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Estimating the Impact of Immigration on Wages in Ireland

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ABSTRACT

Estimating the Impact of Immigration on Wages in Ireland*

We estimate the impact of immigration on the wages of natives in Ireland applying the technique proposed by Borjas (2003). Under this method, the labour market is divided into a number of skill cells, where the cells are defined by groups with similar levels of experience and education (or experience and occupation). Regression analysis is then employed to assess whether the average wages of natives across skill cells is affected by the share of immigrants across cells. When the cells are based on education/experience, our results suggest a negative relationship between native wages and immigrant shares. However, the opposite appears to hold when the cells are based on occupation/experience. These contradictory findings suggest that care should be exercised when applying this method as inaccurate impressions of the impact of immigration on wages may arise.

JEL Classification: J11, J21, J61

Keywords: immigration, wages, Ireland

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Section 1: Introduction

During the period of Ireland's remarkable economic boom[2], one of the notable features of the economic transformation was a rapid increase in inward migration. For much of its history, Ireland had experienced large population outflows but in the late 1990s significant inflows began. The rate of net inflow then increased through this decade, reaching a high point of almost 17 per thousand of population in 2006. Part of the high rate of inward migration was related to the attractive economic conditions that Ireland offered during its "Celtic Tiger" period. Another important dimension was the decision by the Irish government to allow full access to the Irish labour market when the EU expanded to 25 members on 1 May 2004. With the UK and Sweden being the only two other member states also allowing full access, much of the outflow from the new member states was channelled to Ireland.

The emergence of a significant population of immigrants in Ireland led to the production of a body of research which had two aims. First, from a domestic perspective, it was important for policy-makers to have an understanding of the nature of the inflow which Ireland was experiencing and also of the outcomes for immigrants. In this context, studies looked at, amongst other things, the characteristics of immigrants (Barrett et al, 2006), their earnings (Barrett and McCarthy, 2007) and the extent to which they assimilated in the labour market (Barrett and Duffy, 2008).

The second aim of the research was international in its orientation and sought to augment the literature on immigration with lessons from the Irish case. Two features of Ireland's experience of immigration made it particularly interesting. First, the immigration had happened over the course of an economic boom. Second, much of the inflow was of people who, like the majority of the Irish natives, were (a) white and (b) Christian. It was expected that these two elements of the overall context would provide a positive environment for new arrivals. The findings of significant wage disadvantages (Barrett and McCarthy, 2007) and of little assimilation in the labour market (Barrett and Duffy, 2008) suggested that recently arrived immigrants faced difficulties, even in relatively favourable host countries.

[2] Roughly, the period of the boom lasted from 1994 (when real growth first exceeded 5%) to 2007.

In this paper we use the Irish case again, this time to explore the question of whether immigrants tend to increase or reduce the average wages of native workers. Clearly, the issue of immigration impacts is an enormously controversial issue in the public debate on immigration but also within the economics literature. As discussed in the literature review below, immigrants have been found to raise and lower the average wages of native workers, with many other studies finding no significant effects. Given this variety of results, the addition of a study using the Irish experience will be of value.

The approach we take is that which was proposed and applied by Borjas (2003) and applied again by Clark and Drinkwater (2008) and by Carrasco et al (2008). In essence, we break the labour market up into a set of "skill cells", where cells are defined by combinations of experience and education or occupation. We then explore whether the wages of natives within those cells are related to the share of immigrants in the cells, using data for the period 1999-2007. Borjas, and indeed Clark and Drinkwater, found a negative relationship between immigrant shares and the wages of natives. Carrasco et al found no significant impacts. Hence, we had expected that our results would lie in the range of zero to a modest negative impact of immigration on native wages. However, our results actually show both a positive and a negative impact of immigrant on the wages of natives depending on whether skill cells are defined in terms of education or occupation[3]. These are interesting results because they raise a question mark over the use of this approach to estimating the impacts of immigration.

The issue of the impact of immigrants on the wages of Irish workers has been addressed previously (Barrett et al, 2002 and Barrett et al, 2006). In both papers, the approach taken was to use an econometric model of the Irish labour market to simulate the impact of immigration, modelling the inflow as an exogenous increase in labour supply. The big limitation of that approach is that it does not provide direct evidence on the link between immigration and wages. In this paper, we attempt to provide direct evidence although, as mentioned above, a somewhat confusing set of results emerge.

[3] As will be seen below, we control for potential endogeneity between immigrant inflows and wages.

The remainder of the paper is structured as follows. In Section 2, we provide an overview of the literature on the wage effects of immigration, including Borjas (2003) upon which our empirical work is based. In Section 3, we present some broad information on economic and labour market developments in Ireland during the period of our analysis, 1999-2007. In Section 4, we go on to describe how we implement the Borjas approach to estimating the impact of immigration on wages. In so doing, we describe the data which are used and how we construct skill cells. In Section 5, we present our results. In Section 6, we discuss those results.

Section 2: The literature on the wage effects of immigration

Friedberg and Hunt (1995) provided a comprehensive review of work on the impact of immigration and it is helpful to draw on this in discussing work up to that time[4]. They discuss how a number of approaches were taken to measuring impacts. One approach, labelled by Friedberg and Hunt as "cross section differencing", exploits the fact that the share of immigrants tends to differ across regions or cities. A simple regression relating immigrant shares and immigrant wages across cities or regions would suffer from an endogeneity bias, as immigrants are attracted to high wage cities. However, such a bias would be reduced if *changes* in the immigrant share were related to *changes* in wages. One example from the U.S. is Goldin (1994); she found that a 1 percentage point rise in the immigrant share of a city reduce wages by between 1 and 1.6 percent.

Recognising that differencing might not eliminate the endogeneity bias, others moved on to using instrumental variables in measuring immigrant impacts. For example, Altonji and Card (1991) use the stock of immigrants in 1970 as an instrument for the change in the immigrant share of the population in later decades, based on the observation that newly arriving immigrants tend to go to areas where there are already immigrants resident. They find that a 10 percent increase in the immigrant population reduces wages by 0.86 percent.

[4] A more recent survey is provided by Dustmann, Glitz and Frattini (2008a)

Another strand in this literature, again as labelled by Friedberg and Hunt, is the exploitation of "natural experiments". Studies under this heading have analysed labour markets where a large and sudden inflow of immigrants has resulted mainly on foot of political decisions rather than through the more usual push and pull of economic forces. In this way, the endogeneity problem is again addressed. One example of this approach is that of Card (1990). He examined the impact of a 7 percent increase in Miami's population in 1980 as a result of the sudden arrival of Cubans in May of that year. He found that only the wages of Cubans appeared to decline in response to this inflow.

Overall, Friedberg and Hunt conclude their review with the observation that "the effect of immigration on the labour market outcomes of natives is small". [5] However, in papers such as Borjas, Freeman and Katz (1997) a criticism was made of area-based studies that they failed to take account of a possible channel for adjustment, namely, the internal migration of natives. According to this view, the failure to find negative effects of immigration on wages could arise because of the outward migration of natives in response to immigration. Hence, migration impacts had to be estimated at a national level.

Borjas, Freeman and Katz (1997) implement a national level approach by simulating the impacts of migration, using estimates of factor price elasticities. They find that the location decisions of natives do respond to immigration. They also find that "immigration has had a marked adverse impact on the economic status of the least skilled U.S. workers". The results in Borjas, Freeman and Katz (1997) suggested that the findings in other studies of small and/or insignificant effects of immigration on native wages may have been misleading.

Borjas (2003) added to this view that immigration may have had more significant negative wage impacts. He looks at the effect of immigration on wages through the variation of the immigrant share across skill cells, where skills cells are constructed to group immigrants and natives with similar ages and levels of education. According to Borjas, this approach overcomes the problem inherent in area-based studies of internal

[5] Borjas (2003) includes this same quotation.

migration dampening any wages effects. In addition, it has an advantage over the simulation approach (used in Borjas, Freeman and Katz) in that it seeks to estimate directly the impact of immigration. As Borjas puts it "for a given elasticity of substitution, the (simulation) approach mechanically predicts the relative wage consequences of supply shifts" (p1339). According to his estimates the immigration that occurred between 1980 and 2000, and which increased labour supply by 11 percent, reduced the average native wage by 3.2 percent. The approach was applied to the UK case by Clark and Drinkwater (2008); their results suggested that the immigration associated with EU enlargement may have reduced white native earnings by about 2.5 percent.

A number of recent studies have seen the pendulum swing back again on the question of immigration and native wages. These studies have not produced findings in line with the Freidberg and Hunt summary of little or no impacts. Instead, they have found positive impacts of immigration on the average wages of natives. Ottaviano and Peri (2006a)[6] describe themselves as "building on the model presented by Borjas (2003)" and placing the question in a general equilibrium framework where greater account is taken of the multiplicity of cross-elasticities across labour types and also between capital and labour. According to their results, over 90 percent of the U.S. labour force gained from immigration. Similar conclusions are drawn in Ottaviano and Peri (2005 and 2006b) although the focus in these papers was on wage, and other impacts across cities[7]. Peri (2007) focuses on California but again finds positive impact of immigration on wages. Dustmann et al (2008b) consider the UK situation. Their approach is similar to some degree to Borjas (2003) in that skill-cells are created; however, immigrants and natives are grouped according to wages as opposed to the observable characteristics of experience and education. They find positive wage effects of immigration.

How might it be possible that immigration could increase wages? If we assume that all workers are paid their marginal product, then any explanation for a positive impact of immigration on native wages must incorporate a positive impact of immigration on

[6] Borjas et al (2008) contains a critical appraisal of Ottaviano and Peri (2006a).
[7] Card (2007) is another example of a paper which looks at the impact of immigration on wages across cities and also finds positive effects.

the productivity of natives. One route through which this could occur is through complementarities between immigrant and native labour. Alesina and La Ferrera (2005) look at the issue from the perspective of cultural diversity and discuss how a group of diverse people can bring different perspectives to a problem-solving exercise and thereby produce solutions which are superior to those arrived at by more homogeneous groups. While this line of reasoning is probably most relevant to high-skilled occupations, Ottaviano and Peri (2005) suggest that even in lower skilled occupations, immigrants and natives may not be perfect substitutes. As they put it: "a Chinese cook and a U.S.-born cook or an Italian tailor and a U.S.-born tailor do not provide the same services" (p314). Recalling that the immigrant inflow into Ireland from the late 1990s onwards transformed the labour force in terms of national mix, the impacts of cultural diversity on the labour market could well be relevant.

The efficiency wage literature, and in particular Shapiro and Stiglitz (1984), prompts another possible route through which immigration may have impacted upon the productivity of Irish workers. If it is the case that native employees felt that the arrival of a highly flexible and hard-working cohort of immigrants threatened their existing positions, those native employees may have worked harder (or shirked less, in the language of Shapiro and Stiglitz). Blanchflower and Shadforth (2009) discuss how immigration may have lead to a fear of unemployment among UK workers and how this may have depressed wage demands. However, it seems reasonable to suggest that any "fear" which native workers experienced could have led to higher output just as readily as to lower wage demands.

Dustmann et al (2008b) look to situations where there is a divergence between wages and marginal products in order to explain possible positive effects of immigration on wages. One of their scenarios, labelled "downgrading", envisages a situation in which highly skilled immigrants work in lower grade occupations and as a result have marginal products above their wages. If native workers can claim some of the surplus generated by immigrants, then positive effects of immigration on native wages become possible. As significant occupational downgrading has been observed for Ireland immigrants (Barrett et al, 2006; Barrett and Duffy, 2008), this scenario could well be relevant.

As a final note, we consider the work that has been done within Ireland on the impact of immigration on wages. Barrett et al (2002) and Barrett et al (2006) base their approaches on Borjas, Freeman and Katz (1997) and use an econometric model of the Irish labour market to simulate the impacts of immigration. Barrett et al (2002) show how immigration between 1996 and 1999 was mainly of high-skilled individuals. According to their simulation, the wages of high-skilled people fell by 4.5 percentage points as a result of immigration over that period. Barrett et al (2006) take a fuller account of the fact the immigrants are often employed in occupations below what would be predicted given their skill levels. The estimate that average wages were over 3 percent lower in Ireland in 2003 as a result of the immigration in the decade prior to that.

Echoing a point quoted above when discussing Borjas, Freeman and Katz (1997), the estimates of the impact of immigration in Barrett et al (2002) and in Barrett et al (2006) must be viewed somewhat mechanical given that they are the output of simulation exercise as opposed to direct measures of immigration impacts. In the following sections, we aim to provide direct evidence on the issue.

Section 3: Relevant features of Ireland's economy, 1999-2007

During the period 1999-2007, Ireland recorded exceptionally high rates of economic growth. The annual average growth rate was 5.7 percent, with growth peaking at 9.2 percent in 2000. The annual rate of employment growth was just under 4 percent. This meant that employment grew from 1.6 million in 1999 to 2.1 million in 2007, an increase of just over 30 percent. The rate of unemployment averaged 4.4 percent over this period and varied little around that mean, especially from 2002 onwards where the range of unemployment rates was 4.2 percent (2002) to 4.5 percent (2007).

Immigration was strong during the period. The rate of net inflow was 4.6 per thousand of resident population in 1999 but this grew to a rate of 17 per thousand in 2006. The corresponding figure for 2007, at 15.5 per thousand, represented a fall but this was still a large rate of inflow by international standards. One effect of this rate of inflow was to change dramatically the immigration share of Ireland's employees. In 1999, immigrants accounted for just 1.3 percent of Ireland's employees. By 2002, this had risen to just under 5 percent. By 2007, the share had reached 10 percent.

As noted in the Introduction, favourable economic conditions provided a significant pull factor over this period. The decision to allow full access to its labour market from the date of accession (May 2004) to the new members of the European Union added a further impetus to the inflow. But even in the years prior to 2004, the Irish government had been facilitating an increase in inflows through an expansion of it work permit programme. In 1999, 6,250 permits were either issued or renewed. By 2003, this number had increased to 47,551.

Given that our interest is in the relationship between immigration and wages, it is useful to present the trend in the economy wide wage between 1999 and 2007. Dividing the total non-agricultural wage bill, from the National Accounts, by the number of employees, we can see that nominal wages grew by 6 percent on average each year between 1999 and 2007. The year of highest growth was 2000, when nominal wages grew by 7.7 percent. But even in the year of lowest growth, 2007, wages grew by a strong 4.8 percent.

Section 4: Methodology and Data

The skills cell approach that we use to investigate the impact of immigrants on native Irish employees' earnings can be formally written as:

$$Y_{ijt} = \beta P_{ijt} + \delta X_{ijt} + \varepsilon_{ijt}$$

where Y_{ijt} represents the mean value of native Irish workers' earnings who have education i, experience j, and are observed in time period t; P_{ijt}, which is the explanatory variable of interest, captures the share of immigrants in a particular skills cell $(_{ij})$ at time $_t$[8]; X_{ijt} is a vector of fixed effects that captures the skill group's education level, work experience and the time period to which the skill group relates to; and ε_{ijt} is an error term.

[8] The immigrant share for a particular skill group is defined as: $P_{ijt} = M_{ijt} / (M_{ijt} + N_{ijt})$, where M_{ijt} measures the number of immigrants in the skill cell $(_{I,j})$ at time $_t$, and N_{ijt} gives the corresponding number of natives.

Our dependent variable (Y_{ijt}), is the mean of log hourly earnings of native employees in each skills cell and is constructed using earnings data from the 1999, 2000 and 2001 Living in Ireland Surveys and the 2004, 2005, 2006 and 2007 Survey of Income and Living Conditions (SILC).[9] Our earnings data are inflated to 2007 prices using the CSO's Consumer Price Index. Furthermore, we restrict our sample to the working age population (16 to 64 years of age), we exclude self-employed individuals and those in full-time education.[10]

Our immigrant share variable (P_{ijt}) was derived using immigration data from the Quarterly National Household Survey (QNHS)[11] for the years 1999 to 2001 and 2004 to 2007 (Q2)[12]. In this study, an immigrant is defined as an individual that was not born in Ireland and has been living in the country for between one and ten years.

In this approach, dividing the labour market up into separate education-experience cells is motivated by the fact that workers with similar characteristics compete with each other in the labour market. However, recent research has shown that this particular partition may not be appropriate for a country like Ireland. Barrett, Bergin and Duffy (2006) find that although immigrants in Ireland have a higher level of educational attainment than natives they have a similar level of occupational attainment. A similar result has been found for immigrants in the UK (see Drinkwater et al. (2008)). In addition, Barrett and Duffy (2008) find that this situation does not improve with length of residence in Ireland. Therefore, it may be the case that

[9] The Living in Ireland Survey was an annual survey conducted by the Economic and Social Research Institute (ESRI). It gathered information for individuals and households on a wide range of topics such as demographic and employment characteristics, education, health, etc. The Living in Ireland Survey formed the Irish component of the European Community Household Panel (ECHP). The same set of households and individuals were interviewed each year in which the survey was conducted, which was from 1994 to 2001. The SILC is also an annual survey, carried out by the Central Statistics Office (CSO), which gathers information on similar subject matter to the Living in Ireland Survey.

[10] Irish nationals not born in Ireland are also excluded from the analysis.

[11] The QNHS, which is a nationwide survey of households in Ireland, produces quarterly labour force estimates. Information is collected continuously throughout the year, with 3,000 households surveyed each week to give a total sample of 39,000 households in each quarter. Households participate in the survey for five consecutive quarters.

[12] The QNHS offers one of the few large-scale surveys of immigrants in Ireland but it is also known that the survey undercounts the number of immigrants. This undercount may cause concern of non-representativeness in using QNHS data to analyse immigration issues. Furthermore, as the survey is only administered in English, there might be an additional concern that low-skilled immigrants are disproportionally omitted from the QNHS. However, research by Barrett and Kelly (2008) shows that the QNHS provides a reliable profile of Ireland's immigrants. In addition, they found that the QNHS over-estimates the proportion of low-skilled immigrants, which means that work based on this survey may slightly under-estimate the full contribution of immigration to the Irish economy.

immigrants compete with natives within particular occupation-experience groups in the labour market rather than within particular education-experience groups. Hence, it may be more appropriate to conduct the analysis using occupation-experience-time period cells.

Given the education-occupation mismatch issue described above, we construct two separate skill group datasets to investigate the impact of immigration on native Irish workers earnings. The first is based on educational attainment and work experience, while the second uses occupation combined with work experience to sort workers into different skill groups. For our education analysis, we define five distinct education categories: i) primary-level or less, ii) secondary-level, iii) post-secondary, iv) certificate or diploma, and v) degree or higher. We also classify five experience groupings, which we proxy using age due to the absence of an actual work experience measure in the datasets employed[13]. The five experience categories are as follows: i) aged 16-24, ii) aged 25-34, iii) aged 35-44, iv) aged 45-54, and v) aged 55-64. We have seven calendar years, which gives rise to 175 skill cells for our education analysis. In terms of our occupation skill cells dataset, we distinguish five occupations: i) professional and manager, ii) clerical, iii) services, iv) skilled, and v) elementary. The five experience categories used in the education analysis are employed here as well, along with seven calendar years, which results in 175 observations for our occupation analysis.

The five panels in Figure 1 plot the immigrant shares associated with our educational attainment skill groups for 1999 to 2001 and 2004 to 2007, while the panels in Figure 2 give a break down of the immigrant shares by occupation. The first point to note from Figures 1 and 2 is that there is significant variation in the immigrant share, both within and across the different education and occupation categories. Secondly, we can see that the biggest immigrant supply shocks took place in more recent years, specifically since EU enlargement in 2004, and that these shocks consisted mainly of immigrants with low levels of work experience (aged 25-34). Since 2004, the education skill group that has experienced the biggest immigrant supply shock is aged 25-34/Primary or less. In 2004, immigrants made up only 5 per cent of this skill

[13] We are unable to construct a potential experience measure as the age information that is contained in the datasets used in the paper is banded (e.g. 15-24, 25-34, etc.).

cell but by 2007 this had increased to almost 25 per cent. The other education skill group with the largest proportion of immigrants in 2007 is those aged 25-34 with a degree or higher (22 per cent). In relation to the occupation skill cells (Figure 2), since EU enlargement the biggest immigrant supply shock has been felt by those aged 25-34 in elementary occupations. This cell consisted of only 8 per cent of immigrants in 2004 but by 2007 the share of immigrants had risen to 34 per cent. Natives aged 25-34 in services and skilled occupations have also experienced significant immigrant supply shocks since 2004.

<Figures 1 and 2 Here>

Table 1 presents the real hourly earnings of native employees for the education skill groups, while Table 2 gives the breakdown for the occupation cells. As with the immigrant share, there is a considerable variation in the natives' earnings for both the education and occupation skill cells. In relation to the education skill groups (Table 1), almost all the defined cells have experienced some growth in their real hourly earnings between 1999 and 2007. The main exception to this, however, is the group aged 16-24 with primary education. This category's hourly wages grew up to 2004 but since this they have declined. Natives aged 25-34 with post-secondary education experienced the largest growth in hourly earnings over the time period analysed, with their earnings increasing from €11.70 in 1999 to €16.40 in 2007. In relation to the occupation groups, the hourly earnings of all the categories grew between 1999 and 2007. However, certain groups appear to have experienced a moderation in their earnings growth from 2004 onwards, for example, those aged 25-34 in skilled occupations.

<Tables 1 and 2 Here>

Section 5: Results

5.1: OLS Results

We begin by presenting results from OLS regressions but below we conduct additional analyses which deal with the standard endogeneity issue which characterises studies of this type. Table 3 reports the results from an OLS regression where the dependent variable is the mean log real hourly wage for a native education-

experience group at a particular point in time. As expected, higher levels of educational attainment and additional years of work experience have a positive effect on native earnings. In addition, the year controls, intended to capture factors that affect all groups of workers but that change over time, have a positive impact. The key variable of interest is the immigrant share variable. The estimated coefficient is negative, implying that an increase in the immigrant share has a dampening effect on wages, but the coefficient is not statistically different from zero. This result implies that an increase in the share of immigrants does not affect the labour market earnings of natives.

<Table 3 Here>

Table 4 reports the estimated coefficient on the immigrant share variable when additional controls are included in the model. In the first specification, we include an interaction term between education and experience to allow for the possibility that the effect of experience on wages may differ across education groups. The second specification allows for an interaction between education and time as the returns to education may have changed over the time period and the third specification includes an experience and time interaction. Finally, the fourth specification includes all three sets of interactions. In each case, the estimated coefficient on the immigrant share variable remains insignificant and the estimate is negative in each specification apart from the one that just includes the education and experience interaction.

<Table 4 Here>

Table 5 shows the regression results where the dependent variable is the mean log real hourly wage for a native occupation-experience group at a particular point in time. As before, the results indicate that the wages of natives vary positively with years of experience and over the time period considered in this paper. In addition, native workers with lower occupational attainment earn less than those with higher occupational attainment. The regression results also show that the estimated coefficient associated with the main variable of interest, the immigrant share variable, is positive and highly significant. This implies that the inflow of immigrants has

served to increase the wages of native workers[14]. This finding of a positive effect of immigration on outcomes for natives is in line with the results of Ottaviano and Peri (2006a) and Dustmann et al (2008b).

<Table 5 Here>

The estimated coefficient on the immigrant share variable is somewhat difficult to interpret; it is easier to do so if we convert it to an elasticity that gives the percent change in hourly wages associated with a percent change in employment. Following Borjas (2003), the wage elasticity is calculated as follows:

$$\frac{\partial \log w_{ist}}{\partial m_{ist}} = \frac{\beta}{(1 + m_{ist})^2}$$

Where m_{ijt} is the percentage increase of group (ist) due to immigration.[15] Over the time period we consider, the average immigrant share is 5.01 per cent so multiplying the estimated coefficient on the immigrant share variable by 0.907 yields a wage elasticity of 0.67. This implies that a 10 percent increase in the proportion of immigrants in a particular occupation-experience group is associated with a 6.7 per cent increase in native wages.

We also include interaction terms between occupation and experience, occupation and time and experience and time. As before, we include each interaction term separately with the controls for occupation, experience and time and all together with the controls for occupation, experience and time. In each case, the estimated coefficient on the immigrant share variable remains positive and significant (see Table 6).

< Table 6 Here>

5.2: Controlling for Endogeneity

[14] Figure A1 in the Appendix plots the immigrant share against the earnings of natives and the Figure indicates that there are no outliers in the dataset that could be driving the result. Figure A2 graphs native earnings and immigrant share by education-experience cells.

[15] Note the immigrant share approximates $\log m_{ist}$.

An important consideration to take into account is the fact that immigrants may have endogeneously chosen to locate in Ireland due to the very favourable economic conditions that prevailed over the time period under consideration. This may have led to a spurious positive correlation between immigrant shares and wages in the occupation-based analysis. Following Goldin (1994), if the decision of immigrants to locate in Ireland is based on the wage level and not on anticipated increases in wages, then this endogeneity problem can be over come by estimating the regression equation in first differences. If the wage level in Ireland is the key determinant of the decision to locate in Ireland, then the change in the immigrant share will not be affected by the change in wages. Therefore any correlation between the two changes will reflect the effect of a change in immigrant share on the change in wages.

Tables 7 and 8 show the results of the differences estimation for the education-experience analysis and the occupation-experience-analysis respectively. In each specification the estimated coefficient on the immigrant share variable is negative, yet it is only significant in a few specifications. The estimated negative impact of the change in the immigrant share casts doubt on the previous results found in the occupation-experience analysis. This brings our results back into the territory summarised by Friedberg and Hunt (1995) of there being little or no impact of immigration on native wages.

<Tables 7 and 8 Here>

Instrumental variable (IV) estimation is another procedure that has been adopted in the literature to deal with the issue of endogeneity (see, for example, Altonji and Card, 1991). In order to apply this methodology, we need an instrument that is highly correlated with our endogenous immigrant share variable (P_{ijt}) but not wages (Y_{ijt}). To create such an IV we use lagged immigrant share data (P_{ijt-1}) to predict current shares (P_{ijt}) and then include this predicted immigrant share variable in our wage models as an instrument for our endogenous immigrant share variable[16].

[16] Results from the regression model used to create the IV used in this study (i.e., predicted immigrant share) are available from the authors on request.

Table 9 shows the instrumental variable regression results when we use education and experience to define our skill group, while Table 10 gives the results when occupation and experience are employed. Education, experience and year controls are included in all the specifications that are estimated in both tables. Focussing on our education results first (Table 9), we see from the base specification that our immigrant share variable is negative and significant, which suggests that the inflow of immigrants into the Irish economy has had a negative impact on native workers' hourly earnings. This result holds when education and time interactions (specification 2) and experience and time interactions (specification 3) are included separately in the regression model but not when education and experience interactions are included (specification 4) or all the interactions together (specification 5).

When we turn to our occupation results, a different picture emerges. This time we find that when we use occupation to define our skill cells that immigration emerges as having a positive and significant impact on natives' hourly wages (specification 1). This positive outcome persists in all the occupation specifications that were estimated, apart from the occupation and experience interactions model (specification 4). Hence, our results suggest that immigration tended to increase native wages when viewed along one dimension of the labour market and yet reduced wages when viewed along another dimension.

<Tables 9 and 10 Here>

Section 6: Conclusion

Our application of the Borjas (2003) approach to measuring the impact of immigration on wages in Ireland has re-produced the Borjas finding of negative wage impacts but only when we base our skill cells on education. When we repeat the analysis but use occupation as the basis for the skill cells, we find evidence of a positive impact of immigration on wages. While it might seem strange that we are finding two contradictory results using the same data, it should be remembered that the method used is not attempting to assess how the wage of the average native was affected by immigration. Instead, we are asking how average skill cells were affected. As the average education cell is not the same as the average occupation cell, contradictory results are possible, at least in principle. In order to explain the results,

we would need to think in terms of substitution effects between immigrants and native dominating in age/education cells but complementarity effects dominating in age/occupation cells.

While the contradictory results may possible in principle, and while it might be possible to produce a theory to explain them, it could also be the case that something more mundane is at work, namely, spurious correlations. If this is the case, then the lesson of the paper is that the application of this method could have led us to assert mistakenly that there was evidence of wages being reduced (increased) by immigration in Ireland if we had restricted our analysis to education (occupation). This line of reasoning suggests that care needs to be taken when applying this method, or when interpreting results, to ensure that robust results are present.

Figures

Figure 1: Immigrant Share by Educational Attainment, 1999-2001 and 2004-2007

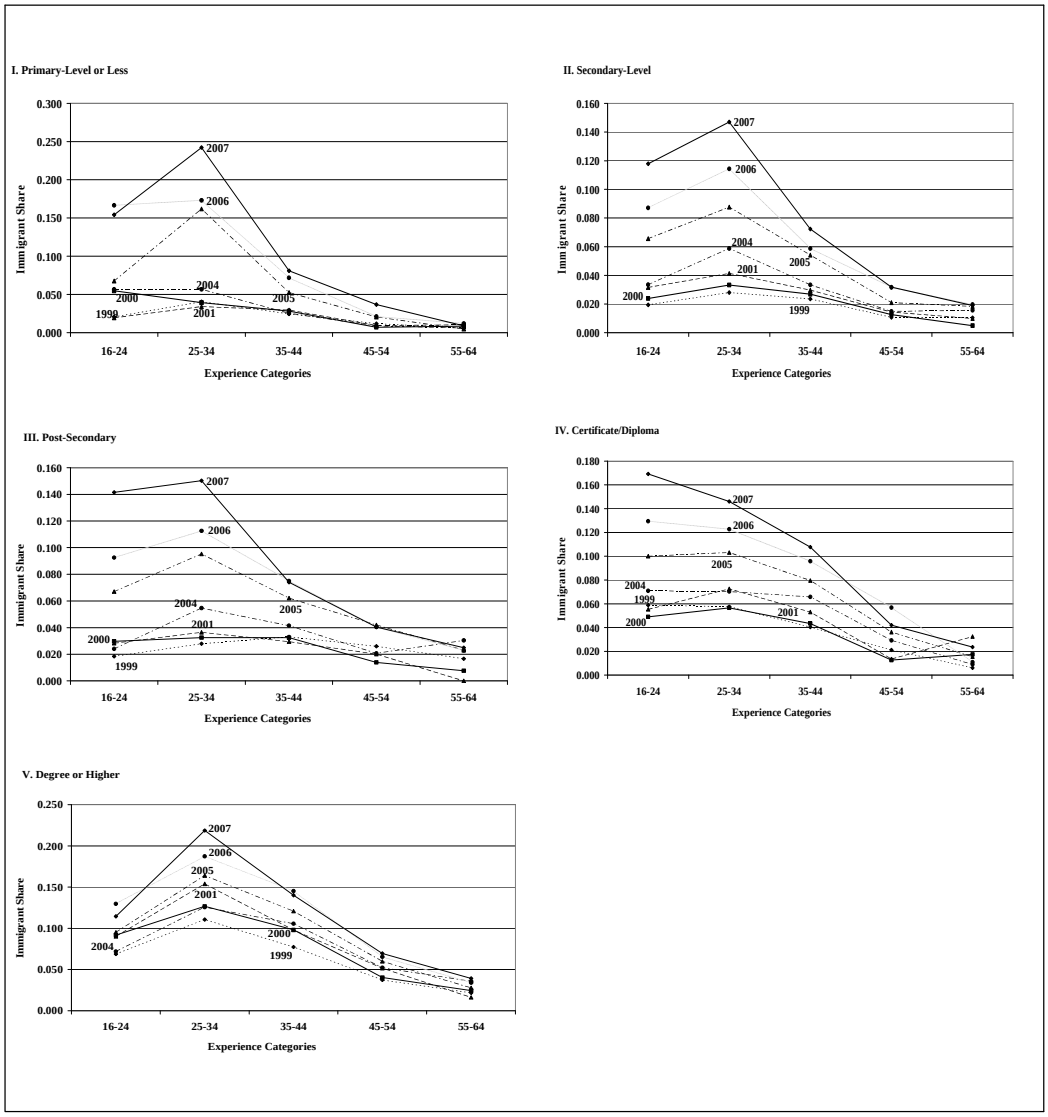
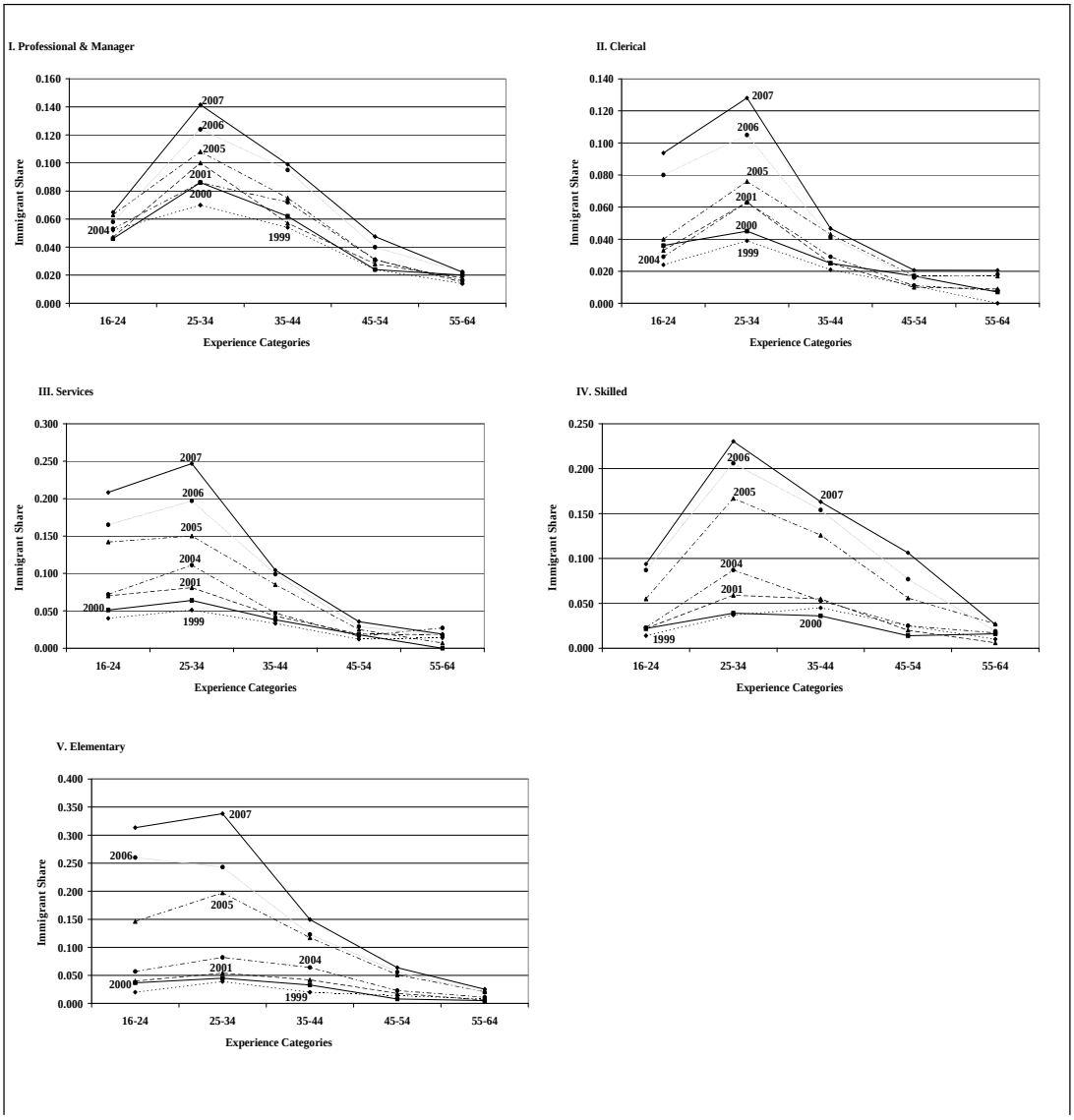


Figure 2: Immigrant Share by Occupation, 1999-2001 and 2004-2007



Tables

Table 1: Real Hourly Earnings of Native Employees by Education Experience Skill Cells, 1999-2001 and 2004-2007

	Experience Category	1999	2000	2001	2004	2005	2006	2007
Primary-Level or Less	*16-24*	11.21	6.50	8.87	11.71	9.81	9.70	9.73
	25-34	11.23	9.75	11.95	10.56	10.60	11.12	12.10
	35-44	11.08	12.55	12.70	12.85	13.45	14.79	13.11
	45-54	11.94	12.37	12.71	13.60	13.83	12.96	13.95
	55-64	14.11	13.13	13.82	12.79	13.88	14.24	14.13
Secondary-Level	*16-24*	8.39	9.25	10.43	10.60	10.70	10.56	10.43
	25-34	12.18	12.46	13.41	13.56	13.36	14.36	14.63
	35-44	14.21	14.22	15.14	16.06	16.39	16.47	16.74
	45-54	15.91	16.09	16.14	17.01	17.62	17.65	17.42
	55-64	16.85	16.34	17.07	15.65	16.93	17.73	18.19
Post-Secondary	*16-24*	9.42	10.57	11.08	12.28	11.20	13.70	11.65
	25-34	11.70	13.12	12.90	15.53	15.21	15.41	16.40
	35-44	16.60	16.56	16.09	16.47	17.96	17.15	19.57
	45-54	10.55	15.64	18.27	17.54	17.99	16.85	19.44
	55-64	45.02	18.46	12.77	17.31	17.84	17.17	17.35
Certificate/Diploma	*16-24*	12.12	10.78	12.37	12.53	12.56	13.39	11.48
	25-34	14.78	15.76	17.50	16.82	17.25	16.94	17.48
	35-44	20.99	19.49	19.20	20.24	21.37	21.22	22.84
	45-54	21.92	20.77	20.92	22.08	25.33	26.00	25.01
	55-64	26.89	22.77	24.56	24.10	24.81	25.27	24.24
Degree or Higher	*16-24*	13.07	13.98	14.04	15.02	13.48	14.94	15.53
	25-34	20.40	21.79	20.59	22.93	22.76	22.90	23.12
	35-44	31.67	27.30	30.61	30.01	30.66	31.79	31.14
	45-54	31.37	32.96	33.53	34.81	34.39	35.16	34.45
	55-64	31.35	31.94	34.38	32.59	33.79	35.73	37.18

Table 2: Real Hourly Earnings of Native Employees by Occupation Experience Skill Cells, 1999-2001 and 2004-2007

	Experience Category	1999	2000	2001	2004	2005	2006	2007
Professional & Manager	*16-24*	12.90	12.51	13.12	15.82	13.43	15.47	15.26
	25-34	18.63	19.47	19.88	21.59	21.00	21.52	22.06
	35-44	23.68	22.23	24.16	24.97	27.62	27.86	28.29
	45-54	26.19	25.68	25.80	27.88	29.45	30.61	30.69
	55-64	27.25	26.43	28.42	27.17	29.28	30.51	31.96
Clerical	*16-24*	9.30	9.99	11.60	11.47	11.40	11.14	11.05
	25-34	11.48	13.08	13.47	15.58	14.83	14.33	15.27
	35-44	13.86	14.32	15.25	16.20	16.73	17.57	18.26
	45-54	14.32	14.71	15.51	15.66	16.08	17.83	18.56
	55-64	16.89	13.51	16.51	17.02	15.57	16.04	17.52
Services	*16-24*	7.36	8.38	8.85	10.39	10.03	10.54	10.02
	25-34	10.15	10.78	11.56	13.19	13.65	13.89	13.72
	35-44	13.36	12.83	14.60	14.41	15.52	14.84	14.57
	45-54	12.19	12.58	13.11	14.10	14.44	14.86	13.14
	55-64	9.96	10.83	11.21	13.21	12.83	15.18	12.95
Skilled	*16-24*	8.70	8.94	10.61	9.86	10.43	10.53	11.06
	25-34	13.23	13.47	13.94	16.94	17.07	16.48	16.43
	35-44	14.84	14.35	16.06	17.52	18.06	20.21	20.32
	45-54	17.03	19.55	17.03	16.20	18.30	18.78	20.69
	55-64	13.51	15.27	16.52	15.28	16.67	18.17	17.66
Elementary	*16-24*	9.36	10.17	11.10	11.57	12.02	12.37	11.61
	25-34	11.48	11.65	12.81	13.60	13.63	15.09	15.00
	35-44	11.81	13.08	12.76	14.29	14.10	14.97	15.46
	45-54	11.85	12.23	14.05	14.40	14.24	14.36	14.76
	55-64	12.97	12.51	13.29	13.08	13.97	13.47	14.53

Table 3: Impact of Immigrant Share on Earnings of Natives using Education-Experience Groups*

	Coefficient	*Robust Standard Error*	*P>|Z|*
Immigrant Share	-0.438	0.434	0.32
Educational Attainment			
(Ref = Primary-Level or Less)			
Secondary-level	0.241	0.021	0.00
Post-Secondary	0.311	0.033	0.00
Certificate/Diploma	0.519	0.025	0.00
Degree or Higher	0.858	0.055	0.00
Age			
(Ref = Age 16-24)			
Age 25-34	0.307	0.042	0.00
Age 35-44	0.495	0.047	0.00
Age 45-54	0.554	0.053	0.00
Age 55-64	0.558	0.057	0.00
Year			
(Ref = 1999)			
2000	0.027	0.018	0.16
2001	0.086	0.029	0.01
2004	0.107	0.028	0.00
2005	0.137	0.029	0.00
2006	0.158	0.031	0.00
2007	0.172	0.035	0.00
Constant	1.952	0.046	0.00
Observations	175		
R-squared	0.9650		
F statistic	288.86		

* Standard errors are adjusted for clustering within education-experience cells. The regression is weighted by the sample size of the education-experience-time period cells.

Table 4: Estimated Coefficient on Immigrant Share with Additional Controls included in the Model

	Estimated Coefficient on Immigrant Share Variable	*Robust Standard Error*	*P>|Z|*
1. Education and Experience Interaction	0.182	0.202	0.38
2. Education and Time Interaction	-0.515	0.483	0.30
3. Experience and Time Interaction	-0.991	0.965	0.32
4. All Interactions	-0.178	0.456	0.70

* Standard errors are adjusted for clustering within education-experience cells. The regressions are weighted by the sample size of the education-experience-time period cells. Each regression also includes controls for education, experience and time.

Table 5: Impact of Immigrant Share on Earnings of Natives using Occupation-Experience Groups*

	Coefficient	*Robust Standard Error*	*P>|Z|*
Immigrant Share	0.735	0.203	0.00
Occupational Attainment			
(Ref = Professional & Manager)			
Clerical	-0.444	0.039	0.00
Services	-0.625	0.040	0.00
Skilled	-0.431	0.045	0.00
Elementary	-0.585	0.052	0.00
Age			
(Ref = Age 16-24)			
Age 25-34	0.257	0.059	0.00
Age 35-44	0.431	0.056	0.00
Age 45-54	0.490	0.066	0.00
Age 55-64	0.474	0.078	0.00
Year			
(Ref = 1999)			
2000	0.022	0.014	0.12
2001	0.082	0.016	0.00
2004	0.126	0.019	0.00
2005	0.130	0.016	0.00
2006	0.152	0.019	0.00
2007	0.148	0.021	0.00
Constant	2.663	0.070	0.00
Observations	175		
R-squared	0.9495		
F statistic	154.45		

* Standard errors are adjusted for clustering within occupation-experience cells. The regression is weighted by the sample size of the occupation-experience-time period cells.

Table 6: Estimated Coefficient on Immigrant Share with Additional Controls included in the Model

	Estimated Coefficient on Immigrant Share Variable	*Robust Standard Error*	*P>|Z|*
1. Occupation and Experience Interaction	0.244	0.105	0.03
2. Occupation and Time Interaction	1.166	0.251	0.00
3. Experience and Time Interaction	1.047	0.215	0.00
4. All Interactions	0.631	0.210	0.01

* Standard errors are adjusted for clustering within education-experience cells. The regressions are weighted by the sample size of the education-experience-time period cells.

Table 7: Estimates of the Impact of Change in Immigrant Share on the Change in Earnings of Natives using Education-Experience Groups*

	Estimated Coefficient on Immigrant Share Variable	*Robust Standard Error*	*P>|Z|*
1. Base Specification (No Interactions)	-0.931	0.502	0.076
2. Education and Time Interaction	-1.185	0.171	0.019
3. Experience and Time Interaction	-0.164	0.641	0.801
4. Education and Experience Interaction	-0.936	0.562	0.109
5. Base Specification and All Interactions	-0.349	0.777	0.658

* Education, experience and year controls are included in all specifications. Results on the other covariates that are included in the five different specifications are available from the authors on request.

Table 8: Estimates of the Impact of Change in Immigrant Share on the Change in Earnings of Natives using Occupation-Experience Groups*

	Estimated Coefficient on Immigrant Share Variable	*Robust Standard Error*	*P>|Z|*
1. Base Specification (No Interactions)	-0.480	0.314	0.139
2. Occupation and Time Interaction	-0.422	0.284	0.151
3. Experience and Time Interaction	-0.097	0.280	0.732
4. Occupation and Experience Interaction	-0.737	0.411	0.086
5. Base Specification and All Interactions	-0.151	0.520	0.775

* Occupation, experience and year controls are included in all specifications. Results on the other covariates that are included in the five different specifications are available from the authors on request.

Table 9: Instrument Variable Estimates of the Impact of Immigrant Share on the Earnings of Natives using Education-Experience Groups*

	Estimated Coefficient on Immigrant Share	*Implied Elasticity*	*Robust Standard Error*	*P>|Z|*
1. Base Specification (No Interactions)	-1.104	-1.001	0.487	0.033
2. Education and Time Interaction	-1.180	-1.070	0.561	0.046
3. Experience and Time Interaction	-1.775	-1.610	0.771	0.030
4. Education and Experience Interaction	0.137	0.124	0.247	0.583
5. Base Specification and All Interactions	0.319	0.289	0.476	0.509

* Education, experience and year controls are included in all specifications. Results on the other covariates that are included in the five different specifications are available from the authors on request.

Table 10: Instrument Variable Estimates of the Impact of Immigrant Share on the Earnings of Natives using Occupation-Experience Groups*

	Estimated Coefficient on Immigrant Share	*Implied Elasticity*	*Robust Standard Error*	*P>|Z|*
1. Base Specification (No Interactions)	0.548	0.497	0.210	0.015
2. Occupation and Time Interaction	0.985	0.893	0.271	0.001
3. Experience and Time Interaction	0.840	0.762	0.237	0.002
4. Occupation and Experience Interaction	0.148	0.134	0.150	0.335
5. Base Specification and All Interactions	0.696	0.631	0.341	0.053

* Education, experience and year controls are included in all specifications. Results on the other covariates that are included in the five different specifications are available from the authors on request.

Appendix

Figure A1: Log of Native Earnings and Immigrant Share by Occupation-Experience Skill Cells

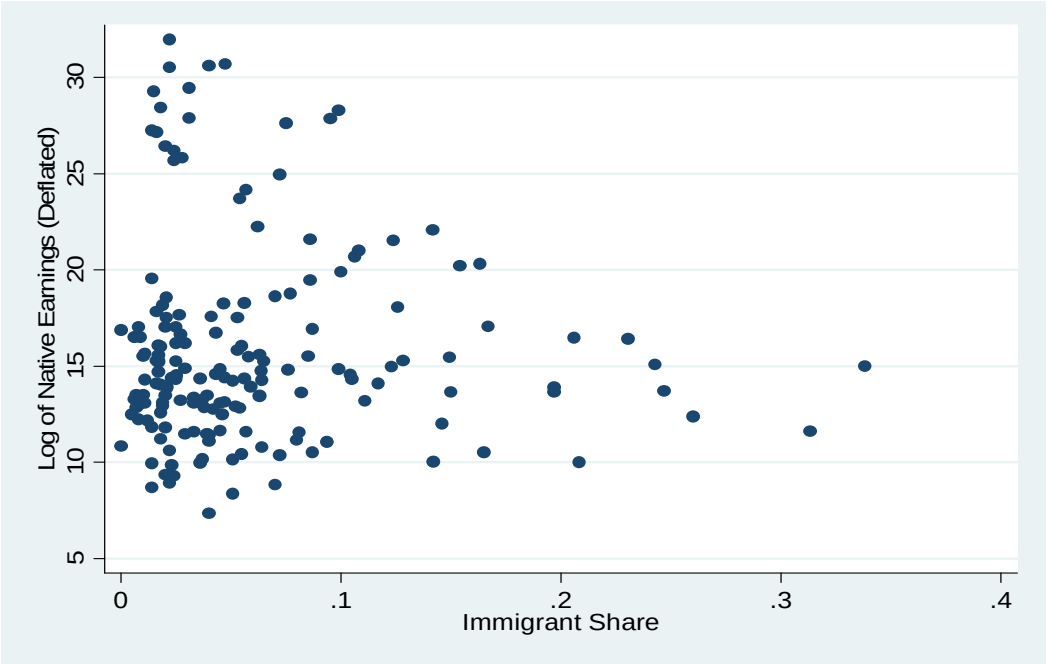
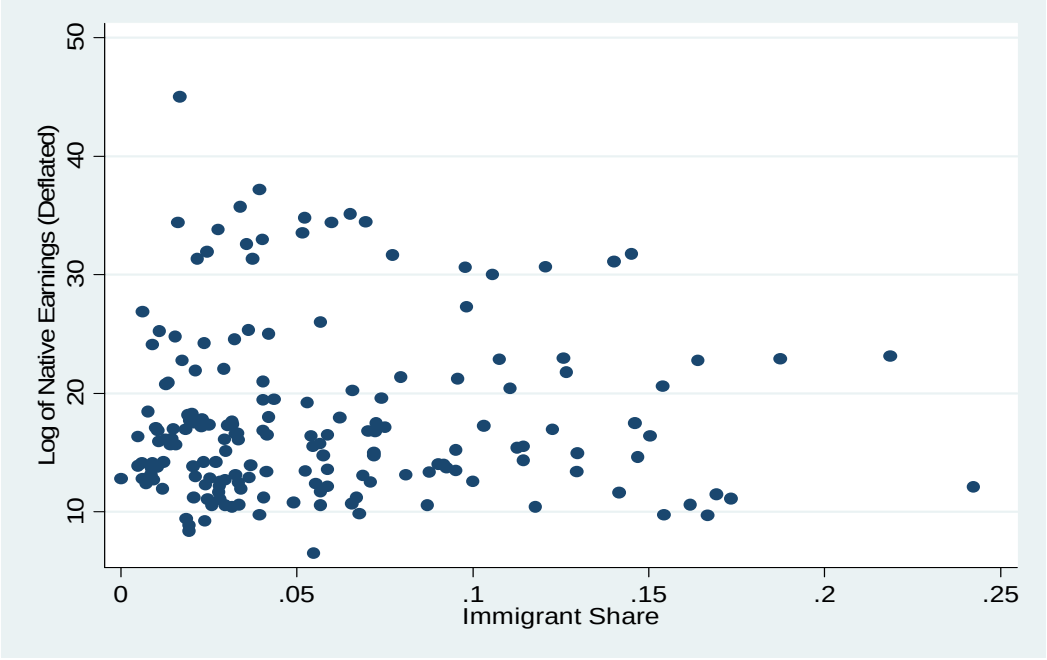


Figure A2: Log of Native Earnings and Immigrant Share by Education-Experience Skill Cells



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