative factor supplies.

Table 4.10: Decomposition of changes in labour supply on the firm level, by firm size

1985-1995	Permanent scale		Permanent intensity		Net New firms		Ambi-guous	Unem-ployment
	small	large	small	large	small	large		
				OLS				
Labour Supply Growth	0.191*** (.036)		0.293*** (.050)		0.217*** (.026)		0.171*** (.044)	0.128*** (.020)
	0.074** (.030)	0.117*** (.024)	0.199*** (.017)	0.095* (.054)	0.177*** (.016)	0.040* (.021)		
				IV				
Labour Supply Growth	0.134** (.068)		0.311** (.128)		0.232*** (.044)		0.285** (.120)	0.039 (.049)
	0.005 (.043)	0.128** (.051)	0.519*** (.058)	-0.208 (.143)	0.301*** (.034)	-0.070 (.043)		

Notes: All regressions use 612 observations and include a full set of skill and region fixed effects. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_r^{85} + 1/N_r^{95})^{-1/2}$ where N_r^t represents the overall labour force in region r in year t. Overall employment in 1985 was 8,482,928 (48.9%) in small firms and 8,858,776 (51.1%) in large firms. The first stage t-stat in the IV regressions is 6.0. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

4.5 Firm Level Wage Responses

An important feature of the Heckscher-Ohlin-Samuelson model introduced in Section 4.4.1 and prerequisite for interpreting the observed changes in factor intensities as changes in production technology is that relative wages do not change in response to changes in local factor endowments. In Section 4.3 we have already shown that there is not much evidence of this for workers in tradable industries at the regional level. However, having moved the analysis to the firm level, it may be instructive to investigate to what extent relative wages have changed within firms in response to changes in their relative factor inputs. For that purpose, we estimate a model of the following form by OLS:

$$\Delta \log\left(\frac{w_i^f}{w_{medium}^f}\right) = controls + \gamma \Delta \log\left(\frac{N_i^f}{N_{medium}^f}\right) + \varepsilon_{if}, \tag{4.10}$$

where the dependent variable is the change in log relative wages in firm f with the base category being individuals with medium skill level, $i \in (high, low)$, and the key explanatory variable is the change in the relative factor inputs

Table 4.11: Wage adjustments to changes in relative firm-specific factor inputs

1985-1995	(1)	(2)	(3)	(4)	(5)
Manufacturing	0.001	-0.004	-0.003	-0.004	-0.003
	(.011)	(.011)	(.010)	(.011)	(.011)
Tradable	0.008	0.003	0.001	-0.012	-0.013
	(.011)	(.010)	(.010)	(.010)	(.009)
Non-tradable	-0.077***	-0.081***	-0.080***	-0.081***	-0.080***
	(.012)	(.012)	(.012)	(.012)	(.012)
All	-0.032***	-0.035***	-0.036***	-0.048***	-0.049***
	(.009)	(.009)	(.009)	(.008)	(.008)
Included fixed effects					
Education	√	√	√	√	√
Industry		√	√	√	√
Region			√		√
Education × industry				√	√

Notes: Entries are coefficient estimates on the log change in firm-specific relative factor inputs, with medium skilled employment being the base category. Dependent variable is the corresponding change in log relative wages. The sample is restricted to permanent firms with more than 100 employees in the base year. There are 10,628 tradable firms of which 8,975 are manufacturing firms, 11,578 non-tradable firms, and 22,206 firms overall. All regressions use 204 West German labour market regions. Robust standard errors are reported in parentheses. Regressions are weighted by $(1/N_f^{85} + 1/N_f^{95})^{-1/2}$ where N_f^t represents the firm size in terms of overall employment in year t. A (*) denotes statistical significance at the 10% level, a (**) at the 5% level and a (***) at the 1% level.

$\Delta\log(N_i^f/N_{medium}^f)$ in firm f. We estimate this model in five different specifications that vary by the set of fixed effects we include.

Table 4.11 reports estimates of γ for large permanent firms operating in different industry sectors. In the most basic formulation we only include a full set of skill group fixed effects.[21] The estimation results for this specification are reported in column (1). Overall, they reflect the empirical results we obtained from the regressions on the regional level in Section 4.3. There is no evidence of a correlation between changes in relative factor inputs and changes in relative

[21]The starting point for such a specification of the regression model is a CES production function in which the skill-specific productivity component of each of the three labour inputs is assumed to vary additively by firm, industry, region, and time. Allowing for differential time trends across industries, regions and skill-groups gives rise to the inclusion of additional sets of fixed effects, as reported in columns (2) to (5) of Table 4.11

wages for firms in manufacturing and other tradable industries, but a significant negative correlation for firms operating in non-tradable industries with a point estimate of -0.077. All estimated correlations are robust to the inclusion of different sets of fixed effects. It is important to point out that these empirical results do not identify the elasticity of substitution between the different skill groups within firms since they do not take the potential endogeneity of the changes in firm-specific relative factor inputs into account. Moreover, under the reasonable assumption that labour is mobile between firms, changes in firm-specific relative factor inputs are not expected to lead to changes in relative wages since these are determined at the labour market rather than the firm level. If we do observe such wage changes, as for firms in non-tradable industries, they are likely to reflect unobserved differences in labour types across firms. Therefore the empirical results in Table 4.11 have to be interpreted as purely descriptive. They indicate that for firms in the tradable sector relative wages are fixed which, given the substantial adjustments in their relative factor inputs found in the previous section, points towards endogenous changes in production technologies. In the non-tradable case, relative wages are more flexible so that changes in relative factor inputs do not necessarily imply changes in technology. Firms could have moved along their isoquant of a given technology. As pointed out before, within firm adjustments in relative factor inputs are only interpretable as endogenous changes in technology if relative wages are fixed.

4.6 Conclusion

In this chapter, we use data on all individuals in the social security system that work in West Germany between 1985 and 1995 to analyse how industries and firms in local labour markets adjust to changes in the local labour supply due to immigration. Starting off with an industry level analysis à la Lewis (2004b), we find that about 62% of labour supply changes in a locality are absorbed within industry through changes in relative factor inputs while only about 20% are absorbed by changes in the industry mix, that is the relative scale of industries.

A further decomposition to the firm level reveals that only under strong assumptions can industry level changes in factor intensities be interpreted as

changes in production technologies. Our firm level results imply that estimates obtained on the industry level are significantly overestimating the contribution of changes in production technology and that in particular the net creation of new firms is an important factor in absorbing changes in local labour supply, accommodating around 23% thereof of which about half can be interpreted as intensity adjustments. Our estimates show that in firms that exist in both 1985 and 1995 changes in relative factor intensities account for more than 31% of the overall changes in relative factor supplies while only around 13% are absorbed by changes in the scale of these firms. Adding the contributions from new firms, the firm level decomposition shows that overall around 44% of labour supply changes are absorbed within firm through changes in relative factor inputs and about 24% by changes in the output mix and the relative scale of firms. Our results therefore imply that, first, firms seem to adjust their production technologies according to the local labour supply mix and, second, changes in output mix are not a major source of adjustments to changes in local labour supply. There are some differences according to the size of a firm and the sector it operates in. Firms in tradable industries predominantly adjust through their factor intensities while firms in non-tradable industries predominantly adjust through their relative scales. Also, while large firms with more than 100 employees primarily adjust through their relative scales, small firms adjust through changes in their factor intensities.

To complement our results on firm-specific employment growth and factor intensities, our wage regressions show that firms in the tradable sector do not experience changes in relative wages in response to changes in relative factor inputs, pointing towards a change in production technology in these firms. Firms in the non-tradable sector on the other hand have experienced a decline in relative wages corresponding to the change in relative factor inputs. This could mean that these firms have moved along their isoquant, and thus not necessarily changed their production technologies.

There are some interesting directions in which to take this analysis in the future. One aspect we have not addressed in this chapter are the dynamics of the scale and intensity adjustment processes. It may well be that in the

short run firms find it easier to increase their scale rather than switch to a new technology and that only after some time the changes in production technology are introduced and factor intensities adjusted to the changes in local labour supply. Also in terms of wages, one would expect the adjustment process to be dynamic. For instance, the Heckscher-Ohlin-Samuelson model predicts short-term changes in response to changes in local factor endowments which lead to positive profits being earned in those industries that use labour types intensively that have become cheaper. The positive profits then attract new entrants into these industries driving wages back up to their initial level in the long run. Analysing the dynamics of these adjustment processes would be helpful in fully understanding the way industries and firms behave when faced with a new labour supply situation. In this context, the analysis should also explicitly cover firm-level capital investments, both in terms of magnitude and type and in terms of timing, since they undoubtedly constitute an important additional component of the adjustment process to immigration.

Finally, we assume throughout this analysis, that output prices for tradable goods are set on the international market and that they are hence fixed from the perspective of the firms. Given that we are looking at a period of ten years, it would be interesting to analyse some data on relative output price changes, at least on the industry level, to see to what extent these changes may have contributed to the optimal choices of relative factor inputs within industries.

4.7 Appendix

4.7.1 Industry Characteristics

Table 4.12: Industry characteristics

Industry	1995									Change 1985 - 1995			
	Total employment	% share employment	Average firm size	% low skill	% medium skill	% high skill	Wage low skill	Wage medium skill	Wage high skill	%Δ employment	%Δ low skill	%Δ medium skill	%Δ high skill
Tradable industries	7,856,455	46.8	20.5	24.1	67.4	8.5	63.9	83.2	131.1	−4.2	−28.1	9.9	64.3
Manufacture of electrical equipment	785,702	4.7	49.3	25.4	60.8	13.8	64.1	83.8	131.1	−8.0	−28.3	10.8	42.0
Financial intermediation and insurance industry	751,137	4.5	24.3	13.0	78.1	8.9	57.5	95.0	128.7	10.8	−28.9	1.8	76.5
Manufacture of motor vehicles	571,270	3.4	283.4	25.6	67.1	7.4	82.8	94.5	131.1	−7.8	−33.0	16.5	71.6
Manufacture of machinery	531,331	3.2	42.5	15.4	76.7	7.9	64.6	87.6	131.1	−8.5	−34.0	6.7	65.1
Manufacture of chemicals and chemical products	484,372	2.9	139.8	21.0	66.8	12.2	73.9	96.9	131.1	−11.3	−32.1	9.9	47.7
Manufacture of earth-moving equipment	330,916	2.0	40.1	35.1	61.4	3.5	64.8	79.1	130.3	2.3	−20.3	13.7	79.9
Legal advice and business consulting	324,067	1.9	5.9	14.5	66.9	18.6	17.9	66.0	118.9	60.5	−33.4	−1.0	74.9
Architecture and engineering firms	286,138	1.7	7.4	8.2	57.4	34.5	33.1	83.0	122.7	61.0	−29.7	−7.2	29.7
Manufacture of gears	284,228	1.7	55.2	19.3	72.0	8.7	67.1	85.5	131.1	−9.2	−27.3	7.4	35.5
Manufacture of food products	282,796	1.7	14.4	29.4	68.4	2.2	52.1	62.8	129.7	−4.6	−25.9	15.7	83.2
Manufacture of furniture	281,252	1.7	10.8	25.9	72.8	1.4	54.9	73.5	106.3	4.4	−14.1	5.3	72.5
Manufacture of plastic products	253,564	1.5	40.4	37.5	58.7	3.8	61.6	76.0	129.0	22.4	−20.3	15.7	70.7
Printing	173,063	1.0	16.1	22.1	75.3	2.6	64.5	88.1	122.9	−0.9	−15.7	4.1	78.9
Manufacture of tanks and containers	169,122	1.0	25.3	18.3	76.1	5.6	65.7	80.5	131.1	4.8	−21.7	4.4	49.7
Precision mechanics and optical equipment	165,509	1.0	14.7	23.8	70.2	6.0	52.4	75.9	130.8	−9.1	−29.0	11.7	65.2
Manufacture of stones and mortars	164,176	1.0	18.4	29.9	66.3	3.8	75.1	84.3	130.8	1.4	−20.2	10.7	46.3
Manufacture of basic iron and steel	154,829	0.9	217.8	32.6	62.2	5.2	74.2	84.4	131.1	−36.4	−19.8	11.7	41.4
Manufacture of ventilation and heating equipment	152,202	0.9	10.9	17.9	78.9	3.2	18.1	74.7	123.5	18.5	−20.7	5.3	29.5
Real estate	147,544	0.9	5.6	12.1	75.5	12.4	54.4	83.3	130.6	59.8	−24.6	0.7	37.8
Manufacture of paper products	135,894	0.8	55.8	37.7	58.7	3.6	65.6	81.3	130.9	−0.4	−22.6	19.6	63.4
Meat processing	128,711	0.8	8.7	27.1	72.3	0.5	46.8	57.1	109.6	−17.7	−27.0	15.6	80.3
Forging, stamping and pressing of steel	127,566	0.8	26.4	37.3	60.1	2.5	67.0	80.0	130.3	2.8	−17.4	13.1	55.4
Manufacture of textiles	126,481	0.8	39.5	43.1	53.9	3.0	56.3	70.6	115.7	−39.6	−21.3	23.3	94.0
Mining and quarrying	125,827	0.8	299.0	29.9	62.9	7.2	74.5	81.8	130.5	−42.5	−12.4	3.7	39.0
Manufacture of beverages and tobacco products	83,629	0.5	35.2	23.9	71.9	4.2	68.8	84.3	130.8	−16.0	−20.5	6.9	56.0
Manufacture of apparel	82,768	0.5	17.7	33.2	65.1	1.8	46.1	56.5	97.4	−51.6	−24.7	17.6	183.9
Shipbuilding and manufacture of aircraft	81,513	0.5	129.3	12.0	71.1	16.8	70.7	93.4	131.1	−12.7	−36.1	3.3	36.8
Casting of metals	77,641	0.5	67.4	41.2	55.9	2.9	74.1	84.8	131.1	−19.3	−15.4	12.9	66.3
Manufacture of rubber products	73,083	0.4	76.8	39.4	54.6	6.0	70.4	78.8	130.5	−22.0	−21.3	16.9	86.7
Locksmith's, grinding and welding shops	71,683	0.4	6.9	21.1	77.4	1.5	47.9	69.7	108.2	14.1	−30.4	12.4	81.3
Manufacture of glass products	57,400	0.3	63.7	35.6	59.5	4.9	66.3	76.5	130.0	−9.4	−25.3	19.7	85.4
Manufacture of wood	53,978	0.3	18.0	43.8	54.4	1.9	62.5	75.4	116.7	−1.6	−13.4	12.4	68.1
Advertising	53,258	0.3	5.7	14.6	74.6	10.8	44.6	78.4	102.6	48.7	−20.3	0.0	51.7
Manufacture of ceramic products	45,838	0.3	46.3	47.1	48.9	3.9	57.7	71.5	130.0	−20.6	−16.7	18.7	77.1
Cold drawing and rolling	38,793	0.2	86.3	41.0	55.6	3.4	73.7	84.4	131.1	−22.5	−17.1	14.5	71.2
Manufacture of data processing equipment	38,625	0.2	34.1	17.0	62.1	20.9	65.6	94.7	131.1	−41.0	−34.3	12.3	10.9
Manufacture of confectionery	38,360	0.2	99.7	48.0	48.6	3.5	49.2	76.7	130.5	4.6	−10.3	8.7	86.8
Manufacture of other wood products	29,099	0.2	14.8	44.2	54.3	1.5	57.5	69.9	110.0	−3.0	−13.0	12.7	47.1
Manufacture of footwear	23,274	0.1	10.4	42.2	55.1	2.7	52.3	62.1	117.6	−48.3	−29.8	40.2	389.0
Manufacture of toys and musical instruments	18,334	0.1	18.3	39.6	58.3	2.1	53.9	71.6	109.5	−14.2	−17.9	15.2	79.9
Upholstery	16,481	0.1	5.7	30.0	69.2	0.8	47.3	60.9	88.8	0.2	−12.9	6.6	23.8
Manufacture of leather products	15,586	0.1	14.6	42.8	55.3	1.9	49.5	63.5	112.0	−36.5	−20.6	22.1	138.0
Manufacture of jewellery	14,451	0.1	7.2	25.6	73.2	1.3	45.1	63.5	107.4	−22.8	−24.2	11.9	36.9
Agriculture	4,964	0.0	4.1	30.3	64.3	5.4	37.6	60.5	106.7	5.9	−24.4	14.6	41.4

continued on next page

Industry	1995									Change 1985 - 1995			
	Total employment	% share employment	Average firm size	% low skill	% medium skill	% high skill	Wage low skill	Wage medium skill	Wage high skill	%Δ employment	%Δ low skill	%Δ medium skill	%Δ high skill
Non-tradable industries	8,915,161	53.2	9.9	21.5	71.7	6.8	49.2	72.5	118.0	7.5	−22.0	6.0	41.8
Retail	2,178,444	13.0	7.9	17.5	78.6	3.9	47.4	67.2	122.9	5.8	−24.3	5.4	70.4
Health	1,032,287	6.2	9.7	19.3	69.8	10.9	27.6	69.2	131.1	18.6	−25.4	6.6	26.2
Main construction trade	729,719	4.4	16.3	26.1	69.7	4.2	66.9	81.1	131.1	−3.4	−6.6	1.2	33.2
Public administration	664,524	4.0	41.6	18.8	69.9	11.3	65.1	75.0	111.5	0.1	−27.9	6.8	32.7
Building installation	429,069	2.6	6.8	22.1	77.2	0.8	18.6	70.4	99.8	9.2	−19.4	6.9	89.7
Hotels and restaurants	319,950	1.9	4.4	38.4	60.7	0.8	31.3	48.0	77.6	−0.8	−17.3	14.6	66.1
Repair of motor vehicles	271,008	1.6	9.9	21.5	77.7	0.8	16.5	70.1	118.9	4.3	−26.2	10.6	40.0
Schools and universities	256,238	1.5	21.3	13.1	49.1	37.8	35.0	79.7	111.2	5.0	−34.6	−3.5	29.8
Residential homes	251,413	1.5	27.4	26.4	67.5	6.1	54.9	72.4	94.3	46.8	−28.7	16.1	25.6
Road traffic	243,443	1.5	8.1	22.8	76.0	1.2	67.8	73.7	115.1	18.4	−19.8	7.3	54.2
Electricity, gas and water supply	221,068	1.3	65.3	11.2	79.0	9.8	72.9	99.4	131.1	0.8	−34.3	4.0	39.9
Goods transportation on the road	215,566	1.3	16.2	25.3	73.1	1.6	62.9	73.8	121.7	28.5	−10.6	3.6	39.6
Other services	200,717	1.2	15.1	28.3	67.0	4.7	40.0	56.1	111.1	103.8	5.0	−2.5	8.2
Political parties	186,505	1.1	11.3	19.4	60.9	19.7	46.4	76.0	101.7	50.5	−18.7	1.7	20.8
Defence, public security and law and order	165,486	1.0	94.1	29.4	67.7	2.9	67.3	74.1	100.2	−34.9	−12.2	3.8	123.3
Other education	160,029	1.0	6.8	17.5	73.8	8.6	32.4	69.4	91.5	27.4	−27.3	7.7	18.5
Social security, extra-territorial organisations	154,674	0.9	26.6	13.8	80.0	6.2	60.0	79.2	106.5	19.4	−25.4	3.4	51.1
Carpentry and tiling	115,714	0.7	8.1	29.6	69.8	0.6	55.2	74.3	98.1	15.9	−4.3	1.7	32.5
Post	114,437	0.7	33.5	15.2	84.1	0.6	24.5	77.1	130.5	−10.1	−50.7	22.6	28.9
Hairdresser	105,031	0.6	3.1	25.3	74.6	0.1	12.1	36.8	44.1	−28.4	−33.9	20.9	84.0
Publishing and press	104,903	0.6	18.6	13.2	71.4	15.4	67.2	93.7	120.7	9.7	−26.3	−2.1	68.7
Aviation	104,583	0.6	13.8	18.6	75.8	5.7	73.8	82.2	129.9	29.2	−12.3	2.3	19.3
Sanitation and refuse disposal	95,256	0.6	18.6	37.2	58.2	4.6	73.5	80.6	115.8	41.8	−21.9	14.4	200.9
Cleaning	94,256	0.6	7.5	52.2	46.7	1.0	42.5	66.7	105.1	23.1	−3.5	3.0	93.7
Horticulture and viniculture	93,941	0.6	5.5	40.6	57.3	2.1	46.5	55.7	79.6	5.8	−15.8	13.9	43.7
Railways	92,604	0.6	91.3	36.2	62.1	1.7	71.4	78.2	103.8	−27.3	−21.2	15.5	565.2
Churches	78,910	0.5	8.3	12.6	60.7	26.7	46.6	75.6	109.5	12.9	−29.0	1.5	18.9
Activities of membership organisations	71,773	0.4	11.7	10.6	68.8	20.6	58.8	85.7	129.7	1.3	−47.1	4.7	44.3
Art, theatre, film, radio and television	58,072	0.3	17.3	12.3	67.4	20.2	70.9	89.2	124.8	11.2	−20.7	−1.8	28.5
Auctioning and pawnbroking	28,540	0.2	6.5	17.2	78.6	4.2	54.5	75.1	125.6	40.8	−12.1	1.9	27.6
Shipping	28,108	0.2	16.3	14.7	73.5	11.7	84.6	91.8	124.8	−11.4	−35.5	−0.1	229.9
Private households	16,543	0.1	1.2	36.5	61.5	2.0	33.3	43.7	65.1	−43.1	−34.7	42.4	112.7
Forestry and hunting	16,132	0.1	5.6	28.6	70.0	1.4	54.8	74.4	98.1	−40.2	−30.6	20.8	65.8
Photographic activities	15,567	0.1	6.7	21.9	75.9	2.2	31.8	63.9	97.4	−4.4	−18.1	5.3	86.5
Fishing	651	0.0	2.8	26.9	71.9	1.2	29.4	58.2	88.0	−37.5	−26.9	17.7	−41.9

Source: IAB

4.7.2 Decompositions I

The change in skill-specific labour supply in a local labour market can be decomposed in the following way:

$$\Delta L_i = \sum_j \Delta N_{ij} + \Delta U_i.$$

Dividing through by the labour supply of skill group i in the base period (denoted by the subscript 0) and then expanding we get

$$\begin{aligned}
\frac{\Delta L_i}{L_{i0}} &= \sum_j \frac{\Delta N_{ij}}{L_{i0}} + \frac{\Delta U_i}{L_{i0}} \\
&= \sum_j \frac{N_{ij0}}{L_{i0}} \frac{\Delta N_{ij}}{N_{ij0}} + \frac{U_{i0}}{L_{i0}} \frac{\Delta U_i}{U_{i0}} \\
&= \sum_j s_{ij0} \%\Delta N_{ij} + s_{iu0} \%\Delta U_i.
\end{aligned} \tag{4.11}$$

Now let M_j be a measure of the size of an industry. Then we have

$$N_{ij} = M_j\left(\frac{N_{ij}}{M_j}\right).$$

This can be decomposed into three terms:

$$\begin{aligned}
\%\Delta N_{ij} = \frac{\Delta N_{ij}}{N_{ij0}} &= \frac{M_j N_{ij}}{N_{ij0} M_j} - \frac{M_{j0} N_{ij0}}{N_{ij0} M_{j0}} = \frac{M_j N_{ij}}{N_{ij0} M_j} - 1 \\
&= \frac{N_{ij} M_{j0}}{M_j N_{ij0}} + \frac{(M_j - M_{j0}) N_{ij}}{M_j N_{ij0}} - 1 \\
&= \frac{M_j - M_{j0}}{M_{j0}} + \frac{N_{ij} M_{j0}}{M_j N_{ij0}} - 1 + \frac{M_j - M_{j0}}{M_{j0}} \left(\frac{N_{ij} M_{j0}}{M_j N_{ij0}} - 1\right) \\
&= \left(\frac{M_j - M_{j0}}{M_{j0}}\right) + \left(\frac{\frac{N_{ij}}{M_j} - \frac{N_{ij0}}{M_{j0}}}{\frac{N_{ij0}}{M_{j0}}}\right) + \left(\frac{M_j - M_{j0}}{M_{j0}}\right)\left(\frac{\frac{N_{ij}}{M_j} - \frac{N_{ij0}}{M_{j0}}}{\frac{N_{ij0}}{M_{j0}}}\right) \\
&= \%\Delta M_j + \%\Delta\left(\frac{N_{ij}}{M_j}\right) + \%\Delta M_j \cdot \%\Delta\left(\frac{N_{ij}}{M_j}\right),
\end{aligned}$$

which, by substitution into Equation 4.11, yields the stated decomposition.

4.7.3 Decompositions II

The change in skill-specific labour supply in a local labour market can be decomposed in the following way:

$$\begin{aligned}\Delta L_i &= \sum_j \Delta N_{ij} + \Delta U_i \\ &= \sum_j (\sum_{fp} \Delta N_{ijfp} + \sum_{fn} \Delta N_{ijfn} + \sum_{fo} \Delta N_{ijfo}) + \Delta U_i.\end{aligned}$$

Dividing through by the labour supply of skill group i in the base period (denoted by the subscript 0) and then expanding we get

$$\begin{aligned}\frac{\Delta L_i}{L_{i0}} &= \sum_j (\sum_{fp} \frac{\Delta N_{ijfp}}{L_{i0}} + \sum_{fn} \frac{\Delta N_{ijfn}}{L_{i0}} + \sum_{fo} \frac{\Delta N_{ijfo}}{L_{i0}}) + \frac{\Delta U_i}{L_{i0}} \\ &= \sum_j \sum_{fp} \frac{N_{ij0}}{L_{i0}} \frac{N_{ijf0}^p}{N_{ij0}} \frac{\Delta N_{ijfp}}{N_{ijf0}^p} + \sum_j \sum_{fn} \frac{\Delta N_{ijfn}}{L_{i0}} + \sum_j \sum_{fo} \frac{N_{ij0}}{L_{i0}} \frac{N_{ijf0}^o}{N_{ij0}} \frac{\Delta N_{ijfo}}{N_{ijf0}^o} + \frac{U_{i0}}{L_{i0}} \frac{\Delta U_i}{U_{i0}} \\ &= \sum_j \sum_{fp} s_{ij0} s_{ijf0}^p (\%\Delta N_{ijfp}) + \sum_j \sum_{fn} \frac{\Delta N_{ijfn}}{L_{i0}} + \sum_j \sum_{fo} (-1) s_{ij0} s_{ijf0}^o + s_{iu0} \%\Delta U_i.\end{aligned}$$

Now let M_{jf} be a measure of the size of a firm. Then we have

$$N_{ijf} = M_{jf}(\frac{N_{ijf}}{M_{jf}}).$$

For all permanent firms (and only for these firms) this can be decomposed into three terms:

$$\begin{aligned}\%\Delta N_{ijf} &= \frac{\Delta N_{ijfp}}{N_{ijf0}^p} = \frac{M_{jfp} N_{ijfp}}{N_{ijf0}^p M_{jfp}} - \frac{M_{jf0}^p N_{ijf0}^p}{N_{ijf0}^p M_{jf0}^p} = \frac{M_{jfp} N_{ijfp}}{N_{ijf0}^p M_{jfp}} - 1 \\ &= \frac{N_{ijfp} M_{jf0}^p}{M_{jfp} N_{ijf0}^p} + \frac{(M_{jfp} - M_{jf0}^p) N_{ijfp}}{M_{jfp} N_{ijf0}^p} - 1 \\ &= \frac{M_{jfp} - M_{jf0}^p}{M_{jf0}^p} + \frac{N_{ijfp} M_{jf0}^p}{M_{jfp} N_{ijf0}^p} - 1 + \frac{M_{jfp} - M_{jf0}^p}{M_{jf0}^p} (\frac{N_{ijfp} M_{jf0}^p}{M_{jfp} N_{ijf0}^p} - 1) \\ &= \left(\frac{M_{jfp} - M_{jf0}^p}{M_{jf0}^p}\right) + \left(\frac{\frac{N_{ijfp}}{M_{jfp}} - \frac{N_{ijf0}^p}{M_{jf0}^p}}{\frac{N_{ijf0}^p}{M_{jf0}^p}}\right) + \left(\frac{M_{jfp} - M_{jf0}^p}{M_{jf0}^p}\right)\left(\frac{\frac{N_{ijfp}}{M_{jfp}} - \frac{N_{ijf0}^p}{M_{jf0}^p}}{\frac{N_{ijf0}^p}{M_{jf0}^p}}\right) \\ &= \%\Delta M_{jfp} + \%\Delta\left(\frac{N_{ijfp}}{M_{jfp}}\right) + \%\Delta M_{jfp} \cdot \%\Delta\left(\frac{N_{ijfp}}{M_{jfp}}\right).\end{aligned}$$

4.7.4 Decompositions III

Here we show how one can transform the Lewis decomposition, which simply gives the contributions of permanent, new and old firms of the measured between and within industry changes (see Equations 4.5 and 4.6), into the new decomposition which accurately reflects between and within firm changes.

The identity for the between industry effect of permanent firms:

$$\begin{aligned}
\sum_j \sum_{fp} s_{ij0}\left(\frac{M_{jfp}-M_{jf_0^p}}{M_{j0}}\right) &= \sum_j \sum_{fp} s_{ij0}\left(\frac{M_{jf_0^p}}{M_{j0}}\right)\left(\frac{M_{jfp}-M_{jf_0^p}}{M_{jf_0^p}}\right) \\
&= \sum_j \sum_{fp} s_{ij0}\left(\frac{M_{jf_0^p}}{M_{j0}}+\frac{N_{ijf_0^p}}{N_{ij0}}-\frac{N_{ijf_0^p}}{N_{ij0}}\right)\left(\frac{M_{jfp}-M_{jf_0^p}}{M_{jf_0^p}}\right) \\
&= \sum_j \sum_{fp} s_{ij0}s_{ijf_0^p}\cdot \%\Delta M_{jfp} + \sum_j \sum_{fp} s_{ij0}\left(\frac{M_{jf_0^p}}{M_{j0}}-\frac{N_{ijf_0^p}}{N_{ij0}}\right)\left(\frac{M_{jfp}-M_{jf_0^p}}{M_{jf_0^p}}\right)
\end{aligned}$$

The identity for the within industry effect of permanent firms:

$$\begin{aligned}
\sum_j \sum_{fp} s_{ij0}\left(\frac{\frac{N_{ijfp}}{M_j}-\frac{N_{ijf_0^p}}{M_{j0}}}{\frac{N_{ij0}}{M_{j0}}}\right) &= \sum_j \sum_{fp} s_{ij0}\left(\frac{\frac{N_{ijfp}}{M_j}}{\frac{N_{ij0}}{M_{j0}}}\right)-\sum_j \sum_{fp} s_{ij0}\left(\frac{\frac{N_{ijf_0^p}}{M_{j0}}}{\frac{N_{ij0}}{M_{j0}}}\right) \\
&= \sum_j \sum_{fp} s_{ij0}\frac{M_{jfp}}{M_{jfp}}\left(\frac{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}\right)\left(\frac{\frac{N_{ijfp}}{M_j}}{\frac{N_{ij0}}{M_{j0}}}\right)-\sum_j \sum_{fp} s_{ij0}\frac{M_{jf_0^p}}{M_{jf_0^p}}\left(\frac{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}\right)\left(\frac{\frac{N_{ijf_0^p}}{M_{j0}}}{\frac{N_{ij0}}{M_{j0}}}\right) \\
&= \sum_j \sum_{fp} s_{ij0}\frac{M_{jfp}}{M_j}\left(\frac{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}{\frac{N_{ij0}}{M_{j0}}}\right)\left(\frac{\frac{N_{ijfp}}{M_{jfp}}}{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}\right)-\sum_j \sum_{fp} s_{ij0}\frac{M_{jf_0^p}}{M_{j0}}\left(\frac{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}{\frac{N_{ij0}}{M_{j0}}}\right)\left(\frac{\frac{N_{ijf_0^p}}{M_{j0}}}{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}\right) \\
&= \sum_j \sum_{fp} s_{ij0}s_{ijf_0^p}\left(\frac{\frac{M_{jfp}}{M_j}}{\frac{M_{jf_0^p}}{M_{j0}}}\right)\left(\frac{\frac{N_{ijfp}}{M_{jfp}}}{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}\right)-\sum_j \sum_{fp} s_{ij0}s_{ijf_0^p}\cdot 1\cdot\left(\frac{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}\right) \\
&= \sum_j \sum_{fp} s_{ij0}s_{ijf_0^p}\left(1+\frac{\frac{M_{jfp}}{M_{jf_0^p}}-\frac{M_j}{M_{j0}}}{\frac{M_j}{M_{j0}}}\right)\left(\frac{\frac{N_{ijfp}}{M_{jfp}}}{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}\right)-\sum_j \sum_{fp} s_{ij0}s_{ijf_0^p}\left(\frac{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}{\frac{N_{ijf_0^p}}{M_{jf_0^p}}}\right) \\
&= \sum_j \sum_{fp} s_{ij0}s_{ijf_0^p}\cdot \%\Delta\left(\frac{N_{ijfp}}{M_{jfp}}\right)+\sum_j \sum_{fp} s_{ij0}s_{ijf_0^p}\left(\frac{\frac{N_{ijfp}}{N_{ijf_0^p}}\cdot\left(\frac{M_{jfp}}{M_{jf_0^p}}-\frac{M_j}{M_{j0}}\right)}{\frac{M_j}{M_{j0}}\frac{M_{jfp}}{M_{jf_0^p}}}\right)
\end{aligned}$$

The identity for new firms (for which $N_{ijf_0^n} = 0$):

$$\begin{aligned}
\sum_j \sum_{f^n} \frac{\Delta N_{ijf^n}}{L_{i_0}} &= \sum_j \sum_{f^n} s_{ij_0} \frac{N_{ijf^n}}{N_{ij_0}} \\
&= \sum_j \sum_{f^n} s_{ij_0} \frac{M_{j_0}}{M_{j_0}} \frac{M_j}{M_j} \frac{N_{ijf^n}}{N_{ij_0}} \\
&= \sum_j \sum_{f^n} s_{ij_0} \left(\frac{\frac{N_{ijf^n}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}} \right) \frac{M_j}{M_{j_0}} \\
&= \sum_j \sum_{f^n} s_{ij_0} \left(\frac{\frac{N_{ijf^n}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}} \right) (1 + \frac{M_j - M_{j_0}}{M_{j_0}}) + \sum_j \sum_{f^n} s_{ij_0} \frac{M_{jf^n} - M_{jf_0^n}}{M_{j_0}} - \sum_j \sum_{f^n} s_{ij_0} \frac{M_{jf^n} - M_{jf_0^n}}{M_{j_0}} \\
&= \sum_j \sum_{f^n} s_{ij_0} \left(\frac{\frac{N_{ijf^n}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}} \right) + \sum_j \sum_{f^n} s_{ij_0} (\frac{M_{jf^n}}{M_{j_0}}) + \sum_j \sum_{f^n} s_{ij_0} \left[\left(\frac{\frac{N_{ijf^n}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}} \right) \frac{M_j - M_{j_0}}{M_{j_0}} - \frac{M_{jf^n}}{M_{j_0}} \right]
\end{aligned}$$

The identity for old firms (for which $N_{ijf^o} = 0$):

$$\begin{aligned}
-\sum_j \sum_{f^o} s_{ij_0} s_{ijf_0^o} &= -\sum_j \sum_{f^o} s_{ij_0} \frac{N_{ijf_0^o}}{N_{ij_0}} \\
&= -\sum_j \sum_{f^o} s_{ij_0} \frac{M_{j_0}}{M_{j_0}} \frac{N_{ijf^o}}{N_{ij_0}} \\
&= -\sum_j \sum_{f^o} s_{ij_0} \left(\frac{\frac{N_{ijf^o}}{M_{j_0}}}{\frac{N_{ij_0}}{M_{j_0}}} \right) \\
&= -\sum_j \sum_{f^o} s_{ij_0} \left(\frac{\frac{N_{ijf^o}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}} \right) + \sum_j \sum_{f^o} s_{ij_0} \frac{M_{jf^o} - M_{jf_0^o}}{M_{j_0}} - \sum_j \sum_{f^o} s_{ij_0} \frac{M_{jf^o} - M_{jf_0^o}}{M_{j_0}} \\
&= -\sum_j \sum_{f^o} s_{ij_0} \left(\frac{\frac{N_{ijf^o}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}} \right) - \sum_j \sum_{f^o} s_{ij_0} (\frac{M_{jf_0^o}}{M_{j_0}}) + \sum_j \sum_{f^o} s_{ij_0} (\frac{M_{jf_0^o}}{M_{j_0}})
\end{aligned}$$

To sum up, we have:

$$\underbrace{\sum_j \sum_{f^p} s_{ij_0}\left(\frac{M_{jf^p} - M_{jf_0^p}}{M_{j_0}}\right)}_{\substack{\text{permanent firms contribution} \\ \text{industry scale effect}}} = \underbrace{\sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} \cdot \%\Delta M_{jf^p}}_{\substack{\text{permanent firms} \\ \text{scale effect}}} + \underbrace{\sum_j \sum_{f^p} s_{ij_0}\left(\frac{M_{jf_0^p}}{M_{j_0}} - \frac{N_{ijf_0^p}}{N_{ij_0}}\right)\left(\frac{M_{jf^p} - M_{jf_0^p}}{M_{jf_0^p}}\right)}_{\text{residual term}}$$

$$\underbrace{\sum_j \sum_{f^p} s_{ij_0}\left(\frac{\frac{N_{ijf^p}}{M_j} - \frac{N_{ijf_0^p}}{M_{j_0}}}{\frac{N_{ij_0}}{M_{j_0}}}\right)}_{\substack{\text{permanent firms contribution} \\ \text{industry intensity effect}}} = \underbrace{\sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p} \cdot \%\Delta\left(\frac{N_{ijf^p}}{M_{jf^p}}\right)}_{\substack{\text{permanent firms} \\ \text{intensity effect}}} + \underbrace{\sum_j \sum_{f^p} s_{ij_0} s_{ijf_0^p}\left(\frac{\frac{N_{ijf^p}}{N_{ijf_0^p}} * \left(\frac{M_{jf^p}}{M_{jf_0^p}} - \frac{M_j}{M_{j_0}}\right)}{\frac{M_j}{M_{j_0}} \frac{M_{jf^p}}{M_{jf_0^p}}}\right)}_{\text{residual term}}$$

$$\underbrace{\sum_j \sum_{f^n} s_{ij_0}\left(\frac{M_{jf^n}}{M_{j_0}}\right)}_{\substack{\text{new firms contribution} \\ \text{industry scale effect}}} + \underbrace{\sum_j \sum_{f^n} s_{ij_0}\left(\frac{\frac{N_{ijf^n}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}}\right)}_{\substack{\text{new firms contribution} \\ \text{industry intensity effect}}} = \underbrace{\sum_j \sum_{f^n} \frac{\Delta N_{ijf^n}}{L_{i_0}}}_{\substack{\text{new firms} \\ \text{contribution}}} - \underbrace{\sum_j \sum_{f^n} s_{ij_0}\left[\left(\frac{\frac{N_{ijf^n}}{M_j}}{\frac{N_{ij_0}}{M_{j_0}}}\right)\frac{M_j - M_{j_0}}{M_{j_0}} - \frac{M_{jf^n}}{M_{j_0}}\right]}_{\text{residual term}}$$

$$\underbrace{-\sum_j \sum_{f^o} s_{ij_0}\left(\frac{M_{jf_0^o}}{M_{j_0}}\right)}_{\substack{\text{old firms contribution} \\ \text{industry scale effect}}} - \underbrace{\sum_j \sum_{f^o} s_{ij_0}\left(\frac{\frac{N_{ijf_0^o}}{M_{j_0}}}{\frac{N_{ij_0}}{M_{j_0}}}\right)}_{\substack{\text{old firms contribution} \\ \text{industry intensity effect}}} = \underbrace{-\sum_j \sum_{f^o} s_{ij_0} s_{ijf_0^o}}_{\substack{\text{old firms} \\ \text{contribution}}} - \underbrace{\sum_j \sum_{f^o} s_{ij_0}\left(\frac{M_{jf_0^o}}{M_{j_0}}\right)}_{\text{residual term}}$$

Chapter 5

Employment, Wage Structure and the Economic Cycle: Differences between Immigrants and Natives in Germany and the UK*

5.1 Introduction

A large number of studies on the labour market impact of immigration assume that immigrants and natives with the same observable skill level are perfect substitutes in the production process (for instance Borjas, 2003; Card, 2001). Similarly, the literature on the earnings assimilation of immigrants commonly relies on the identifying assumption that immigrants and natives are equally affected by aggregate economic shocks (for instance Bell, 1997; Borjas, 1995a; Longva and Raaum, 2002).[1] In this chapter, we take a closer look at these assumptions by investigating the way different immigrant groups respond to

[1] A notable exception is recent work by Barth et al. (2004, 2006).

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the economic cycle in comparison to native workers. Tentative evidence for the U.S. (Chiswick et al., 1997) and Canada (McDonald and Worswick, 1997) shows that macroeconomic downturns affect the employment levels of immigrants more adversely than that of natives. Hoynes (2000) reaches a similar conclusion for various skill groups in the U.S. context. Her findings consistently show that non-white workers are more strongly affected by business cycle fluctuations than whites of comparable skill levels. Like Hoynes, we will look at differential responses of immigrants and natives both within and across skill groups. Our analysis concerns two of the largest economies in Europe - Germany and the UK - and stretches over more than two decades, comprising the years 1980 to 2001 for Germany, and 1981 to 2005 for the UK. Comparing these two countries is particularly interesting as they have experienced substantially different patterns of change in the earnings distributions of their workforces (see, for example, Katz and Autor, 1999) as well as economic conditions over the last decade. Furthermore, both countries have large and heterogenous immigrant populations which differ in terms of both educational background and origin composition, with the UK's immigrants being more highly skilled than those of Germany.

Our analysis focuses on unemployment and wages as economic outcomes. We show that there are substantial differences in cyclical responses between immigrants and natives in both countries and illustrate the magnitude of these differences, distinguishing between two groups of immigrants: immigrants from OECD countries and immigrants from non-OECD countries. We also discuss some possible reasons. Responses may vary because of differences in the skill distribution between the two immigrant groups and natives, or differences in demand for immigrants and natives with the same skills arising from a differential allocation across industries and regions. We demonstrate that even within narrowly defined groups, substantial differences in cyclical patterns remain. We also show that developments of the relative wage position of immigrants have differed significantly in the UK and Germany, in particular over the last decade. Finally, we estimate a structural factor-type model, which, using regional variation in economic conditions, separates responses to economic shocks from a secular trend and allows us to obtain a summary measure for the differences in cyclicality within education groups. This analysis confirms the larger responsiveness of im-

migrant unemployment to fluctuations in the economic cycle - especially for those immigrants originating from non-OECD countries - in both Germany and the UK.

The structure of the chapter is as follows: in Section 5.2 we provide some background information about immigration into Germany and the UK, including differences in the economic outcomes of immigrants between these two countries and relative to the corresponding native populations. We then discuss the data we use for our analysis, and the samples that we draw. Section 5.3 illustrates the economic cycle in terms of GDP growth and unemployment rates in Germany and the UK. Section 5.4 shows the economic outcomes for OECD and non-OECD immigrants in both countries over the economic cycle, and compares these to the outcomes of native workers. Section 5.5 investigates the extent to which the differences are due to observable characteristics, such as education, age, industry allocation and regional allocation. Section 5.6 estimates a model that summarises these differences in a set of parameters that allow comparisons between groups and across countries. Finally, Section 5.7 presents a summary and conclusion.

5.2 Background and Data

5.2.1 Migration to Germany and the UK

Both the UK and Germany experienced large waves of immigration in the period after World War II. The first large wave of immigration into Germany was an inflow of ethnic Germans, expelled from former German territory, totalling 12 million between 1945 and 1949 (see Oezcan, 2004, for details). After 1955, the West German economy experienced a strong boom, and immigration from Italy, Spain, Greece, Turkey, Portugal, and Yugoslavia in the late 1950s and early 1960s led to a rise of foreign workers to 1.2 million in 1965, which peaked in 1973 with 2.6 million, or 12% of the total labour force. The overall foreign population increased from 700,000 in 1961 to around 4 million in 1973. The period after 1973 was characterised by family unification. The early 1980s saw the arrival of the first larger waves of asylum seekers. Finally, towards the end of the 1980s, and accelerated by the fall of the Berlin wall, Germany experienced a new large wave of immigration from the East. Ethnic German immigrants (so-called *Aussiedler*, see Chapter 3), who under Soviet rule were not allowed to move, migrated from

Eastern Europe and beyond to Germany, totalling 2.8 million between 1987 and 2001. In 2002, there were 7.3 million foreigners living in Germany, representing 8.9% of the total population.[2]

Immigration legislation in the UK after World War II, embodied in the 1905 Aliens Act and the 1948 British Nationality Act, distinguished formally between non-Commonwealth and Commonwealth citizens. All Commonwealth citizens notionally enjoyed unrestricted freedom to enter the UK. In subsequent decades, immigration regulations were progressively tightened. The 1971 Immigration Act brought an end to the privileged position of Commonwealth citizens, replacing the previous distinction between aliens and British subjects with one between "patrials" and "non-patrials". The 1980s and 1990s saw continuing restrictive reforms to immigration legislation. Immigration of Commonwealth citizens was most pronounced in the two decades after the war. While the early 1950s were characterised by migration from the Caribbean, the late 1950s saw a growing number of immigrants arriving from the Indian subcontinent. Later, migrants arrived from Pakistan and Bangladesh. Labour market shortages in the period after the war also led to the recruitment of European workers, predominantly from southern Europe, but also from Poland. After the 1971 Immigration Act, an increasing proportion of immigration was due to family unification, which remained for a time largely unrestricted. Recently, immigration has again increased significantly, mainly as a result of the strong British economy and, after May 2004, the allowing of free movement of labour from the new EU accession countries. By 2005, about 2.7% of the population of Britain had migrated to the UK within the previous five years. In 2002, there were 4.9 million foreigners living in the UK, representing 8.3% of the total population (using Labour Force Survey data).

5.2.2 Data and Samples

The analysis that follows is based on two large longitudinal data sets: the Employment Subsample provided by the Institute for Employment Research for Germany (IAB Subsample or IABS), and the Labour Force Survey (LFS) for the UK. Both data sets cover approximately the same period, and are sufficiently large to

[2]Figures provided by the Federal Statistical Office in Germany.

analyse minority populations.

The IABS

The basis for our analysis of the situation in Germany is the IAB Employment Subsample 1975-2001. This administrative data set comprises a 2% subsample of all dependent employees subject to social security contributions in Germany. This includes all wage-earners and salaried employees, but excludes the self-employed, civil servants and the military. In 2001, 77.2% of all workers in the German economy were covered by social security. The data also include all unemployed receiving unemployment compensation. The IABS does not include individuals who are out of the labour force. We use information from this data set for each year between 1980 and 2001. Because of the numerous adjustment processes in the East German labour market after German unification in 1990, and the relatively small immigrant population (the immigrant concentration in East Germany was only about 2.5% in 2001 compared to more than 10% in West Germany), we focus on West Germany throughout, excluding Berlin. For a detailed description of the data set, see Bender et al. (2000).

The LFS

Our analysis for the UK is based on the British and the Northern Ireland Labour Force Surveys (LFS) between 1981 and 2005. The British LFS is a survey of private households living in Great Britain, carried out by the Office for National Statistics (ONS), while the Northern Ireland Labour Force Survey is carried out by the Department of Finance and Personnel. Both surveys were conducted biennially from 1973 to 1983, and annually between 1984 and 1991. Since the spring of 1992, the survey in Britain has been conducted each quarter and changed to a rotating panel, with individuals included in five consecutive waves of the survey. In Northern Ireland, the quarterly LFS was only introduced in the winter of 1994. Both the British and the Northern Ireland LFS collect data on a wide range of aspects of the labour market. Since 1984, the LFS uses the International Labour Organization (ILO) definition of unemployment. For the years 1981 and 1983, the information in the LFS allows us to ascertain whether or not a person was unemployed according to the ILO definition. Questions on earnings were not

asked before the winter quarter of 1992/93 in Great Britain. In Northern Ireland, this set of questions was only included in the questionnaire from 1994 onwards.

Definition of Immigrants

In the UK, immigrant status is defined by country of birth. By contrast, official data in Germany distinguish between foreign and German citizenship rather than country of birth (following the principle of nationality by descent). In the IABS, therefore, we can only observe an individual's citizenship - not their place of birth or year of entry into the country. Since an individual born in Germany to foreign parents does not automatically obtain German citizenship but keeps the citizenship of the parents, there is a group of people included in our immigrant sample who were born in the country but have foreign citizenship. Between 1993 and 2002, the share of these second-generation immigrants in the 25-54 age bracket that constitutes the basis of our analysis is quite small. It lies between 3.5% and 7.5%.[3] On the other hand, individuals who were born abroad but received German citizenship upon arrival, such as the group of ethnic German immigrants, are recorded as Germans in our data. We are well aware that these definitional problems imply that comparisons across the countries need to be made with care. For simplicity, in what follows we refer to the foreign sample in the German data as "immigrants" and the German sample as "natives" and use the same terminology for the foreign-born and native-born in the UK.

Samples Used for Analysis

To account for group differences in a parsimonious way that allows comparability across Germany and the UK, we distinguish two groups of immigrants in our analysis of the two countries - those from OECD countries and those from non-OECD countries. We expect immigrants from OECD countries to be endowed with human capital that is more suited to the requirements of the host countries' labour markets. Current OECD member countries are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Australia,

[3]Source: Tabulations provided by the Federal Statistical Office in Germany.

Table 5.1: OECD and non-OECD immigrants, Germany and UK

	Germany				UK		
Citizenship	1981	1991	2001		1981	1991	2001
OECD				OECD			
Share (in %)	6.8	6.3	5.8	Share (in %)	2.7	2.7	3.2
of which				of which			
Turkey	39.5	42.1	43.9	Ireland	40.8	38.2	27.5
Italy	20.8	14.9	15.5	Germany	12.3	12.8	13.5
Greece	9.3	8.8	8.7	USA	6.9	7.6	8.4
Poland	0.5	3.7	3.9	Australia	3.8	3.8	5.4
Other	29.9	30.5	28.0	Other	36.2	37.6	45.2
non-OECD				non-OECD			
Share (in %)	2.2	2.2	2.8	Share (in %)	3.3	3.5	4.6
of which				of which			
Former Yugoslavia	70.2	61.9	47.9	India	24.0	19.9	15.2
Asia	13.3	18.5	23.0	Pakistan	9.3	12.2	9.8
Africa	7.9	9.7	12.4	Bangladesh	1.8	4.5	6.2
Former Soviet Union	0.1	1.4	6.8	Jamaica	9.7	6.3	5.4
Other	8.5	8.5	9.9	Other	55.2	57.1	63.4

Source: IABS and LFS, all observations (men and women, all ages).

Japan, Korea, Mexico, New Zealand, the United States, Canada, the Czech Republic, Hungary, Slovakia, Poland, and Turkey.

Because we use two different data sources for our analysis, the two outcome measures we use, unemployment rates and wages, are not fully comparable. In particular, the definition of the state of unemployment varies in the two data sets. In Section 5.8.1 in the appendix to this chapter, we describe in more detail how we construct our outcome measures of wages and unemployment rates.

Composition of Immigrant Population

Reflecting the different migration histories of Germany and the UK, the composition of their immigrant populations differs considerably. In Table 5.1, we display the composition of the OECD and non-OECD immigrant populations for both countries for the years 1981, 1991 and 2001.

The figures for Germany suggest that, in 1981, about a quarter of immigrants was from a non-OECD country; by 2001, this figure had increased to about a third. For the UK, the numbers of OECD and non-OECD immigrants were approximately the same in 1981; as in Germany, there was a relative increase in the proportion of non-OECD immigrants by 2001, with a share of 4.6% in the overall population, compared to 3.2% for OECD immigrants.

The country of origin composition of both groups differs considerably between the two countries. In Germany, the largest OECD group is Turkish, whereas in the UK it is immigrants from Ireland. While the relative size of the Turkish group remains fairly constant in Germany, the Irish group in the UK diminishes considerably both in percentages as well as in total numbers (from about 600,000 in 1981 to 520,000 in 2001). Immigrants from India, Pakistan and Bangladesh make up most of the non-OECD group in the UK in 2001, while in Germany the largest non-OECD immigrant groups are from Former Yugoslavia, Asia and Africa.

Individual Characteristics

In Tables 5.2 and 5.3, we report some key characteristics for natives and immigrants for the years 1981 and 2001. As before, we distinguish the immigrant population by OECD and non-OECD origin. For Germany (Table 5.2), we distinguish between three educational levels: individuals who have no post-secondary education (low education); individuals who have post-secondary vocational training (intermediate education); and individuals who have college education (high education). For the UK (Table 5.3), we aggregate qualifications into the same three broad classes (low, intermediate, high). Similar to the classification in the German data, the first class refers to people without any post-secondary education; as intermediate education we code GCE A Level or equivalent, GCSE grades A*-C or equivalent and other qualifications; and high education comprises individuals holding a university degree or other higher education qualifications.

Tables 5.2 and 5.3 show that the percentage of college graduates among natives in Germany is far lower than in the UK. This is due to the different classification in both the German and the UK data, because a large part of professional train-

Table 5.2: Individual characteristics, Germany

IABS	1981				2001			
(persons aged 25-54)	Natives	Immi.	OECD	non-OECD	Natives	Immi.	OECD	non-OECD
Mean age	39.2	37.6	37.8	37.0	39.3	38.0	37.8	38.4
Education								
Low	25.4	66.0	68.7	58.9	16.3	53.1	52.9	53.7
Intermediate	69.0	30.4	27.8	37.3	73.4	41.0	41.2	40.6
High	5.6	3.6	3.5	3.8	10.2	5.8	5.9	5.7
Mean log daily wage (in 1995 €)								
Men	4.30	4.20	4.20	4.18	4.45	4.23	4.28	4.12
	(0.26)	(0.26)	(0.25)	(0.27)	(0.37)	(0.43)	(0.40)	(0.46)
Women	3.90	3.88	3.87	3.88	4.15	4.01	4.02	3.98
	(0.45)	(0.32)	(0.33)	(0.31)	(0.49)	(0.50)	(0.51)	(0.48)
Unemployment/LF rate								
Men	3.4	5.0	4.4	6.5	6.8	11.8	11.1	13.5
Women	4.8	7.4	7.7	6.7	5.8	11.1	12.4	8.7
Regional concentration (Herfindahl index)	0.08	0.11	0.11	0.12	0.08	0.11	0.11	0.10

Note: See text for definition of unemployment rate. Standard deviations in parenthesis.

ing that is offered by colleges in the UK is offered by the apprenticeship system in Germany. In both countries, the percentage of college-educated individuals in the labour force has dramatically increased among natives, from 5.6% to 10.2% in Germany, and from 14.0% to 27.0% in the UK. Of particular interest is the different educational background of immigrants compared to natives in Germany and the UK: while in Germany the percentage of college-educated individuals in the immigrant population is substantially lower than in the native population, in the UK the percentage of those with a college education is higher for immigrants, in both 1981 and 2001, and among OECD as well as non-OECD immigrants. Overall, immigrants in Germany have considerably lower levels of education than those in the UK. In both countries, but particularly in Germany, the percentage of individuals in the lowest educational category is higher among immigrants. While in 2001 about 16% of Germans had no post-secondary education, this was the case for more than 53% of immigrants, with similar percentages for both OECD and non-OECD immigrants.

Table 5.3: Individual characteristics, UK

LFS	1981				2001			
(persons aged 25-54)	Natives	Immi.	OECD	non-OECD	Natives	Immi.	OECD	non-OECD
Mean age	38.7	38.4	39.8	37.4	39.5	38.4	37.6	38.8
Education								
Low	47.2	48.7	48.7	48.8	14.5	18.3	12.0	21.6
Intermediate	38.8	31.3	32.4	30.5	58.5	52.8	56.7	50.7
High	14.0	20.0	19.0	20.7	27.0	28.9	31.2	27.7
Mean log hourly wage (in 1992 $)								
Men					2.10	2.12	2.27	2.03
					(0.54)	(0.65)	(0.65)	(0.59)
Women					1.82	1.97	2.02	1.92
					(0.52)	(0.56)	(0.59)	(0.54)
Unemployment/LF rate								
Men	8.6	11.8	9.3	13.4	4.6	8.0	4.5	10.0
Women	6.8	8.6	7.3	9.8	3.6	6.5	4.7	7.7
Participation rate								
Men	96.7	92.8	93.9	92.0	91.6	86.7	89.6	85.2
Women	63.2	58.6	62.9	54.7	77.4	62.3	70.5	57.7
Regional concentration (Herfindahl index)	0.01	0.11	0.08	0.15	0.02	0.15	0.11	0.18

Note: See text for definition of unemployment rate. Standard deviations in parenthesis.

In the middle of each table we report mean log real wages distinguishing between men and women. For Germany, the difference in real wages in 1981 between natives and immigrants was about 11% for men, and 2% for women, increasing to 25% for men and 15% for women in 2001.[4] Non-OECD immigrants seem to do worse than immigrants from OECD countries. This suggests a dramatic deterioration of the relative wage position of immigrants over the two decades. For the UK, wage data are only available from 1992 onwards. The data for the year 2001 show that immigrant men earned on average wages similar to those of natives, while native women earned on average 14% less than immigrant

[4]We compute percent differences as $e^{\Delta \ln w} - 1$ where $\Delta \ln w$ is the difference in log wages between natives and immigrants.

women. The performance of immigrants from OECD countries is particularly remarkable. Native men and women earned on average 16% and 18% lower wages, respectively, than their immigrant counterparts.

Between 1981 and 2001, unemployment rates for German men (women) increased from 3.4% (4.8%) in 1981 to 6.8% (5.8%) in 2001. For immigrants, the unemployment rate of men (women) increased from 5.0% (7.4%) in 1981 to 11.8% (11.1%) in 2001, suggesting a dramatic increase in the unemployment gap between natives and immigrants. For men, the gap increased from 47% to 74%.[5] For the UK, unemployment, in overall terms, went down over the period 1981-2001. As for Germany, there was a substantial difference in the unemployment rate between immigrants and natives in 2001: for men, the overall difference was 74% compared to only about 37% in 1981. Mainly responsible for this difference were non-OECD immigrants who experienced unemployment rates that were twice as high as the ones for natives.

In the bottom row of Tables 5.2 and 5.3, we present the normalised Herfindahl index to measure the regional concentration of natives and immigrants.[6] This index takes on numbers between zero (individuals are equally distributed across regions) and one (complete concentration in one region). For Germany, the index is 0.08 for natives and 0.11 for immigrants in both 1981 and 2001. The higher values for immigrants are driven by their stronger concentration in North Rhine-Westphalia and Baden-Württemberg where more than 50% of the immigrant population lives, compared to only 44.6% of the native population. Overall, however, immigrants in Germany are not particularly concentrated in certain areas relative to the native population, and concentration has been remarkably stable between 1981 and 2001. This is in stark contrast to the UK. Here, the index is 0.01 for natives and 0.11 for immigrants in 1981, increasing to 0.02 and 0.15 in 2001, respectively. This suggests a much stronger regional concentration

[5]These unemployment rates are lower than the official unemployment rates for West Germany - 4.5% (6.9%) in 1981 and 8.6% (7.9%) in 2001, with numbers in brackets referring to women - because of our sample selection; in particular, we focus on the population aged 25-54 in which unemployment is relatively low.

[6]The index is defined as $H = (\sum_i^N s_i^2 - 1/N)/(1 - (1/N))$, where s_i is the share of individuals, either natives, OECD or non-OECD immigrants, living in region i, and N is the overall number of regions, 10 in Germany and 11 in the UK.

of immigrants than of natives, which further increased over the period 1981-2001. Concentration is particularly strong for immigrants from non-OECD countries. About 40% of non-OECD immigrants live in London, compared to only 8% of the native-born population.

To sum up, it appears that over the last two decades the employment situation of immigrants relative to natives has considerably deteriorated in both Germany and the UK. In Germany, the average wages of immigrants have at the same time dramatically decreased relative to natives. There is hardly any overall wage gap between immigrants and natives in the UK; if at all, wages seem to be higher for immigrants. Therefore, while there seem to be some common developments in the two countries with respect to unemployment, the large disadvantage of immigrants with respect to wages is a particular feature of Germany. This could be related to the different skill structure: Tables 5.2 and 5.3 suggest that immigration to Germany is predominantly low-skilled, while the skill structure of immigrants in the UK resembles closely that of the native population.

5.3 Macroeconomic Conditions in Germany and the UK

Before we discuss how employment and wages of immigrants and natives react to the economic cycles in these two countries, we briefly illustrate their macroeconomic conditions over time. In Figure 5.1, we present GDP growth and unemployment rates for Germany (left graph) and the UK (right graph). Time series are provided by the Statistical Office and the OECD for Germany and the UK, respectively. For the years prior to re-unification, data for Germany refer to West Germany and from 1991 to unified Germany. The shaded areas indicate recessions in the corresponding economy.[7]

In general, recessions in Germany and the UK occur simultaneously. A noticeable exception was the recession of the early 1990s, which hit the German economy about one year later than the UK. This was because of the huge de-

[7]The dates used in the construction of Figure 5.1 are those published by the Economic Cycle Research Institute (ECRI) and the Business Cycle Dating Committee of the Centre for Economic Policy Research (CEPR).

Figure 5.1: GDP growth and unemployment rates, Germany and UK

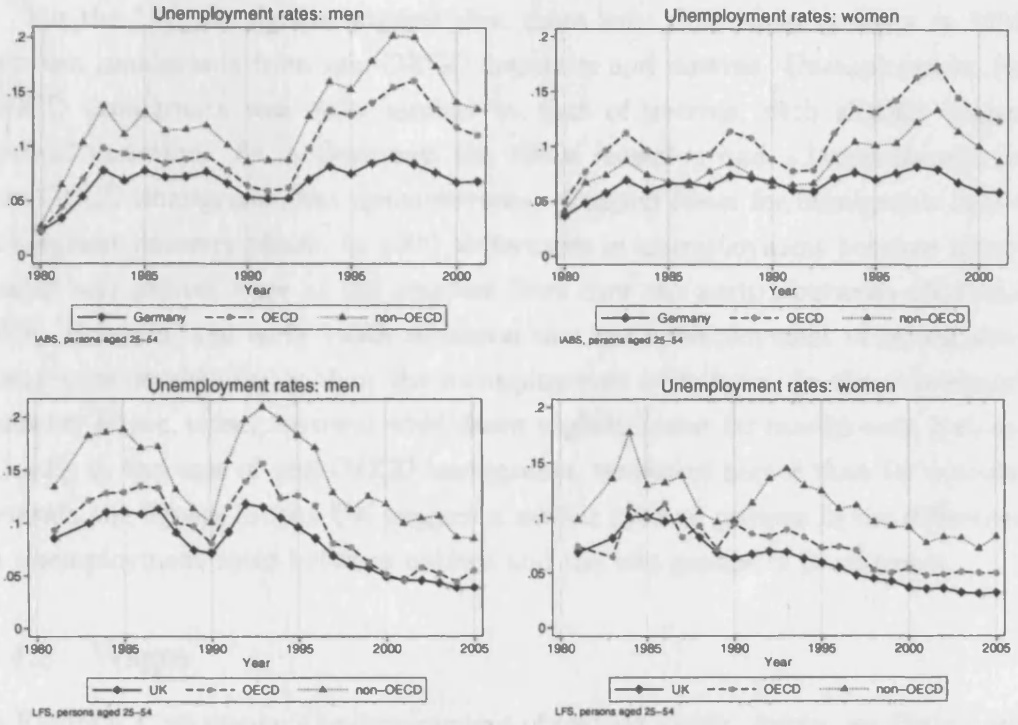
mand for consumption and investment goods after the German re-unification. The figures seem to indicate that both Germany and the UK experienced considerable increases in unemployment in the early-mid 1980s recession, with some improvement towards the end of the decade. The early 1990s recession led again to an increase in unemployment in both countries. However, while unemployment figures started coming down shortly after this recession in the UK, this was not the case for Germany where unemployment continued to rise throughout the decade, with a small temporary decrease towards the end of the 1990s/early 2000s. Since the recession of the early 1990s, the British economy has grown at a steady pace of approximately 2.8% per year in real terms, and the unemployment rate has continuously declined to a level of less than 5% in 2004. In Germany, unemployment has steadily increased over the entire period, reaching about 11% in 2004. Furthermore, economic growth was sluggish with an average annual growth rate of only about 0.9%.

5.4 Economic Outcomes and the Economic Cycle

5.4.1 Unemployment

In Figure 5.2, we display unemployment rates of natives and immigrants from OECD and non-OECD countries for Germany and the UK. In Germany at the start of the 1980s, unemployment rates were very similar for natives and the two

Figure 5.2: Unemployment, Germany and UK: men and women



groups of immigrants for both men and women. The 1980s recession led to a larger increase in unemployment for immigrants but, in the subsequent recovery phase, unemployment dropped slightly faster for the two immigrant groups. In the 1990s recession, unemployment grew considerably faster for immigrants than it did for natives, leading to a dramatic difference in unemployment between natives and both groups of immigrants. Over the last twenty years, unemployment was lower among OECD than non-OECD immigrants. Towards the end of the 1990s, unemployment of immigrants again seemed to drop more rapidly than unemployment of natives, but, compared to the early 1980s, there remained a large difference between the two immigrant groups and natives. The cyclical patterns were similar for men and women although, interestingly, while unemployment was higher for non-OECD men than OECD men, it was the opposite for women: OECD women experienced higher unemployment rates than non-OECD women. The figures suggest a strong cyclical development in unemployment differences

between immigrants and natives in Germany.

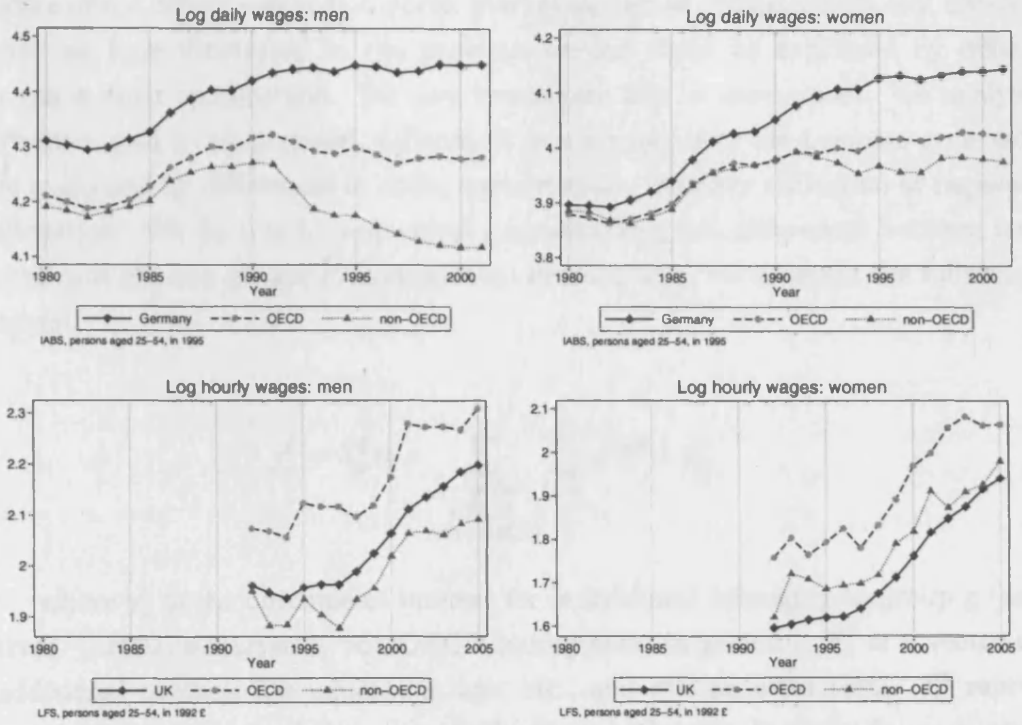
For the UK, the figures suggest that there were differences as early as 1981 between immigrants from non-OECD countries and natives. Unemployment for OECD immigrants was quite similar to that of natives, with slightly higher cyclical variation. As in Germany, the 1980s recession had a larger impact on non-OECD immigrants, but unemployment dropped faster for immigrants in the subsequent recovery phase. In 1990, differences in unemployment between immigrants and natives were at the smallest level over the period between 1981 and 2005. However, the early 1990s recession saw the unemployment of immigrants rising considerably faster than the unemployment of natives. In the subsequent recovery phase, unemployment went down slightly faster for immigrants, but, especially in the case of non-OECD immigrants, remained higher than for natives. Overall, the figures for the UK suggest a similar cyclical pattern in the difference in unemployment rates between natives and the two groups of immigrants.

5.4.2 Wages

In Figure 5.3, we display the development of real log wages. Again, we distinguish between men and women. Although there was hardly any difference in unemployment between the different groups in Germany in 1980, there was a wage differential of about 11% (2%) in favour of native men (women) relative to OECD immigrants, and 13% (1%) relative to non-OECD immigrants. During the first recession, the wage differential remained constant, but it increased dramatically from the early 1990s onwards, in particular for non-OECD immigrants. This can partly be attributed to a change in composition due to the large number of new immigrant arrivals from Former Yugoslavia. For non-OECD immigrant men, the wage differential increased from about 16% in 1990 to 39% in 2000. The increase was less dramatic for OECD immigrants. For women the pattern is similar, although the difference in wages between native women and both OECD and non-OECD immigrant women was smaller.

For the UK, we only observe wages in the LFS after 1991 (for Northern Ireland after 1993). This is the decade where we saw the most dramatic divergence in log wages between immigrants and natives in Germany, but also a much more

Figure 5.3: Log wages, Germany and UK: men and women



favourable economic development in the UK. Real wages increased steadily between 1992 and 2001 with an average wage growth rate of 1.7% (2.5%) per year for native men (women), 2.4% (2.7%) for OECD immigrant men (women) and 1.0% (3.1%) for non-OECD immigrant men (women). In comparison, in Germany, native wages of men (women) grew at a rate of only 0.3% (0.8%), those of OECD immigrants at a rate of -0.2% (0.7%) and those of non-OECD immigrants at a rate of -1.2% (0.2%). In both countries, non-OECD immigrant men therefore had slower wage growth than their native counterparts; in Germany they even experienced negative wage growth. In the UK, wages of OECD immigrants were slightly above those of natives and non-OECD immigrants. As opposed to the German situation, we do not observe a deterioration in relative wages for immigrants in the UK between 1992 and 2005.

5.5 Adjusting for Composition

Some of the differences in the labour market outcomes of immigrants and natives that we have illustrated in the previous section could be explained by differences in their composition. We now investigate this in more detail. We analyse whether, and to what extent, differences in outcomes over the business cycle can be explained by differences in skills, age structure, industry allocation or regional allocation. We do this by sequentially conditioning out differences between natives and the two groups of immigrants. In particular, we estimate the following model:

$$y_{it}^{g} = X_{it}^{g}\alpha + \sum_{\substack{g=natives,\\ OECD,\\ non-OECD}} \sum_{t=t_1}^{T} \gamma_t^g T_t^g + e_{it}^{g}$$

where y_{it}^{g} is the outcome of interest for individual i belonging to group g (natives, OECD immigrants, non-OECD immigrants) in period t, X_{it}^{g} is a vector of additional controls like education, age, etc., and $e_{it}^{g}$is an error term. T_t^g represents the interaction of the group indicator g with year dummies for each year t. The parameters γ_t^g estimated for these interaction terms measure the average outcome y for group g in period t, conditional on observables X_{it}^{g}. Simple re-parameterisation allows estimating the differences in outcomes over time relative to a reference group. We estimate the following model by choosing as the reference group the native German and UK population, respectively:

$$y_{it}^{g} = X_{it}^{g}\alpha + \sum_{\substack{g=OECD,\\ non-OECD}} \sum_{t=t_1}^{T} \gamma_t^g T_t^g + \sum_{t=t_1}^{T} \gamma_t d_t + e_{it}^{g}$$

d_t are here year dummies for each year t. When restricting α to zero, the estimated parameters γ_t^g are the group mean labour market outcomes of OECD/non-OECD immigrants relative to the native population (picked up by γ_t) as illustrated in the figures in the last section. By sequentially adding education and age, regional and, for Germany, industry controls, we eliminate differences in estimates of economic outcomes between our groups that may be due to differences in these

observable characteristics. We plot the resulting estimates of γ_t^g in the figures that follow. This amounts to comparing immigrants and natives who are identical in observables. In the initial estimations without controls, illustrated by the solid line, the only variable included in X_{it}^g (apart from a constant term) is an indicator for the gender of the individual. In the next step, represented by a dashed line, we add age, age squared and interactions of our education groups and year dummies. Finally, in the last step, illustrated by a dotted line, we also include interactions of region and year and, in the case of Germany, industry and year dummies. Unfortunately, the LFS data do not allow to condition on industry allocation since information on industry affiliation is not available for a large proportion of the unemployed - up to 40% of the observations in many years. Notice that we assume that all three groups respond in the same way to changes in the X_{it}^g, so there are no group-specific α coefficients (although we allow α to vary with time by using interactions of education, region and industry dummies with year dummies).

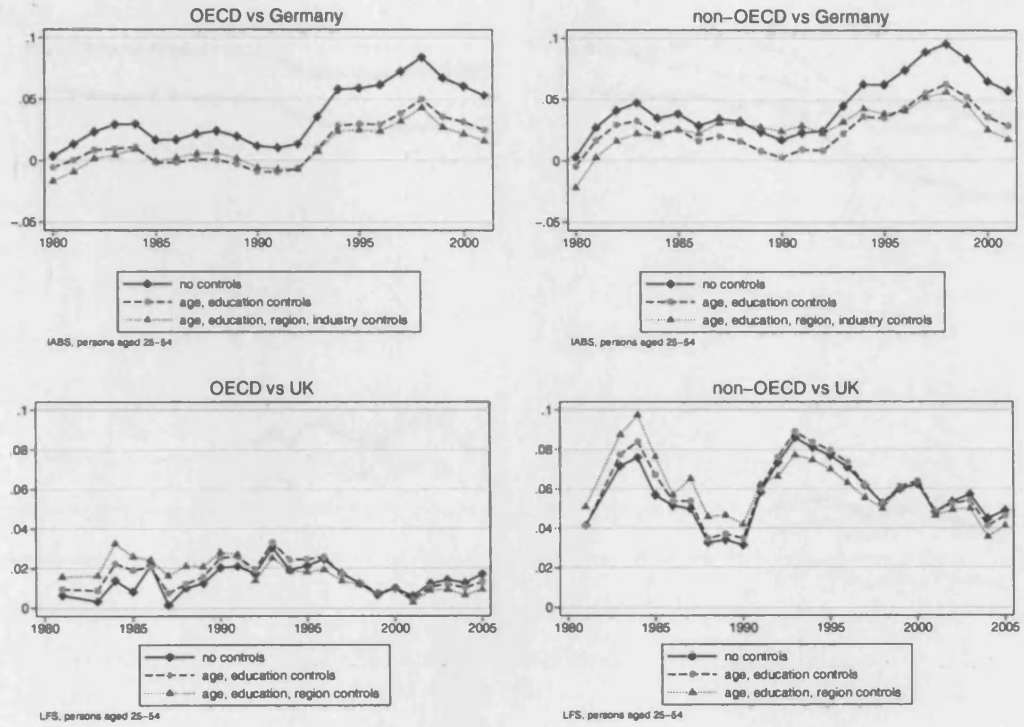
5.5.1 Unemployment

In the upper panel of Figure 5.4, we show the unemployment rates of OECD and non-OECD immigrants relative to the unemployment rates of natives for Germany. The solid line is the unconditional differential; the dashed and dotted lines control for differences in age and education structure, and differences in age, education, industry and regional allocation between immigrants and natives.

The figures suggest that conditioning on age and education reduces the unemployment differential between Germans and immigrants in both groups; however, there remains a large difference and the cyclical pattern is clearly visible. Conditioning also on industry structure and regional allocation does not systematically change these differences except in the case of non-OECD immigrants during the period 1985-1995, where it tends to increase the unemployment differential and to some extent smooth the cyclical pattern. The figures that separate men and women look very similar to the pooled figure and can be found in Section 5.8.2 in the appendix to this chapter.

In the lower panel in Figure 5.4, we display the conditional and unconditional

Figure 5.4: Conditional unemployment rate differentials, Germany and UK

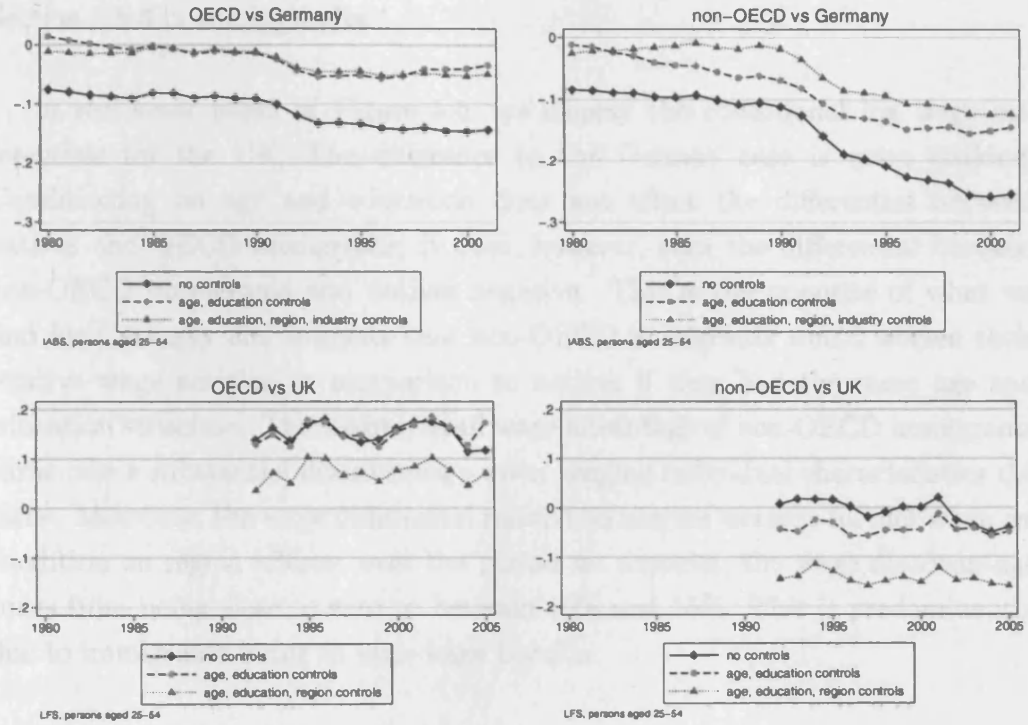


unemployment differentials for the UK. The differences between the conditional and unconditional patterns are much smaller than in Germany. This is not surprising, because the age and education structure of immigrants in the UK resembles those of the native population quite closely, as we have shown earlier. Furthermore, although immigrants are highly concentrated in London, this is not an area with particularly untypical unemployment rates. Overall, we again see considerable differences between OECD and non-OECD immigrants, as well as the cyclical pattern in the early 1980s and 1990s which is particularly pronounced for the group of non-OECD immigrants.

5.5.2 Wages

In Figure 5.5, we display the unconditional and conditional log wage differentials for Germany and the UK. Again, the solid line depicts the unconditional differentials. As for the unemployment rate, we see a reduction in the wage

Figure 5.5: Conditional log wage differentials, Germany and UK



differential between the two immigrant groups and natives for Germany when we condition on age and education, suggesting that part of the differential is due to differences in the age and education composition of the two populations. This is not surprising because we find large educational differences between groups in Table 5.2. However, there remain substantial differences, in particular for non-OECD immigrants. For this group, the differential decreases further when taking account of differences in industry and regional allocation. This suggests that non-OECD immigrants are particularly affected by the cycle not only because of their low education level, but also because they have an unfavourable allocation across industries and regions. Conditioning on these, up to 1990, the wage differential vanishes entirely. However, after 1990, controlling for education, age, industry structure and regional allocation can only account for around 50% of the widening wage gap between natives and non-OECD immigrants, thereby still leaving a gap of more than 10% unexplained in 2000. The gap between

Germans and OECD immigrants remains at about 5% after also controlling for industry and regional allocation. For separate graphs for men and women, see Section 5.8.3 in the appendix.

In the lower panel of Figure 5.5, we display the conditional log wage differentials for the UK. The difference to the German case is quite striking. Conditioning on age and education does not affect the differential between natives and OECD immigrants; it does, however, turn the differential between non-OECD immigrants and natives negative. This is the opposite of what we find for Germany and suggests that non-OECD immigrants would worsen their relative wage position in comparison to natives if they had the same age and education structure. The slight overall wage advantage of non-OECD immigrants turns into a substantial disadvantage when keeping individual characteristics the same. Moreover, the wage differential relative to natives worsens further when we condition on region effects: over the period we consider, the wage disadvantage turns from being close to zero to between 10% and 15%. This is predominantly due to immigrants living in high-wage London.

To sum up, our findings suggest that, for both Germany and the UK, unemployment probabilities of immigrants are more sensitive to the economic cycle than those of natives. Conditioning on individual characteristics and regional (and, in the case of Germany, industry) allocation, reduces this differential slightly, but the stronger cyclical pattern for immigrants remains. The common pattern in both countries, despite the different skill composition of their immigrant populations, is particularly interesting.

For wages, differences between the two countries are partly due to the different composition of immigrants and natives. The differences in average wages in 2000 between immigrants from non-OECD countries and natives in Germany and the UK are similar after conditioning on composition and regional allocation: in both countries, non-OECD immigrants face a substantial wage disadvantage when compared to native workers. This is very different from the unconditional differentials, where non-OECD immigrants in the UK have approximately similar average wages to those of natives, while they earn even less relative to natives

in Germany. Before the early 1990s, the conditional wage differential was close to zero in Germany but already negative in the UK. Over the last decade, we observe a stark diverging trend for Germany but not the UK where wages of immigrants and natives seem to move largely in parallel. Compared to the pattern for the unemployment rate, the differential cyclical responsiveness of immigrants and natives is less pronounced when looking at their wages.

5.6 Differential Responses to Economic Shocks across Groups

We now estimate a more structural model to summarise the evidence we have provided so far, and to quantify the differential response of both different skill groups and natives and immigrants within skill groups. This will also enable us to distinguish between permanent changes over time (which we capture by a time trend), and differences in responses to economic shocks. For example, the large increase in the wage gap between immigrant groups and natives that we observe in Germany since the 1990s is likely to be more a secular trend than a differential response to economic shocks.

We implement this decomposition using a parsimonious factor structure. The idea of our approach is similar to Hoynes (2000). We utilise differences in economic shocks across regions and over time to identify the relative response of different education and population groups to such shocks, conditional on region effects and a time trend. Our outcome variables are unemployment and wages. This allows us to asses the magnitude by which the groups react differently to economic shocks, and test whether these differences are statistically significant.

More formally, consider the following outcome equation:

$$y^g_{jrt} = a^g_j + b^g_j t + c^g_j f_{rt} + \mu_r + \nu_{jrt},$$

where y_{jrt} is the labour market outcome (average log wages or unemployment rates) of skill group j (defined by education and sex) in region r in time period

t. The index g distinguishes between different groups of immigrants and native workers. The skill-specific labour market outcome is a function of a fixed group and skill effect a_j^g, a group and skill-specific time trend b_j^g, a fixed region effect μ_r and a measure of the region-specific business cycle f_{rt}. Importantly, the common factor f_{rt} is assumed to be identical for all skill and immigrant groups. The coefficient c_j^g then gives the responsiveness of group g (immigrants or natives) with skill level j to the business cycle fluctuations in region r at time t. To eliminate fixed group and skill effects, we estimate the above equation in first differences:

$$\Delta y_{jrt}^g = b_j^g + c_j^g \Delta f_{rt} + \Delta v_{jrt}.$$

In our data there is no natural measure for business cycle shocks - that is, for the common factor f_{rt} and hence for Δf_{rt}. One may think of taking the unemployment rate as a measure of business cycle shocks, but in that instance left- and right-hand side variables would be mechanically linked. In the absence of such a measure, we proceed by treating the shock as unobserved and estimate each Δf_{rt} as the parameter on the interaction term of year t and region r, T_{rt}.[8] Denote these parameters as β_{rt}. Our final estimation model is then given by:

$$\Delta y_{jrt}^g = b_j^g + c_j^g \beta_{rt} T_{rt} + \Delta v_{jrt}. \tag{5.1}$$

The parameter of interest is c_j^g, measuring the effect of local labour market shocks on group g in skill group j. These c_j^g are only identified after normalisation. We therefore set c_j^g equal to one for the base group, which we choose to be native male workers with college education in Germany, and native male workers with a degree in the UK. In addition, the intercept for this reference group b_j^g is set to zero in estimation, so the intercepts for the other groups are interpreted as the average trend for group g with skill level j relative to the trend for the reference group.

[8]The model of this section is thus a variant of a dynamic factor model which recently has become quite popular in empirical macroeconomics. For a survey of dynamic factor models, see Breitung and Eickmeier (2005).

In this model, identification is obtained by our assumption that the labour market specific shock β_{rt} is identical for all groups g and skill levels j. Due to our normalisation ($b_j^g = 0$ and $c_j^g = 1$ for the reference group), our estimates of β_{rt} are simply the expected change in the outcome variable of the reference group in region r and year t. Notice that in this model we have interactions of two coefficients, c_j^g and β_{rt}, so the model is non-linear in the coefficients, which renders Ordinary Least Squares (OLS) inappropriate for estimation; instead, we use Nonlinear Least Squares (NLS).

We now return to our original question. Suppose that the differential response to the economic cycle, as we have shown in the figures in Section 5.5, is only due to different skill compositions of the native and the immigrant population, and that the cycle affects both groups (immigrants and natives) equally. In this case, for a given skill group j, the parameter c_j^g should be the same for immigrant and native workers. For instance, for high-skilled immigrant male workers, the estimates should be, as for the reference group, equal to one. This is a testable hypothesis. If these skill-specific parameters are not the same across natives and immigrant groups (within skill groups), then this provides evidence that business cycle shocks affect immigrants differently from natives.

Tables 5.4 and 5.5 report our NLS estimation results of Equation 5.1 for Germany and the UK. For the latter, we pool two years together in order to sustain a sufficient number of observations per skill and origin group for each of the 11 UK regions we use in our analysis.[9] We report the estimated parameters c_j^g for the unemployment rates for each of our 18 skill groups (2 sex, 3 education, 3 nationality/origin) in Germany and the UK in columns (1) and (2), and the respective parameters for wages in columns (3) and (4). The results for the skill-specific trend coefficients b_j^g are reported in Section 5.8.4 in the appendix to this chapter. We report the standard errors underneath the coefficient estimates

[9]We distinguish the three constituent countries Wales, Scotland and Northern Ireland and, in the case of English regional units, we aggregate to the level of Government Office Regions, which are London, South East, South West, West Midlands, North West, North East, Yorkshire and the Humber, East Midlands, and East. For Germany, we use the 10 West German federal states (Länder) as our regional units.

Table 5.4: Estimation results, group specific effect c_j^k: men

IABS/LFS (persons aged 25-54)	(1)	(2)	(3)	(4)
	Unemployment Rate		Log Wages	
	Germany	UK	Germany	UK
High education				
non-immigrant	1	1	1	1
OECD	1.831	1.411	1.281	1.039
	(0.692)	(0.264)	(0.328)	(0.949)
non-OECD	1.973	1.660*+	−0.729*+	0.323*+
	(1.231)	(0.180)	(0.810)	(0.130)
Intermediate education				
non-immigrant	2.407*	2.556*	1.580*	0.976
	(0.470)	(0.136)	(0.099)	(0.097)
OECD	4.192*+	2.689*	1.350*	1.501
	(0.957)	(0.562)	(0.176)	(0.502)
non-OECD	5.805*+	3.816*+	1.870*	1.460*+
	(1.422)	(0.312)	(0.181)	(0.169)
Low education				
non-immigrant	4.680*	3.580*	2.341*	1.136
	(0.914)	(0.202)	(0.143)	(0.147)
OECD	4.792*	4.917*	2.075*	2.417
	(0.937)	(1.225)	(0.193)	(0.885)
non-OECD	6.979*+	4.904*	2.294*	1.214
	(1.359)	(0.805)	(0.224)	(0.476)
Observations	3,409	2,371	3,408	1,152
R^2	0.610	0.514	0.585	0.410

Note: Regressions are estimated using nonlinear weighted least squares, using the cells' population as the weights. The sample covers men and women aged 25-54 from 1982 to 2001 for Germany and from 1981 to 2005 for the UK. In the case of the UK, two years are pooled together so that for the unemployment rates we generate two-year intervals starting with years 1981, 1983 and so on. For the wage regression for the UK, data are only available from the fourth quarter of 1992 onwards. We therefore form two-year clusters 1992/1993, 1994/1995 and so on. As the regional unit we use the 10 West German states (Länder) and for the UK the 11 regional units listed in the text. For details on the construction of the outcome variables, see the text. Cluster-robust standard errors are in parentheses. An asterisk (*) indicates the parameter is different from one at the 5% level. A cross (+) indicates that the parameter is different from the corresponding parameter of the native group at the 5% level.

where asterisks (*) are used to indicate that a coefficient is statistically different from one (the parameter of the base group) at the 5% level. We also test the hypothesis that responses of the two immigrant groups are different from those of native workers *within* the same skill group. Significant differences in estimates at the 5% level are in this case marked with a cross (+).

5.6.1 Unemployment

Table 5.4 reports results for men, and Table 5.5 for women. We first concentrate on men. Columns (1) and (2) report results for unemployment. For both Germany and the UK, there is a clear tendency that the lower the educational attainment, the stronger the cyclical fluctuations in the unemployment rate. For instance, for native men in Germany, the estimate increases from 1 for the reference group with college education to 2.41 for those with intermediate education, and to 4.68 for those with low education. This suggests that the unemployment response to macroeconomic shocks for the low-educated is stronger by factor 4 than for the highly educated men. The numbers for the UK are remarkably similar, with point estimates of 2.56 for the intermediate and 3.58 for the low-educated men.

Within skill groups, there seems to be a higher responsiveness of unemployment for immigrants than for natives. For Germany, as noted, native men with intermediate education respond 2.41 times stronger to business cycle shocks than native German men with college education; however, OECD immigrants in the same education category react more strongly by factor 4.19, and non-OECD immigrants by factor 5.81. Both estimates for immigrants are significantly different from those of natives within the same skill group. For the low-educated group, OECD immigrants react similarly in magnitude to shocks than natives (always compared to native men with high education), with point estimates of 4.79 and 4.68 respectively. Non-OECD immigrants react more strongly, with a point estimate of 6.98. This estimate is again significantly different from that of native men in the same skill group.

For the UK, natives and OECD immigrants with medium qualifications react very similarly to shocks with estimates of 2.56 and 2.69 respectively. On the other hand, non-OECD immigrants react significantly more strongly than both of these groups, with a point estimate of 3.82. For the group of low-educated workers, point estimates suggest again that both groups of immigrants respond more strongly than their native counterparts (4.92 and 4.90, respectively, versus 3.58 for natives). However, these estimates are not significantly different between groups.

Table 5.5: Estimation results, group specific effect c_j^k: women

IABS/LFS (persons aged 25-54)	(1)	(2)	(3)	(4)
	Unemployment Rate		Log Wages	
	Germany	UK	Germany	UK
High education				
non-immigrant	1.490	0.489*	1.739*	0.909
	(0.566)	(0.083)	(0.155)	(0.109)
OECD	2.165	0.560	0.882	1.586
	(1.130)	(0.235)	(0.983)	(0.329)
non-OECD	-0.466	0.095*	-0.797	0.289
	(1.345)	(0.234)	(1.390)	(0.414)
Intermediate education				
non-immigrant	1.477	0.825	1.419*	1.151
	(0.299)	(0.089)	(0.087)	(0.099)
OECD	2.239*+	1.040	1.111	1.814*
	(0.540)	(0.219)	(0.231)	(0.379)
non-OECD	2.366*+	1.919*+	1.770	1.292
	(0.606)	(0.219)	(0.435)	(0.311)
Low education				
non-immigrant	2.412*	1.424*	2.108*	1.147
	(0.488)	(0.180)	(0.136)	(0.128)
OECD	4.192*+	0.713	1.786*	1.543
	(0.951)	(0.649)	(0.187)	(0.434)
non-OECD	2.815*	2.501	1.639*+	1.538
	(0.879)	(0.803)	(0.176)	(0.399)
Observations	3,409	2,371	3,408	1,152
R^2	0.610	0.514	0.585	0.410

Note: Regressions are estimated using nonlinear weighted least squares, using the cells' population as the weights. The sample covers men and women aged 25-54 from 1982 to 2001 for Germany and from 1981 to 2005 for the UK. In the case of the UK, two years are pooled together so that for the unemployment rates we generate two-year intervals starting with years 1981, 1983 and so on. For the wage regression for the UK, data are only available from the fourth quarter of 1992 onwards. We therefore form two-year clusters 1992/1993, 1994/1995 and so on. As the regional unit we use the 10 West German states (Länder) and for the UK the 11 regional units listed in the text. For details on the construction of the outcome variables, see the text. Cluster-robust standard errors are in parentheses. An asterisk (*) indicates the parameter is different from one at the 5% level. A cross (+) indicates that the parameter is different from the corresponding parameter of the native group at the 5% level.

We report the results for women in Table 5.5. The reference group is still highly educated men. The estimates confirm the overall pattern that we find for men, with somewhat smaller differences across skill groups. In Germany, immigrant women of both groups react more strongly than their native counterparts

with intermediate education while in the group with low educational attainment, only immigrant women from OECD countries react significantly stronger than native women. In the UK, only non-OECD immigrant women seem to be particularly sensitive to economic shocks relative to native women of the same skill group.

5.6.2 Wages

We now turn to wages and report results in the last two columns of Table 5.4 (men) and Table 5.5 (women). For Germany, the numbers in column (3) suggest that the wage fluctuations over the business cycle are larger for the intermediate educational group and still larger for the low-skilled when compared to the estimates of the high-skilled reference group, with all coefficients being significantly different from one. Within skill groups, though, we do not find statistically significant differences in the responsiveness of wages to economic shocks between natives and immigrants. The large divergence in the conditional wage gap between immigrants and natives that we have seen in the figures in Section 5.5 is therefore unlikely to be due to differences in the response to shocks. Inspecting the trend coefficients which we display in Appendix 5.8.4, these become more negative the lower the educational attainment, implying a deterioration in the relative wages of low-skilled workers. Furthermore, the relative downward trend is significantly stronger for non-OECD immigrant men among the medium-educated and for both immigrant groups among the low-educated men compared to natives within the same skill category.

Results for men in the UK are displayed in the last column (4) of Table 5.4. There seem to be no clear differences across skill groups in the response to economic shocks. This may be because wage data are only available since 1992, and the British economy experienced a steady growth over most of the last decade. As in Germany, there is little evidence of a differential response to economic shocks between immigrants and natives within skill categories. Only the estimate for non-OECD immigrants with intermediate education is significantly higher than its native counterpart. As opposed to Germany, the trend estimates in Appendix 5.8.4 do not suggest large differences in time trends across groups. For women, results are reported in Table 5.5. For Germany, low-educated women

react more strongly to business cycle shocks than the reference group, but less so than equally educated men. For both countries, there is little evidence of large differences between immigrants and natives within skill groups. For Germany, only low-educated non-OECD women react significantly differently from their native counterparts; in this case, they show a lower responsiveness to economic shocks. For the UK, none of the estimated parameters for immigrants is significantly different from the corresponding coefficients of the natives, and only the coefficient for women with intermediate education who immigrated to the UK from an OECD country is significantly different from one (the coefficient of the reference group).

5.7 Summary and Conclusion

In this chapter, we analyse differences in the responsiveness of immigrants and natives to the economic cycle. Our investigation covers Germany and the UK. Both countries are among the largest economies in Europe and have large immigrant populations. However, they differ in the skill and origin composition of their immigrant communities, as well as the development of wage inequality over the last decades and economic growth over the last 10 years. We commence by illustrating the magnitude of differences in cyclical responses for the two countries, distinguishing between immigrants from OECD countries and immigrants from non-OECD countries. We then analyse reasons for the observed differences. Our analysis is based on two longitudinal data sets, both covering the period from 1980 onwards: for the UK, we use the LFS of Britain and Northern Ireland. For Germany, we use a 2% sample from the Social Security Records.

We demonstrate substantial differences in the origin and skill composition of the immigrant population between Germany and the UK. While immigrants to the UK are, overall, similarly or even better educated than the native-born, immigration to Germany is largely unskilled. In both countries, unemployment is higher in the immigrant population, in particular when considering immigrants from non-OECD countries. While there are substantial differences in average unconditional earnings between immigrants and natives in Germany, this seems not the case for the UK, where wages are on average similar or even higher for

both immigrant groups. In the UK, the regional distribution of immigrants is more concentrated than that of the native-born, while in Germany natives and immigrants are similarly distributed across regions.

When considering the cyclical development of unemployment for immigrants from OECD and non-OECD countries, it appears that both groups react more pro-cyclically than natives in both countries. These differences reduce in size but remain significant after conditioning on individual characteristics like age and education, regional distribution and, in the case of Germany, industry allocation. For wages, we find that in Germany the unconditional average wages of both groups of immigrants have dramatically decreased relative to natives since the early 1990s. There is hardly any overall wage gap between immigrants and natives in the UK; if at all, wages seem to be higher for immigrants. However, when we control for composition and regional allocation, we find that this leads to a significant drop in the relative wage position of immigrants in the UK, and to an improvement in the relative gap in Germany. Interestingly, eliminating composition effects leads to a similar wage gap in 2000 between non-OECD immigrants and natives in Germany and the UK. However, while the conditional gap was fairly constant for immigrants in the UK over the last decade, it was close to zero in Germany in 1990 and has increased to about 5% and 12% for OECD and non-OECD immigrants respectively.

We then estimate a structural factor-type model, where we use differences in the exposure to economic shocks across regions to provide a summary measure of the magnitude of differences between skill and origin groups in their responsiveness to shocks, conditional on a secular trend. This enables us to distinguish between long-term changes over time (which we capture by a time trend) and differences in responses to economic shocks. The results suggest that, for both Germany and the UK, individuals are more responsive to economic shocks in terms of their unemployment rates the lower their educational attainment, with approximately similar differences between countries. When distinguishing further between immigrants and natives within educational cells, we find that immigrants are more responsive to shocks than natives in both Germany and the UK. This holds in particular for immigrants from non-OECD

countries which, depending on their skill levels, react between 1.5 and 2.4 and between 1.4 and 1.6 times stronger to business cycle shocks in Germany and the UK, respectively, than natives with the same observable skill levels. For wages, we again find, in particular for Germany, that lower-skilled workers react more sensitively to shocks than the highly skilled; however, the magnitude of these differences is much lower than the one with respect to unemployment. There is not much evidence for both countries that within skill groups, and after accounting for secular trends, immigrants react differently to economic shocks relative to natives in terms of wages. The above-mentioned increase in the gap in wages between immigrants and natives in Germany is mainly captured by a secular trend, rather than differential responses to economic shocks. The trend effects are significantly larger for both groups of immigrants than for natives in Germany. For the UK, where our wage series is based on little over a decade of data only, we find no evidence of differential group specific wage trends.

What do we conclude from all this? Our results suggest larger unemployment responses of immigrants than natives to economic shocks within skill groups. These differences are particularly pronounced for non-OECD immigrants, and evident for both countries. By contrast, despite largely different secular changes in the relative wage gap between immigrants and natives in the UK and Germany, we find little evidence in either country that wage responses of immigrants to shocks are different from those of natives with the same skill levels. Overall, it seems that changes in the demand for labour over the economic cycle affect immigrant workers, and in particular those from non-OECD countries, more than natives. An interesting result is the similarity in this pattern for the UK and Germany, despite their differences in immigrant populations and economic conditions. There are a number of possible reasons for the higher unemployment responsiveness of immigrants. Immigrants may have fewer permanent employment contracts and lower dismissal costs than natives. Immigrants may also be discriminated against, with employers singling them out when economic conditions deteriorate, but re-employing them when the situation improves. Our finding that there is little evidence of differential wage reactions suggests that there is no differential adjustment at this margin. However, if those immigrants who are laid off in an economic downturn are predominantly drawn from the

lower end of the productivity distribution, selection may distort our analysis on wages, leading to an increase in the observed average wages of those immigrants who remain employed.

The results of this analysis cast, to some extent, doubt on the assumption of perfect substitutability between immigrants and natives that underlies many analyses on the labour market impact of immigration. If immigrants and natives with the same observable skill levels were indeed perfect substitutes, one would not expect a differential response to economic shocks. A solution for this problem in future studies could be to either explicitly allow for imperfect substitutability between immigrants and natives within skill groups as suggested by Manacorda et al. (2006) and Ottaviano and Peri (2006a), or to abstain altogether from an explicit pre-allocation of immigrants to particular skill groups as suggested by Dustmann et al. (2007).

Our analysis also has implications for other areas of research. In the literature on the economic assimilation of immigrants it is often implicitly assumed that immigrants and natives react to macroeconomic shocks in the same way, at least within skill groups.[10] Work by Borjas (1995a, 1999a) assumes as an identification strategy for immigrant cohort effects the same response of immigrants and natives to the economic cycle, conditional on observed characteristics. In two recent papers, Barth et al. (2004, 2006) point out that differences in the response to macroeconomic conditions between immigrants and natives invalidate Borjas's (1995a) identification assumption. They propose, as an alternative strategy, to parameterise time effects as a function of local labour market conditions. Our analysis in this chapter supports their argument. Although we find little evidence that macroeconomic shocks around a trend affect wages of immigrants and natives differently within skill groups, we find large differences in trends for

[10]For papers investigating immigrants' earnings assimilation, see, for instance, Borjas (1995a) for the U.S., Baker and Benjamin (1994) and McDonald and Worswick (1998) for Canada, Friedberg (2000) for Israel, Chiswick (1980), Bell (1997) and Schmitt and Wadsworth (2006) for the UK, Constant and Massey (2003) for Germany, and Barth et al. (2002) for Norway. For papers investigating immigrants' employment and unemployment dynamics, see, for example, Chiswick et al. (1997) and Chiswick and Hurst (2000) for the U.S., Wheatley Price (2001), Frijters et al. (2005) and Schmitt and Wadsworth (2006) for the UK, or Husted et al. (2001) for Denmark.

Germany, which would lead to different time period effects in straightforward earnings regressions. Our analysis adds a further concern. As we point out earlier, the strong cyclical pattern in the difference in unemployment rates between immigrants and natives within skill groups may lead to differential selection between immigrants and natives over the economic cycle. This may in turn lead to a bias in estimated coefficients of typical human capital variables and estimates of the corresponding assimilation profiles. The sign and magnitude of this bias will depend on the cyclicality of the period that is considered, and the differences in the responses of the immigrant and native groups.

5.8 Appendix

5.8.1 Data Samples

Germany

The sample population for the analysis on Germany comprises all dependent employees as well as the registered unemployed. In order to avoid issues of differential labour market entries and early retirement, we restrict our sample to the population aged 25-54. Self-employed individuals, who made up 8.4% of the foreign and 10.0% of the German workforce in 2001 (Institut für Mittelstandsforschung, 2003), as well as civil servants and the military, are excluded from the analysis. Throughout the analysis, we consider two labour market outcomes for Germany: the unemployment rate and average daily wages.

Some explanation is necessary with regard to the construction of our unemployment rate for West Germany. The IABS includes two groups of individuals: first, employees who are subject to social security contributions and, second, unemployed persons who are recipients of official unemployment compensation. Therefore, the rate of unemployment that can be derived using the IABS is the number of these unemployed over the total number of unemployed plus employees.

The second important labour market outcome variable we use is the daily wage of full-time workers. The wage data are taken directly from the IABS and adjusted to real 1995 prices using the consumer price index for all private households. All wages (or log wages) are reported in Euros. Wage records in the IABS are top coded at the social security contribution ceiling. We impute wages above that ceiling using a tobit-based method suggested by Gartner (2004). The IABS is a unique data source, both in its accurateness and its sample size that allows an examination of wage changes over a long period.

UK

The UK LFS allows an assessment of unemployment status according to the ILO definition of unemployment. The ILO definition defines an individual as

unemployed if he/she is without work during the reference period, but available for work and actively seeking work. Hence, in the LFS individuals who are actively seeking work but are not eligible for official unemployment compensation are counted as unemployed, while the IABS does not cover this group of people at all. On the other hand, individuals who are not available for work or are not actively seeking employment but receive unemployment benefits are not included in the number of unemployed persons in the LFS, although they are in the IABS.[11] In order to make unemployment rates in both Germany and the UK as closely comparable as possible, we exclude the self-employed and people on government schemes from our analysis for the UK. The reported unemployment rates may therefore deviate slightly from the numbers in official publications.

As pointed out earlier, from the winter quarter 1992/93 (1994/1995) onwards, the LFS for Britain (Northern Ireland) also contains information on wages of employees. The LFS does not report earnings of self-employed people which, however, does not pose further problems because we exclude the self-employed to improve the comparability of our UK results with those of Germany. Wage data used throughout the analysis are hourly wages in pounds sterling where prices are adjusted to 1992 prices using the consumer price index.

[11]It should be noted that a sizeable proportion of the German labour force above 55 falls under this category. Based on the ILO definition of unemployment, these individuals would not be classified as unemployed. This is one reason why we restrict our analysis to individuals below the age of 55.

5.8.2 Conditional Unemployment Differentials by Sex

Figure 5.6: Conditional unemployment rate differentials, Germany and UK: men

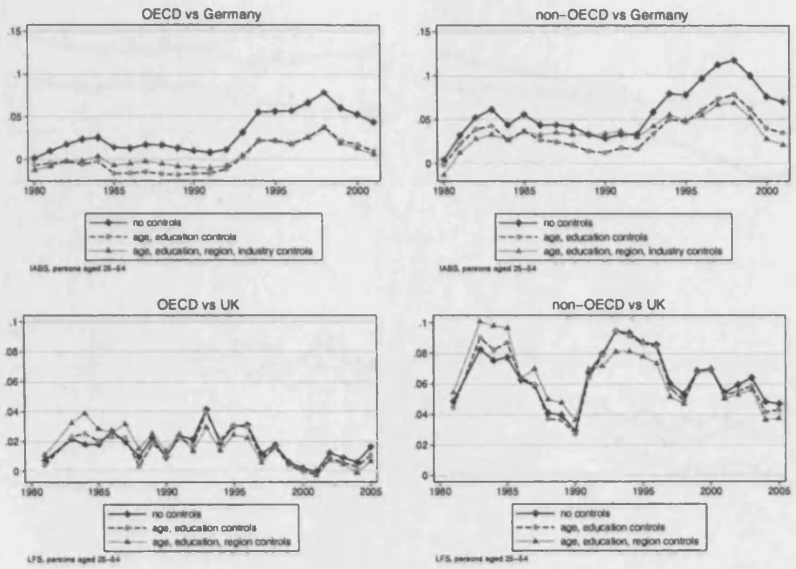
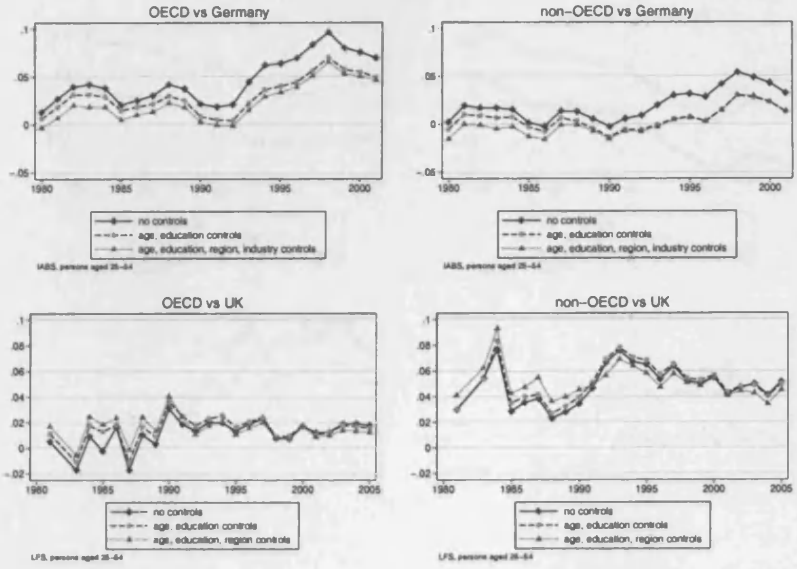


Figure 5.7: Conditional unemployment differentials, Germany and UK: women



5.8.3 Conditional Log Wage Differentials by Sex

Figure 5.8: Conditional log wage differentials, Germany and UK: men

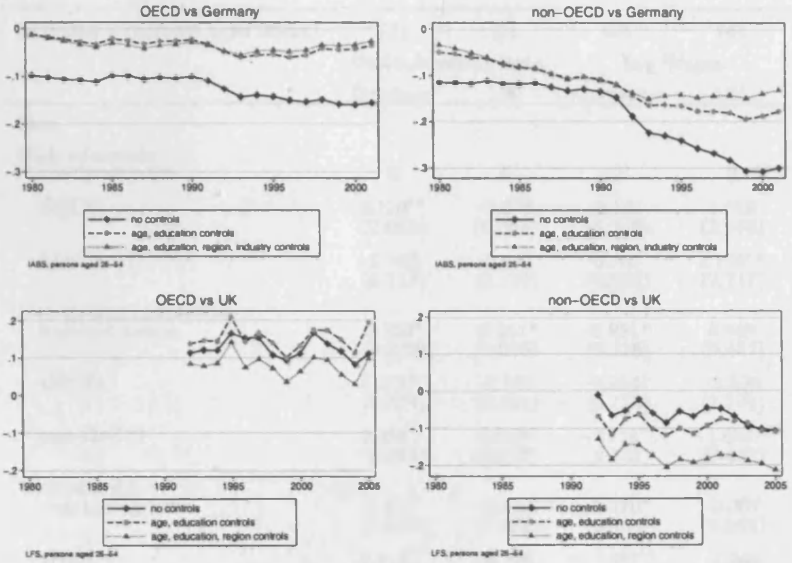
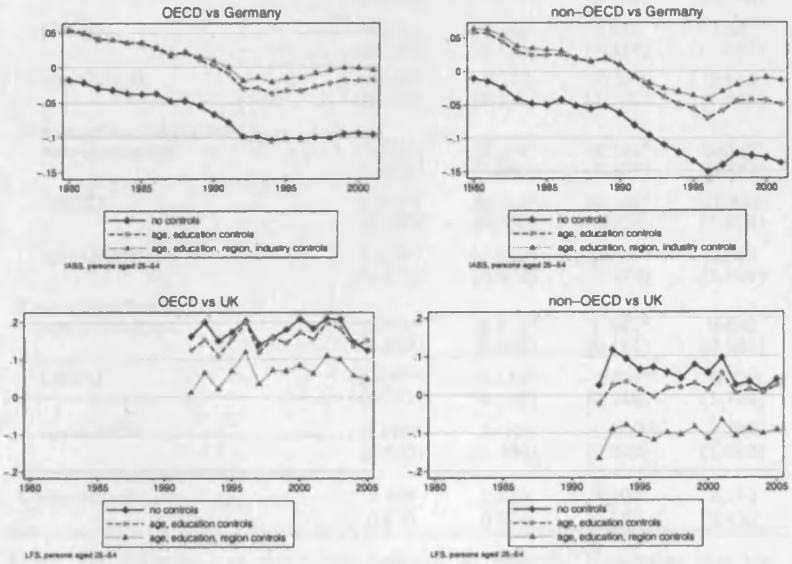


Figure 5.9: Conditional log wage differentials, Germany and UK: women



5.8.4 Time Trend Estimates

Table 5.6: Estimation results, time trend effect $b_j^k \times 100$

IABS/LFS (persons aged 25-54)	(1)	(2)	(3)	(4)
	Unemployment Rate		Log Wages	
	Germany	UK	Germany	UK
Men				
High education				
non-immigrant	0	0	0	0
OECD	0.110*+	-0.076	-0.561	0.796
	(0.055)	(0.098)	(0.349)	(3.678)
non-OECD	0.102	-0.041	0.731	2.170*+
	(0.114)	(0.125)	(0.996)	(0.717)
Intermediate education				
non-immigrant	0.150*	-0.261*	-0.951*	0.665
	(0.030)	(0.065)	(0.118)	(0.447)
OECD	0.323*+	-0.193	-0.954*	-2.506
	(0.054)	(0.104)	(0.173)	(1.771)
non-OECD	0.396*+	-0.378*	−2.118*+	−1.694*+
	(0.081)	(0.126)	(0.181)	(0.845)
Low education				
non-immigrant	0.448*	-0.412*	-2.370*	-0.307
	(0.056)	(0.103)	(0.184)	(0.562)
OECD	0.515*+	-0.395	−1.989*+	-6.048
	(0.060)	(0.304)	(0.220)	(3.379)
non-OECD	0.507*	-0.317	−3.123*+	-1.044
	(0.102)	(0.221)	(0.267)	(2.364)
Women				
High education				
non-immigrant	-0.139*	-0.163*	-0.315	0.754
	(0.033)	(0.027)	(0.178)	(0.486)
OECD	0.160	-0.108	0.410	−1.541+
	(0.185)	(0.163)	(1.117)	(1.157)
non-OECD	-0.037	-0.120	-0.340	2.846
	(0.313)	(0.110)	(1.572)	(1.843)
Intermediate education				
non-immigrant	0.028	-0.368*	-0.422*	0.980*
	(0.021)	(0.041)	(0.107)	(0.472)
OECD	0.195*+	-0.314*	-0.649*	-1.849
	(0.045)	(0.088)	(0.228)	(1.835)
non-OECD	0.173*+	-0.342*	−1.470*+	0.092
	(0.076)	(0.094)	(0.476)	(1.476)
Low education				
non-immigrant	0.274*	-0.213*	-1.542*	0.603
	(0.033)	(0.052)	(0.161)	(0.588)
OECD	0.477*+	-0.442*	−1.936*+	-0.725
	(0.071)	(0.197)	(0.216)	(1.762)
non-OECD	0.246*	-0.092	−1.955*+	-1.820
	(0.080)	(0.336)	(0.222)	(1.942)
Observations	3,409	2,371	3,408	1,152
R^2	0.610	0.514	0.585	0.410

Note: See Table 5.4. In this table, however, an asterisk(*) indicates that the parameter is different from zero at the 5% level.

Chapter 6

Concluding Summary

The question of whether or not immigration has a detrimental effect on the labour market outcomes of natives in the host economies has received significant attention both in the public policy debate and in the economic literature. In this thesis, I have added to this literature by providing new insights into both the magnitude of the immigrant impact on wages and employment and the adjustment mechanisms through which labour markets react to immigrant inflows. I have also assessed the assumption of perfect substitutability of immigrants and natives with identical observable skills and their relative behaviour over the business cycle.

To begin with, Chapter 2 introduces the economic theory that is guiding most of the empirical analysis in the literature and presents the main methodological approaches as well as the theoretical and empirical problems associated with them. It then provides a comprehensive overview of the literature on the labour market impact of immigration and its related sub-fields, covering a variety of immigration episodes in numerous countries throughout the world.

Chapter 3 analyses the labour market impact of ethnic German immigration to Germany between 1996 and 2001. The unique feature of this study lies in the exogeneity of the immigrant inflows with regard to local labour market conditions. Because ethnic German immigrants are allocated to particular regions by the German government based on pre-specified county quotas, they are not able to self-select into those labour markets that offer the most favourable conditions,

a behaviour that typically leads to an underestimation of their true impact on local labour market outcomes. The results from this natural experiment show that immigration has a negative effect on the relative employment rates of the resident population but no effect on relative wages. The estimates imply that for every 10 immigrants that find a job, 4 resident workers become unemployed or fail to find a job when they otherwise would have, with resident foreign nationals appearing to be particularly affected. There is no evidence of any systematic out-migration of resident workers in response to the inflow of ethnic German immigrants which could have dissipated their local labour market impact across the national economy.

Chapter 4 focuses on two alternative adjustment channels recently put forward in the literature, the adjustment through changes in the output mix and the adjustment through changes in the production technologies of local industries and firms. We analyse how much of the change in labour supply induced by the immigrant inflows to Germany between 1985 and 1995 is absorbed by an increase in scale of those industries and firms that use the skills supplied by the immigrant workers more intensively, and how much is absorbed by an endogenous change in relative factor intensities. Our results on the industry level show that most of the labour supply changes, about 62%, are absorbed through changes in relative factor intensities and only about 20% through changes in the relative scale of industries. We show that as a result of the aggregation of firms to the industry level, estimates of the relative share absorbed through industry-level intensity adjustments cannot necessarily be interpreted as changes in production technologies. A suitable firm level decomposition reveals that around 44% of the changes in local labour supply are absorbed through changes in relative factor intensities within firms while around 24% are absorbed by a differential growth in the scale of firms. Firms in tradable industries as well as small firms predominantly adjust through their factor intensities while firms in non-tradable industries and large firms predominantly adjust through their relative scales. Overall, intensity adjustments are the most important mechanism by which local firms respond to immigrant inflows. Since we do not find any evidence of adjustments in relative wages, particularly in firms that operate in tradable industries, these changes in relative factor intensities point towards endogenous

changes in production technologies.

Chapter 5 analyses to what extent immigrants and natives in Germany and the UK differ in their responsiveness to business cycle fluctuations. Many impact and assimilation studies assume that immigrants and natives with the same observable skills are perfect substitutes. If that was the case, we would not expect them to behave differently over the economic cycle. We investigate this issue by first showing descriptive evidence of the relative unemployment and wage profiles of immigrants and natives over the last two decades in both Germany and the UK, conditioning step by step on individuals' age, education, regional distribution, and industry allocation. We then estimate a structural factor-type model that provides summary measures of the relative responsiveness of immigrants and natives of different skill levels to business cycle shocks. Our results from this analysis suggest that in both countries, the lower the educational attainment of workers, the higher is their responsiveness to economic shocks in terms of their unemployment rate. Within educational groups, however, immigrants and especially those from non-OECD countries react significantly more pro-cyclically than comparable natives. Depending on the skill level, non-OECD immigrants respond between 1.5 and 2.4 and between 1.4 and 1.6 times stronger to business cycle shocks in Germany and the UK, respectively, than comparable natives. Wage responses on the other hand do not differ between immigrants and natives within skill groups after taking account of differential secular trends, neither in Germany nor in the UK. The differences in responsiveness to business cycle fluctuations cast doubt on the assumption of perfect substitutability of immigrants and natives of the same skill level common in many impact analyses. It also has implications for other areas of the migration literature, in particular the literature concerned with identifying assimilation profiles of immigrants in their host economies. Until recently, and perhaps unduly, this literature has to a large extent relied on the assumption that immigrants and natives are equally affected by aggregate economic shocks.

Despite the substantial breadth of the literature on the labour market impact of immigration, a consensus about its magnitude has yet to evolve. This is a clear indication for the complexity of the issue. As pointed out throughout this thesis,

there are many channels through which labour markets can respond to immigrant inflows, some of which have been studied extensively while others still call for more thorough investigation. Future research will have to fill these gaps as well as place more emphasis on the dynamic aspects of the labour market impact of immigration. The final challenge will be to put all pieces together to one coherent knowledge base that will allow decision makers to design immigration policies suited to their objectives and on the basis of credible empirical evidence.

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