Lubomira Anastassova-Chirmiciu

Essays on Social Welfare Systems, Education and Agglomeration across the EU

Dissertation

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Dissertation Committee

Doc. Ing. Štěpán Jurajda, Ph.D. (CERGE-EI; chair)

Prof. Randall K. Filer, Ph.D. (Hunter College, CUNY)

Libor Dusek, Ph.D. (CERGE-EI)

Doc. Ing. Daniel Münich, Ph.D. (CERGE-EI)

Referees

Jan Fidrmuc, Ph.D. (Brunel University, UK)

Gábor Kézdi, Ph.D. (Central European University)

To my parents for always believing…

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Abstract

The thesis focuses on three topics of interest: the difference between native and immigrant welfare receipts, returns to education due to educational mismatch between natives and the foreign-born employees, and the effects of agglomeration on earnings. The first chapter of the dissertation examines the difference in social income between natives and immigrants across a number of EU countries and the US, based on the generosity of the existing welfare systems. The findings confirm the existence of large social income gaps in favour of non - EU immigrants, and these gaps are mainly due to the fact that immigrants' families have more children, fewer earners and are more likely to have non-wage income than the natives. The second chapter compares the difference in returns to education between foreign-born and native workers in France, Germany, and Austria. Using an educational matching approach, the results show that immigrants have lower wage returns in being over-educated than natives but are penalized less for being under-educated. The third chapter focuses on the distribution of earnings across the UK from a spatial perspective, which is determined by the endogenous relationship between productivity and agglomeration or employment density. While the agglomeration effects are similar across different levels of territorial aggregation, they prove to be strongest in the Metropolitan areas of the UK.

Tato práce se zabývá následujícími třemi tématy: rozdíly mezi sociální podporou pro rodilé státní příslušníky a imigranty, výnosy ze vzdělání rodilých státních příslušníků a imigrantů a efekty aglomerace na příjmy. První kapitola disertace analyzuje rozdíly v sociálních příjmech mezi rodilými státními příslušníky a imigranty ve vybraných zemích EU a v USA, s ohledem na velkorysost stávajících sociálních systémů. Závěry potvrzují existenci značných rozdílů zvýhodňujících imigranty ze zemí mimo EU. Tyto rozdíly je možné vysvětlit zejména tím, že rodiny imigrantů mají více dětí, méně vydělávajících rodinných příslušníků a mají častěji vedlejší (nemzdové) příjmy než rodilí státní příslušníci. Druhá kapitola analyzuje rozdíly ve výnosech ze vzdělání mezi rodilými pracovníky a ostatními pracovníky ve Francii, Německu a Rakousku. Závěry založené na přístupu párování úrovně vzdělání ukazují, že imigranti mají nižší zvýšení příjmů spojené s překvalifikací a nižší snížení příjmů spojené s nedostatečnou kvalifikací. Třetí kapitola se zaměřuje na distribuci příjmů ve Spojeném království (UK), determinovanou endogenním vztahem mezi produktivitou a aglomerací nebo hustotou zaměstnanosti. Zatímco efekty aglomerace jsou podobné na různých úrovních teritoriální aglomerace, nejsilnější efekty lze nalézt v metropolitních oblastech UK.

Introduction

The first two chapters of my dissertation address issues related to differences in earnings between natives and immigrants across a number of European countries based on the generosity of welfare systems as a magnet for immigration or the existence of an educational mismatch between natives and immigrants. The third chapter also focuses on the distribution of earnings but from a spatial perspective, based on the endogenous relationship between productivity and agglomeration (employment density). The empirical analysis in all chapters is based on data from household surveys; the first two chapters use data from the Luxemburg Income Study which provides extensive information on all types of social benefits and comparable standardized data across countries, while the third chapter is based on data from the UK Office for National Statistics.

The first chapter focuses on the concept of 'welfare migration' which explains migration motivated by welfare receipt. In this paper I use comparable data from five countries - Norway, Sweden, Belgium, France and the U.S. - to ask whether immigrants benefit more from social support than natives. Looking at the European countries, distinguishing between migrants within and from outside the EU shows that within - EU migrants are similar to natives both in terms of their characteristics and social support receipt. On the other hand, I confirm the existence of large social income gaps in favour of the non - EU immigrants, and these gaps are mainly due to the fact that immigrants' families have more children, fewer earners and are more likely to have no wage income. Household characteristics play a key role in 'explaining' the gap in Scandinavian countries, while individual characteristics matter as well in Belgium and France. In contrast to the European situation, U.S. immigrants receive less social income than natives and this is attributable mainly to their different individual characteristics

The second chapter is on measuring the gap in returns to education between foreign-born and native workers in France, Germany, and Austria and investigates the extent to which this gap can be explained by a mis-match between the actual and the years of schooling typical for a given occupation. The return to usual years of schooling across different occupations is found to be higher than that for actual years of education. In the case of correctly matched workers who have the 'typical' education in a certain occupation, there is no additional reward in earnings for natives compared to foreign workers. Immigrants, however, have significantly lower wage returns in being over-educated than natives but are penalized less for being under-educated.

The third chapter examines the impact of employment density (agglomeration) on the hourly earnings of workers across districts within Great Britain. The potential two-way causality between agglomeration and productivity is addressed by using two instruments, namely, the total land area of a district and its population density. The estimated agglomeration effect is similar across different levels of territorial aggregation; however, the effect is stronger when looking only across Metropolitan areas. While the paper finds some evidence of endogeneity when the sample is split into Metropolitan and Non-Metropolitan areas, this only has a minor effect on the estimates.

Chapter 1

What Is Behind Native-Immigrant Social Income Gaps?*

Co-authored with Teodora Paligorova

1.1 Introduction

European Union enlargement fuels the debate on whether the large inflows of immigrants impose a fiscal burden on host counties[1]. Typically younger than natives, immigrants can ameliorate the negative effect of progressive aging in Europe by increasing the ratio of workers to retirees (Razin and Sadka, 2004; Facchini, Razin and Willmann, 2004). On the other hand, lower skilled migrants may be net beneficiaries of Western Europe welfare systems. In Sweden, Germany and Denmark, where immigrants account for approximately 10 percent of the total population, they receive more than 30 percent of total welfare expenditure (Wildasin, 2004). Sinn (2005) argues that migrant workers in Germany are net beneficiaries of the redistributive activities of the welfare system. To better understand how welfare generosity affects migration choices ("welfare migration") and its net impact on the state, it is important to shed light on the sources of the overall welfare gap between immigrants and natives.

The question of whether immigrants rely on welfare programs more than natives has received lots of attention in the literature. Borjas and Hilton (1996) show that immigrants draw more heavily on cash benefits than natives in the US. In the same spirit, Hansen and Lofstrom (2003) conclude that welfare payments are still

* This paper is co-authored with Teodora Paligorova. The authors are grateful to Štěpán Jurajda and Randall Filer for their helpful comments and creative ideas.

[1] Total net annual migration into the EU is close to 1 million persons during 2000-2002. The number of legal immigrants into the EU reached a peak of 1.2 million in 1992, mainly due to a large influx of refugees from former Yugoslavia. Most of the voluntary migration in recent decades is characterized by temporary labour migrants who are generally low-skilled, low-paid and depend extensively on welfare benefits (Eurostat, 2000).

higher among immigrants in Sweden even after accounting for observed characteristics. Brücker et al. (2002) estimates a probability model of welfare dependence for each of the eleven EU countries. After controlling for various observable characteristics, they find mixed evidence that immigrants are more likely to rely on welfare receipt.

One aspect of immigrants' experience that has attracted less attention is how differences in individual and household characteristics explain the social income differential between immigrants and natives. We use data from the Luxembourg Income Study (LIS) for 2000 to make a comparative analysis of the determinants of social income in four European countries known for their high immigration rates, namely France, Belgium, Sweden and Norway.[2] We also include the US as a useful benchmark given the extensive literature on welfare dependence of immigrants in that country.

First, we estimate a social income function for each country, separately for EU and non-EU migrants. We then use the Oaxaca-Blinder method to decompose the immigrant-native social income gap into two parts. One related to differences in individual and household characteristics, and the second, a "discrimination" component, that is deviations from the evaluation of observables. If there is a favour toward immigrants in welfare take-up, the gap between immigrants and natives will increase the latter component.

Our study differs from previous studies in several aspects. First, we use Luxembourg Income Study data, which provide extensive information on all types of social benefits that is comparable across countries. This allows us to conduct comparative analysis of the various factors affecting the social incomes of EU/non-EU immigrants and natives. This is valuable information given the relevance of further harmonization of national social policies across EU members (De Giorgi and Pellizzari, 2009). Second, most studies examine welfare rates focusing on only one country (e.g., Riphahn (2004), Gustafsson and Osterberg (2001), Sinn (2005)). Brücker et al. (2002) is one exception that analyses 11 European countries. Instead of estimating the probability of welfare receipt, we examine the social income

[2] Although not a member of the EU as of 2000, Norway has access to the EU internal labour market through the European Economic Area Agreement (EEA). The Agreement commits Norway to implement all EU legislation related to the internal labour market.

differential, which allows us to determine the relative position of the EU and non-EU immigrants with respect to natives in terms of their characteristics.

Third, this paper also examines differences between EU and non-EU immigrants. It is expected that immigrants from EU countries have similar characteristics to natives in the host county and thus receive similar social benefits. In addition, welfare regimes in the EU are harmonized to a larger extent than between EU and non-EU countries.[3] Non-EU immigrants, who immigrate to a certain EU country, are subject to the immigration and welfare policies of that particular country. We find that, compared to natives, non-EU immigrants are younger, live in larger families with fewer earners and have more children, while EU immigrants similar to natives. The social income gaps between the non-EU migrants and natives are substantially larger than those among natives and within-EU migrants.

Our decomposition results show that a substantial part of the gap in Sweden, Norway, Belgium and France is due to the fact that non-EU immigrants live in families with fewer earners, have more children, and are more likely not to have any labour income. In addition to household characteristics, individual characteristics of immigrants such as age, gender and education play an important role in explaining the differentials in Belgium and France. Consistent with previous evidence, the US provides higher social income to natives mainly due to differences in individual characteristics.

The magnitude of the "unexplained" portion of the social income differential varies across countries. One interpretation is that EU states prefer non-EU immigrants compared to natives when distributing social benefits, all other things equal. For example Brücker et al. (2002) suggest that the unexplained portion may arise from the choice of immigrants to live in a country with generous welfare benefits based on some unobserved factor, or it may be that language problems make immigrants more reliant on welfare. Whatever the reason for the 'unexplained" social income differential, it highlights that the heterogeneity of welfare provision across EU countries is still present.

[3] Since the Maastricht Treaty (1992), the European Union guarantees free movement of people within its borders and according to a proposal by the European Commission, all workers with EU citizenship are "entitled to the full social security benefits of whatever EU country they are employed in and these benefits would be transferred from one member state to another in case the worker moved" (COM, 2003/596).

The benefit of reducing such heterogeneity is highlighted by Giorgi and Pellizzari (2009) who find that welfare driven migration may offset the potential benefits of migration flows. Assumed to be more mobile than natives, if migrants choose locations based only on high wages and high employment probabilities their migration decisions will mitigate the effect of labor demand shocks. However, if they prefer a country also because of its welfare generosity, decisions may not counterbalance labor demand shocks.

1.2 Legal Developments in the EU concerning Mobility and Immigration and Literature Review

The Treaty of Amsterdam 1999, which covers wide range of EU issues such as the policy on asylum, visa policy, the free movement of persons, rules on crossing EU external borders, immigration policy, the rights of nationals of third countries, is a symbol of the steps toward common asylum and immigration policy of the European Union. Since then, various regulations by the Commission, the Council and the Court of Justice have strengthened even further the basis of the Amsterdam treaty (EUROSTAT, 2002). The European Employment Strategy focused on facilitating labour mobility within the EU and providing access to lifelong earnings.[4] The Stockholm European Council in 2001 enhanced also mobility by endorsing the strategy to foster the development of the New European Labour Markets.[5] In the field of social security there have been several initiatives in order to improve coordination and provide more opportunities for workers and job seekers to make use of their right to free movement. The new European Strategy to promote social inclusion emerged naturally due to the National Action Plans of several member states which feared the higher risk of social exclusion for ethnic minorities and immigrants due to the growing ethnic and cultural diversities in the EU.[6]

In line with conclusions of the Tampere European Council (October 1999), the Commission proposed a co-ordinated approach on how to manage the migration flows and fight illegal immigration. This has been followed by various integration and anti-

[4] Guidelines For Member States Employment Policies for the year 2002 - COM(2001) 511.
[5] New European Labour Market: Open to All with Access to All - COM(2001) 116.
[6] Joint Inclusion Report by the Council and the Commission, adopted by the Council on 3/12/2001.

discrimination policies in the host countries which called for equal treatment irrespective of ethnic or race origin.[7] Within the European regulations, a key distinction is currently being made between individuals who migrate from within the EU and third country immigrants. While the EU migrant workers have the same rights and obligations as the host country nationals with respect to the social security (Kvist, 2004), third country migrants are clearly a different category despite all the co-ordination regulations in immigration and asylum policies (Cohen and Razin, 2008).[8]

The question of whether immigrants rely more on welfare than natives has received lots of attention in the literature. Enchautegui (1997) finds a positive correlation between welfare and migration in the United Sates. This premise is supported by a range of studies on U.S. data such as those by Blau (1984), Borjas and Trejo (1991), Borjas and Hilton (1996), and Hu (1998). Borjas and Hilton (1996) document the extent to which immigrants participate in welfare programs. They suggest the existence of a large 'welfare gap'. U.S. immigrants experience more and longer unemployment spells, and there is a positive correlation between the types of welfare benefits received by earlier immigrants and those obtained by recently arrived immigrants.

Siklos and Marr (1998) find that immigrants in Canada are more likely to receive social benefits, while according to Baker and Benjamin (1995) it is the local population who benefits primarily from the social welfare system. Gustman and Steinmeir (1998) conclude that immigrants receive much higher social benefits relative to US born workers with identical earnings but these transfers do not result from low incomes of immigrants. The immigrants with high earnings who have been working in the US for up to two decades are found to benefit the most from public transfers. Although, foreign born workers have a higher return to their social security taxes, US born workers still prefer that immigrants participate in the social security program since the retired immigrants contribute more to social security taxes in comparison to the amount of the received benefits.

There is also literature on the incidence of welfare take-ups in the EU. Brücker et al. (2002) use the European Community Household Panel (ECHP) for the period

[7] Implementation of the principle of equal treatment between persons irrespective of race or ethnic origin. Directive 2000/43/EC.

[8] EU migrants can transfer benefits, eligibility periods at different times can be aggregated, the setting of benefits could be accumulated on the basis of time spent in the host country. Council Regulation 1408/71.

1994-2006 to examine the differences in the rate of welfare dependency between natives and non-EU immigrants. They find that even after controlling for individual characteristics the "immigrant effect" still remains.

Bird et al. (1999) use data from the German Socio-Economic Panel Study (GSOEP) to test whether immigrants in Germany, given their eligibility, are more likely to claim welfare benefits than natives. The authors find positive evidence of immigrants receiving more welfare benefits in comparison to natives mainly because of two reasons: first, there is a higher probability of immigrants being eligible to receive benefits, and second, the immigrants who are eligible are more likely to actually claim these benefits.

Riphahn (1998) who focuses on the higher welfare dependence of immigrants in Germany using the German Socio-Economic Panel, finds that the difference in aggregate welfare dependence between natives and foreigners appears to be due to their characteristics, where the household head's labour market status and single parent status are central. Castranova et al. (2001) examine whether German immigrants are more likely to receive benefits conditional on eligibility. They find that they are not more likely to take up welfare than natives conditional on eligibility; however, they are more likely to be eligible. Büchel and Frick (2003) compare the immigrants' pre-tax to after tax labour income across eight European Union countries using the European Household Panel Survey. They find persistent differences across the examined countries in the relative economic performance (gross income) of immigrants in comparison to the local population. The authors explain this heterogeneity both by the variation of entry conditions to the EU and country-specific institutional aspects.

There is growing literature on whether difference in welfare regimes lead to differences in the nature of the immigrant inflow across countries. De Giorgi and Pellizzari (2009) discuss the role of generous welfare transfers in attracting migrants and explore the issue of welfare migration across the countries of the pre-enlargement European Union. Their empirical analysis is based on data from the European Community Household panel (ECHP) and the OECD data-base on benefit entitlements and replacement rates, which shows that migrants decide which country to migrate to based, among other factors, on the generosity of the welfare systems across host-countries. Despite the significant but small effect of the generosity of

welfare on migration decisions, this effect is still large enough to distort the distribution of migration flows.

Cohen and Razin (2008) analyze the effect of the generosity of the welfare state on the skill composition of immigrants. The authors develop a model in which higher generosity (and taxes) of the welfare state worsens the skill composition of immigrants under free migration. In particular it attracts more unskilled migrants who tend to benefit more from the welfare system than spend on taxes and deters skilled immigrants who contribute in taxes more than in benefits. However, once the migration is controlled by a policy, there is a positive impact of generous welfare systems on the skills composition of migrants. Thus, skilled migrants who are net contributors to the welfare state, can help finance a more generous welfare-state system and are preferred by the policy maker over unskilled migrants. The authors test their hypothesis on a cross-sectional data on source-host, OECD-EU country pairs for the year 2000. They split the sample into two groups: a "free migration" group, source-host country pairs within the EU, and "policy-controlled migration" group, the pairs from non-EU countries into the EU. The findings support of the predictions of the model, that the countries with more generous welfare systems attract higher proportions of unskilled migrants in case of free migration but encourage skilled migration in case of controlled migration.

1.3 The Data

We use the Luxembourg Income Study (LIS).[9] The LIS is a micro-database collected from a large range of industrialized countries. It provides demographic, labour market, income and expenditure data, both at the household and individual level. At the household level, the LIS includes such demographic variables as age, marital status, number of income earners in a family, number of children, education, ethnicity, migration status, labour force status, etc. Income variables contain gross income, disposable income and a detailed classification of social income. This classification is appropriate for our analysis of the determinants of immigrant social income since we can examine directly the types of benefits that both natives and immigrants receive. The database covers twenty-nine countries and its main objective is to provide comparable data that can be considered as a reliable source of cross-country analysis.

[9] Available at www.lisproject.org

The advantage of the LIS is that it provides similar data based on household labour force surveys across countries, by transforming the original data files into a harmonized LIS data format that contains the same set of standardized variables for each country. This allows us to compare the social income of immigrants and natives within each country of analysis on one hand, and the effect of household and individual characteristics on social income across counties on the other hand.

In our study we include Norway, Sweden, Belgium, France and the USA for the year 2000.[10] The choice of countries was determined by the existing welfare regimes as described by Esping-Andersen (1990) where the level of generosity of social support varies based on differences among the socio-democratic, corporatist and liberal welfare systems. We tried to represent each of these systems subject to data availability and consistency concerns. Norway and Sweden belong to the generous socio-democratic system, Belgium and France are corporate states which favour the main bread-earner in the family, while the USA is a liberal state with minimal social support.

We employ annual cross-sectional data for each of these five countries. The unit of analysis is an individual in the household context, since some welfare benefits are reported only at the household level (particularly those related to means-tested cash benefits like housing subsidies, social assistance, unemployment assistance and near cash benefits such as food benefits, housing benefits, cash medical benefits, heating benefits, etc.).[11] An important assumption made in our study, similar to other studies e.g. Buchel and Frick (2003), is that families pool resources and share the utility of income, derived partly because of the 'family' status. Thus, although we analyze social income at the individual level, income information in the LIS is provided at the household level. In order to normalize the gross social income variable, we employ an equivalence scale which takes the square root of the total size of the family.[12] One of the family members is called by the LIS the 'head' of the

[10] Data on immigration status is missing or inconsistent for the Netherlands, United Kingdom, Germany, Denmark and Italy; the total number of immigrants is too small for Austria (95) and Ireland (58). Thus these countries are excluded from the study.

[11] The analysis includes households that receive only social income and those who receive both social and wage income.

[12] We also applied the modified OECD equivalence scale, which gives weights of 1.0 to the head, 0.5 to other adult member, and 0.3 to children. The results were not significantly different.

family or the main bread-winner in the family.[13] The analysis is based on individuals of working age.

The LIS provides the variable 'immigrant status' which shows whether an individual is foreign-born or born in the host country. Buchel and Frick (2003) point out that defining immigrants as foreign-born is more appropriate than using a citizen-based immigration definition since it avoids the differences in country-specific citizenship legislation. Borjas and Hilton (1996), Shields and Price (1998) and Bell (1997) also employ this definition of immigrant status. However, the definition of the immigrant status does not provide information on the country of origin. That is why we use 'ethnicity' status in our analysis, which defines the country of origin and allows us to make a clear distinction between EU and non-EU migrants.[14] The LIS does not offer information on the number of years since migrants' arrival in the host country which is a weak point. However, in our analysis we consider families who receive social income support, which indicates that the head of the family has spent at least 2 or 3 years in the host country (depending on eligibility criteria in different countries).

The variable social income requires a clear definition since there is no harmonized social system across the EU and each country is free to define differently the eligibility criteria and the components of its social protection program.[15] The social income variable provided by the LIS and used in our study includes all possible types of social expenditure by the government (social retirement benefits, child and family benefits, unemployment compensation, sick pay, accident pay, disability pay, maternity pay, means-tested cash benefits, near-cash benefits, etc.) apart from pensions and labour income. In our paper we use gross social income since in some countries benefits are taxed and in others they are not (Cornelisse and Goudswaard, 2002).

[13] In most of the countries a large majority of the heads of households are male. Therefore, the results are similar to those received when male heads are considered only. However, the sample is not split between male and female heads since the observations for female migrant heads are too low across most countries.

[14] We compare to what extent the variables immigrant status and ethnicity overlap for each country. We find that for all countries the number of foreign-born is the same as the number of individuals assigned with ethnicity different than that of natives.

[15] Benefits may be provided by public and /or market institutions. Still market provisions could be regulated by the government so that they are equivalent to public provision.

1.4 Descriptive Analysis

1.4.1 Raw Social Income Gaps

Table 1 summarizes the average social income of the family head (in US dollars - base year 2000) for the EU, non-EU migrants and natives. It is constructed by adjusting the annual household social income with the household size using the equivalence scale specified earlier. On average Sweden turns out to be the country with the highest social income expenditure with respect to all the groups (EU, non-EU immigrants and natives) in the sample, followed by Belgium, France, Norway and the US.[16] We test whether the social income gaps between the EU/non-EU migrants and natives are significantly different from zero, since their existence would allow us to explore further how certain socio-economic individual and family characteristics could explain these differentials. The table shows that for all the countries, the gap between the non-EU migrants and natives is highly significant and is in favour of the migrants except for USA where natives receive higher social income than immigrants. Belgium, Sweden and the US exhibit a large social income gap of 50%, decreases to 36% in the case of France and falls to 30% in Norway. The welfare gap in the US is 52 % in favour of natives.

The social income gap between non-EU immigrants and natives is substantially larger than that between EU migrants and natives. The latter is significant only in Sweden and Norway and represents 22% and 9% in favour of immigrants respectively. The existence of large disparities between the social support for immigrants (especially non-EU ones) and natives poses the relevant question of what determines the existence of these gaps, and to what extent the individual and family characteristics of the immigrants and natives could shed light on this phenomenon.

1.4.2 Household and Individual Characteristics

Table 2 shows the average demographic characteristics for natives, EU immigrants and non- EU immigrants in all countries. The table confirms the differences in

[16] We do not consider EU/Non-EU migrants in the US.

personal and household characteristics that other researchers have documented (Borjas 1995; Buchel and Frick, 2003; SOPEMI, 2001): compared to natives, immigrants are on average younger, live in larger families, have more children and fewer income earners in the family. While previous studies confirm this tendency for immigrants in general, we observe that it holds mainly for the non-EU immigrants, while the EU immigrants exhibit characteristics similar to these of natives. In all countries subject to analysis, non-EU immigrants are younger on average than natives (for USA all migrants are in one group). This is not the case for the EU immigrants though, since in Sweden, Belgium and France they are only slightly older than the locals (the difference is less than a year on average except in France) and thus share similar age structure with natives.

Comparing the household size, we find a similar tendency. The non-EU immigrants have larger families than both the natives and the EU immigrants. The average non-EU immigrant family consists of four members with the exception of the US where the family usually incorporates five persons. On average the non-EU families have fewer earners than natives for all counties. France records the lowest number of earners (1.21), while USA and Norway have the highest (1.97 and 1.8 respectively). The tendency of fewer earners in the non-EU immigrants' family increases its chances for receiving higher social income. Similarly to previous studies (Borjas, 1995; Hu, 1998), we assume that the number of earners in a family explains a substantial part of the social income variation. Another factor that influences the family social income is the number of children in a family (Buchel and Frick, 2003; Borjas and Hilton, 1996). For all the countries the non-EU immigrants have on average more children than locals and the EU migrants. We expect that the number of children is positively related to the social income.

The analysis so far reveals two important patterns. Firstly, our descriptive results confirm the existing research studies with respect to the characteristics of the non-EU immigrants (Borjas, 1995; Buchel and Frick, 2003; SOPEMI, 2001), they are younger, live in bigger families with fewer earners and have more children, while the EU immigrants seem to be similar to natives. Secondly, the non-EU immigrants and locals differ in their relative social incomes across the welfare regimes in all the countries. The social income gaps between the non-EU migrants and natives are substantially larger than those between natives and the EU movers.

The current migration literature has paid little attention to the social income of EU and non-EU immigrants in the Union. We presume that the differences in the social income gaps between EU/non-EU immigrants and natives are to a large extent due to different immigration legislation with respect to EU and non-EU migrants across different countries. The distinction between EU and non-EU immigrants is an important one, since it would allow us to analyze the social income gaps between the non-EU immigrants and natives excluding the effect of the EU migrants who share similar characteristics with the natives.

1.5 Estimation Methodology

We perform an OLS regression analysis that allows us to ask to what extent social income is 'explained' in each country, and to compare the social income impact of each of the explanatory variables. We consider two separate samples namely the EU immigrants and natives on one hand, and the non-EU immigrants and natives on the other hand. In order to distinguish between household and individual characteristics and see to what extent family characteristics contribute towards explaining the social income gap, we estimate two different specifications. The first one includes only the household specifics, while the second one accounts for all the characteristics simultaneously. The general form of the regression equation is the following:

$$\begin{aligned} LnY_i = {} & \alpha_0 + \beta_0 ImmigrantStatus_i + \beta_1 Age_i + \beta_2 Age_i^2 + \beta_3 Gender_i + \\ & + \beta_4 Education_i + \beta_5 NoWageIncome_i + \beta_6 Earners_i + \\ & + \beta_7 Children_i + \beta_8 Region_i + \varepsilon_i \end{aligned}$$

where *i* indicates the EU or non-EU immigrant status. *LnY* is the social income, *Immigrant Status* is a dummy variable, which equals to one in case of immigrant and zero in case of native status. Since EU and non-EU immigrants are treated differently by the host country (law restrictions such as residence, work permits, etc.), we consider two separate decompositions: non-EU/natives and EU/natives.[17] As non-EU immigrants have characteristics that are likely to call for

[17] The Chow test rejects the null hypothesis of similar coefficients between regressions that include EU and non-EU migrants at 5% confidence level, which justifies the split of the regressions. Furthermore,

higher social income than the natives and the EU immigrants (see Table 2), we expect that the size of the social income differential between natives and non-EU immigrants to be larger than that between the EU immigrants and natives.

The explanatory variables *Age*, *Earners* and *Children* are linear variables which can be attributed to immigrants or natives depending on the specification. *Education* is a set of dummy variables, which takes the value of one when the head of the family has a college or university degree. *No Wage* dummy is an indicator variable that equals to one if the whole household has zero average gross wage income and zero otherwise[18]. *Gender* is an indicator variable-one for male and zero for female. The *Region* dummies account for regional specificities across countries. The dependent variables are measured in PPP-adjusted U.S. dollars[19] and are transformed logarithmically. We include the age of the head of the family together with the age squared as a regressor in the social income equation in order to control for experience even though we acknowledge that this is not a precise measure.[20] Assuming that the age of the head is positively correlated with the number of children, controlling for age serves as an insurance against omitted variable bias. The education variable serves as a proxy for the ability of the head of the family.

We are aware that the exogeneity of the number of earners and the number of children in the regression equation may be violated for at least two reasons: there may be unobserved factors that affect social income propensities and at the same time, social income take-up and fertility decisions may be simultaneously determined. We therefore regard our approach more as a correlation analysis rather than as a causal one.

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we want to estimate the effect of individual and other characteristics on social income separately for EU/non-EU because we expect different sensitivities due to differences in immigration law and benefit eligibility.

[18] In the study we assume that the welfare regime does not affect the choice of employment. Rather, we want to analyze how the welfare state 'rewards' the household in the case all its members are unemployed compared to their employed counterparts. Specifically we run probit regressions of the choice to work or not on the social income and social-economic characteristics. We document that social income' coefficient estimates are not significant.

[19] OECD Purchasing Power Parities.

[20] We could use the popular approximation for experience, however, the LIS household data does not include years of education.

1.6 Regression Analysis

1.6.1 The Role of Non-EU Immigrant Status

The dependent variable of all the regressions in Table 3 is the logarithm of the social income of the non-EU immigrants and natives. In the first specification for each country we explore the change in the existing gap due to different household characteristics. In Sweden the raw gap of 50% is reduced to 18% after including the household variables, which suggests that around 36 percentage points of the gap could be due to the fact that the immigrants have fewer earners, more children and are more likely to have no wage income in the family. Belgium exhibits very similar pattern to Sweden and we can see that the family characteristics contribute for closing the social income gap from 52% to 24%. In Norway the impact of the household structure is less pronounced than in Sweden and Belgium. At most a fifth of the 30% gap or only 6% points can be explained by the household characteristics. Shifting our attention to one of the largest economies in the EU, we find that the gap between non-EU immigrants and natives in France has decreased to 23% and therefore household and individual characteristics explain more than half of the social income gap. In the US the natives take higher level of social benefits although immigrant families have more children but surprisingly they have more earners in a family than the natives. The 52% of social income gap is reduced by only 8 percentage points due to the differences in family structure.

The second specification in Table 3 controls simultaneously for the individual and household characteristics. In Sweden and Norway the gap increases slightly after controlling for age, gender and education of the family head, suggesting that the non-EU immigrants' characteristics are not that relevant for receiving higher social income. In Belgium and France the tendency is the opposite, namely that after adding the individual specifics, the unexplained gap is reduced from 24% to 19% in case of Belgium and from 23% to 20% for France. In the US despite the fact that the gap falls from 44% to 30% when accounting for individual characteristics, the natives still take more social income than immigrants.

Overall, in all the countries the household variables prove to be important in explaining the social income differential between non-EU immigrants and natives. It

seems that a substantial part of the gap in Sweden, Norway, France and Belgium is due to the fact that non-EU immigrants live in families with less earners, have more children and are more likely not to have any labour income. The individual characteristics are equally important in Belgium and France and of vital importance for USA where individuals support their families based on their own merits.

1.6.2 The Role of EU Immigrant Status

It is worth noting that the raw social income gap between the EU immigrants and natives is much smaller than the non-EU/natives' one. In fact, the gap in Belgium and France is not significant. This tendency could be explained by the similarity of the household structure between natives and the EU immigrants. We perform similar estimation of the gap by control- ling first for household variables and then adding the individual characteristics. Table 4 shows the results. Approximately half of the gap in Sweden, or 9 percentage points, can be accounted for by the higher number of children and less earners in EU migrants' families than those in local ones. The age, education and gender of the head do not help much to explain the gap. In Norway, both specifications have very small impact on the EU/natives gap since they reduce it by only one percentage point.

In sum, we document that the household and individual characteristics have different explanatory contribution for the income gap among EU/Non-EU immigrants and natives across countries.

1.6.3 Median Regressions

Many studies on migration suggest that one might face the problem of skewed distribution i.e. the immigrant status is likely to have a strong influence on the people that appear in the upper part of the social income distribution and much smaller effect on the lower tail of the distribution. We perform quantile regressions as a form of robustness check to our results based on the OLS regression analysis. Buchinsky (1998) points out that the estimated coefficient vector in median regression analysis is not sensitive to outliers in the dependent.

Table 5 presents the median regression results of the immigrants' dummy estimates. We control for both individual and household characteristics and estimate a specification similar to specification (2) from table 3 and table 4 for non-EU and EU immigrants respectively. The coefficient of the non-EU immigrants' dummy in the median regressions for Sweden, Belgium, France and the US is quite similar to that of the OLS analysis (0.23 vs. 0.29; 0.20 vs. 0.17; 0.36 vs. 0.36; 0.30 vs. 0.29). The difference between the median and OLS estimates is slightly bigger in Norway (0.25 versus 0.35).[21] The social income gap estimates for EU immigrants are not significant for France and Belgium using both regression analyses, while for Norway the median estimate is higher (0.08 vs. 0.19) than the OLS one. Overall, the median and OLS estimates are very similar which confirms that the results are not driven by outliers.

1.6.4 Decomposing the Social Income Gap

Using the results from columns (2) of Tables 3 and 4, we calculate the Oaxaca-Blinder mean social income. This method decomposes the overall gap into a part that is due to differences in observable factors (age, gender, education, wage income dummy, number of earners, and number of children) and a part that remains unexplained. We run separate OLS regressions for natives, EU and non-EU immigrants, and then we describe the social income gap as written below:

$$\overline{LnY_j} - \overline{LnY_n} = \overline{X_j}'\left(\hat{\beta}_j - \beta^*\right) + \overline{X_n}'\left(\beta^* - \hat{\beta}_n\right) + \left(\overline{X_j} - \overline{X_n}\right)'\beta^*$$

where j denotes EU/non-EU immigrants and n denotes natives, $\overline{LnY}$ is the immigrants/natives mean of the natural logarithm of social income, and $\overline{X}$ represents the respective vectors of mean values of explanatory variables for immigrants and natives. Finally, $\hat{\beta}$ is the corresponding vector of estimated coefficients and β^* represents the non-discriminatory welfare effect obtained from the pooled sample of immigrants and natives.[22] The first two terms are the part of the gap that remains

[21] We do not perform an analysis of the median social income, since Oaxaca-Blinder assume decomposition of the average incomes.

[22] In the original approaches developed by Oaxaca (1973) and Blinder (1973), it is assumed that the wage structure (in this paper the social income structure) of the advantageous group (non-EU immigrants) would prevail in the absence of discrimination, i.e., $\beta^* = \beta_n$. However, later research

'unexplained" and the third term is due to differences in observable characteristics. The unexplained part can be due to differences in unobservable time-invariant characteristics, coined as 'immigration effect" (Riphahn, 2004). As pointed by Brücker et al. (2002) a number of reasons can explain the presence of such effect: self selection (immigrants' unobserved characteristics make them more likely choose a host country with more generous welfare benefits), migration-specific effects (psychological trauma could make immigrants more dependent on welfare), network effects and reduced wages (exclusion from certain high paid jobs that leads to lower salary and hence more social welfare receipt).

The decomposition of non-EU immigrants/natives' log social income differential is presented in Table 6, row (1). The first row lists unadjusted social income gaps for each country. Row (2) shows the "unexplained" gap that remains after controlling for individual and household characteristics. Row (3) presents the gap that is attributable to uneven distribution of observables between non-EU immigrants and natives. Large portion of the gaps in Sweden, Belgium, France and the US is due to observable factors which account for 57%, 63%, 58% and 55% respectively. Norway which is not an EU member but participates in the European Free Trade Association exhibits quite different pattern since the observable characteristics account for only 26% of the gap.

Looking at the impact of the household characteristics (row 5), the family structure plays an important role in Sweden, Norway, France and Belgium where 67 percent, 43 percent, 29 percent and 47 percent of the gaps are explained. Among all household variables, the number of earners and number of children are the two most important factors in explaining the social income gap in all the countries.

The differences of individual characteristics between non-EU immigrants and natives are not important to explain the social income differential in Sweden and Norway (row 6). In fact, the results suggest that non-EU immigrants have characteristics that prevent them from receiving benefits compared to natives. This is not the case in Belgium, France and the US where individual characteristics are responsible for 33 percent, 11 percent and 42 percent of the gap respectively. The

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suggests that this assumption is ad hoc and Neumark (1988), Oaxaca and Ransom (1994) advance the idea that the non-discriminatory productivity factor estimates fall between the two groups; hence, they are the weighted average of each group's social income.

negative sign of the values of the social income gap in the USA indicates that the natives take higher social income than the immigrants. Regarding the individual characteristics the factor age is crucial for the natives to get high social income in the US.

The welfare gap can be reduced through immigration policy (e.g., skill-based admission criteria) and/or change of eligibility rules. Assuming that immigrants have not altered significantly their family structure and levels of education after arriving in the host country, the results imply that Norway and Sweden have attracted non-EU immigrants with similar individual profile as that of natives so that it does not seem to explain difference in welfare receipt. While in Belgium, France and the US, individual disparities drive a substantial part of the gap. To close the social income gap in Belgium and France, the policy makers may have to focus on reducing the disparities of individual factors, for example, by more favourable skill-based selection of immigrants at the point of entry. However, the implementation of such policy rule may offset the potential benefits of migration as an inflow of more mobile labor force than natives that can attenuate potential shocks to unemployment.

If the immigrants in Sweden and Norway have increased their level of education after arrival to the host country than instead of a change in the immigration policy, the disparity may be reduced through change in eligibility based on household characteristics. Potentially, such a rule will not make presumably assimilated migrants to leave the country and thus offset the positive effect of migrant inflows.

The "unexplained" part of the gap varies across countries (see row 2 of Table 6). In Norway it accounts for two thirds of the gap, while in Belgium it is reduced to one third of it. It may be the case that a time-invariant unobserved factor such as preference to migrate to more generous countries, language and network effects play a role. There is evidence that low skilled migrants may choose their host country based on its welfare generosity (Giorgi and Pellizzari, 2009; Cohen and Razin, 2008; Razin and Sadka, 2004). The cross-country heterogeneity of the unexplained part of the gap highlights that differences in welfare provisions are still present.

Finally, Table 7 shows the results for the Oaxaca-Blinder decomposition of the log social income gap between the EU immigrants and natives. Sweden and Norway are the only two countries for which the gaps are significantly different from zero. The values of the income gaps in both countries are substantially smaller than their

counterparts in table 6. This supports the premise that the EU immigrants are similar to natives, a fact suggested also by the descriptive analysis earlier on. The observable characteristics in Sweden and Norway account for respectively 36% and 22% of their social income gaps (row 2).

1.7 Concluding remarks

While there is extensive research on welfare migration, the social income differences among EU/non-EU immigrants and natives remain unexplored. The main goal of this paper is to find out whether natives and immigrants' social income differs within a country and across groups of countries. We document, in accordance with previous studies that non-EU immigrants tend to be younger, live in larger families with fewer earners and more children than native families. EU immigrants share similar characteristics with natives. Social income gaps between non-EU immigrants and natives are larger than those between EU immigrants and natives. The USA exhibits a very different tendency by providing natives with higher social income than immigrants. Overall, we find that the wage income, the number of earners in the family and the presence of children are the main factors for the existence of the social income gap between natives and non-EU immigrants.

The main finding of this paper is that in Sweden and Norway, a large part of the non- EU immigrants/natives' social income gap is explained by the family characteristics, while in Belgium and France family and individual characteristics play an important role as well. The US provides higher social income to natives which is mainly based on individual characteristics. We contribute to the literature by decomposing the sources of the actual social income gap using LIS data for the year 2000. Previous studies examine the probability of welfare receipt which does not allow to quantify the contribution of each factor.

Our results have policy implications for reducing welfare gaps. In Belgium, France and the US, policy makers may reduce the gap by more favourable selection of immigrants at the point of entry such that the level of education of immigrants is similar to the natives' level of education.

Since the gap is driven only by differences in household characteristics in Sweden and Norway, policies limiting eligibility based on the number of earners and

children may be applied. The optimal policy, however, demands that a cost-benefit analysis be performed that estimates not only the welfare costs of immigrants but also the related benefits.

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1.A Appendix

Table 1. Summary Statistics for the Annual Average Social Family Income

	Non-EU/Natives Gap				EU/Natives Gap			
	Non-EU Immigrants	Natives	Abs. Gap	Raw[c] Gap	EU Immigrants	Natives	Abs. Gap	Raw Gap
Sweden	6808 (4033)[a]	5012 (4731)	1796 (0.00)[b]	0.50 (0.00)	6116 (5627)	5012 (4731)	1104 (0.00)	0.22 (0.00)
Norway	5018 (4571)	3652 (4355)	1366 (0.00)	0.31 (0.00)	4000 (4193)	3652 (4355)	348 (0.10)	0.09 (0.05)
Belgium	6097 (3994)	4269 (4623)	1827.42 (0.03)	0.52 (0.00)	4678.73 (3975)	4270 (4623)	409 (0.52)	0.13 (0.23)
France	5294 (4583.61)	3862 (6843.24)	1432 (0.00)	0.36 (0.00)	4129 (6478.41)	4362 (6843.24)	-233 (0.30)	-0.05 (0.58)
USA[d]	2741 (4715)	4127 (4937)	-1386 (0.00)	-0.52 (0.00)				

Source : The data is from the Luxembourg Income Study for 2000.

Notes : [a] Standard Errors in Parentheses; [b] P-value for the gap in sample means between non-EU and natives, and EU and natives; [c] The gap is reported in log points; Social income are reported in U.S. dollars; [d] We do not distinguish between EU/Non-EU immigrants.

Table 2. Descriptive Statistics for Natives, EU and Non-EU Immigrants by Country

	Sweden			Norway			Belgium			France			USA	
	Natives	EU Immigr.	Non-EU Immigr.	Natives	EU Immigr.	Non-EU Immigr.	Natives	EU Immigr.	Non-EU Immigr.	Natives	EU Immigr.	Non-EU Immigr.	Natives	Immigr.
Age of Family Head	42.6	43.06	37.9	42.06	41.03	40.04	43.64	48.24	42.30	43.67	46.67	44.17	41.76	37.72
	(10.51)	(9.75)	(8.77)	(10.92)	(10.16)	(9.75)	(9.25)	(9.15)	(8.15)	(11.71)	(11.59)	(10.92)	(12.02)	(10.29)
Household Size	3.32	3.33	3.69	3.14	3.51	3.71	3.63	3.63	4.13	2.70	2.92	3.62	3.72	4.81
	(1.38)	(1.36)	(1.71)	(1.45)	(1.63)	(1.75)	(1.31)	(1.40)	(1.31)	(1.34)	(1.28)	(2.06)	(1.75)	(2.00)
Number of Earners	1.93	1.76	1.36	1.97	1.84	1.8	1.66	1.22	1.63	1.46	1.42	1.21	1.75	1.97
	(0.87)	(0.89)	(0.93)	(0.95)	(0.93)	(1.06)	(0.89)	(1.00)	(1.10)	(0.86)	(0.96)	(0.84)	(1.08)	(1.19)
Number of Children	1.33	1.4	1.8	1.14	1.45	1.6	1.42	1.21	1.78	0.75	0.85	1.45	1.48	2.09
	(1.2)	(1.23)	(1.47)	(1.19)	(1.34)	(1.41)	(1.24)	(1.25)	(1.04)	(1.03)	(0.68)	(1.53)	(1.45)	(1.6)
Observations	7258	200	189	10320	579	466	1390	98	80	7224	185	267	14953	1793

Source: The data is from the Luxembourg Income Study for 2000.

Notes: All means are weighted with the LIS sampling weight and include heads of families between 18-60 years

Table 3. Estimated Social Income Gaps for the Non-EU Immigrants and Natives

	Sweden		Norway		France		Belgium		USA	
Independent variables	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Non-EU Immigrant[a]	0.18***	0.23***	0.24***	0.25***	0.23***	0.20**	0.24**	0.20*	-0.44***	-0.30***
	(0.06)	(0.06)	(0.05)	(0.05)	(0.07)	(0.11)	(0.05)	(0.11)	(0.04)	(0.05)
No-Wage Dummy[b]	0.48***	0.38***	0.83***	0.59***	0.56***	0.19***	0.90***	0.58***	0.73***	0.55***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.51)	(0.05)	(0.12)	(0.11)	(0.04)	(0.05)
Number of Earners	-0.36***	-0.36***	-0.29***	-0.26***	-0.47***	-0.38***	-0.30***	-0.37***	-0.13***	-0.12***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.02)	(0.02)
Number of Children	0.14***	0.21***	0.07***	0.21***	-0.01	0.19***	-0.003	0.18***	-0.1***	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)	(0.03)	(0.03)	(0.01)	(0.01)
Age of Family Head		-0.04***		-0.09***		-0.17***		-0.10***		-0.05***
		(0.01)		(0.01)		(0.01)		(0.02)		(0.01)
Age of Family Head Squared		0.001***		0.001***		0.002***		0.002***		0.001***
		(0.0001)		(0.0001)		(0.0001)		(0.0002)		(0.0001)
Female Family Head[c]		-0.18***		-0.45***		-0.23***		-0.40***		-0.36***
		(0.03)		(0.04)		(0.04)		(0.08)		(0.03)
Education Dummies		Yes		Yes		Yes		Yes		Yes
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.13	0.17	0.16	0.25	0.25	0.37	0.32	0.44	0.09	0.14
Number of observations	7 447	7 417	7 961	7 961	5 222	5 222	1 308	1 308	16 746	16 746

Source : The data is from Luxembourg Income Study for 2000

Notes : *** Statistically significant at the 0.01 level; ** at the 0.05 level; * at the 0.10 level; [a]Native is the reference group; [b] Non-zero family income is the reference group; [c] Male is the reference group.

Table 4. Estimated Social Income Gap for the EU Immigrants and Natives

	Sweden		Norway		France		Belgium	
Independent variables	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
EU Immigrant[a]	0.13***	0.14***	0.06	0.08*	-0.05	-0.09	-0.03	0.03
	(0.07)	(0.07)	(0.06)	(0.05)	(0.57)	(0.26)	(0.15)	(0.13)
No-Wage Dummy[b]	0.55***	0.43***	0.86***	0.61***			0.99	0.67
	(0.05)	(0.05)	(0.04)	(0.05)			(0.11)	(0.10)
Number of Earners	-0.36***	-0.36***	-0.29***	-0.26***			-0.51***	-0.21***
	(0.01)	(0.02)	(0.02)	(0.02)			(0.04)	(0.05)
Number of Children	0.14***	0.22***	0.07***	0.21***			0.02	0.19***
	(0.01)	(0.01)	(0.01)	(0.01)			(0.03)	(0.03)
Age of Family Head		-0.04***		-0.10***				-0.10***
		(0.01)		(0.01)				(0.02)
Age of Family Head Squared		0.001***		0.001***				0.001***
		(0.0001)		(0.0001)				(0.0002)
Female Family Head[c]		-0.18		-0.47***				-0.43***
		(0.03)		(0.04)				(0.08)
Education Dummies		Yes		Yes		Yes		Yes
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.13	0.17	0.16	0.25	0.31	0.37	0.31	0.39
Number of observations	7458	7434	8 022	8 022	5125	5125	1294	1294

Source : The data is from the Luxembourg Income Study for 2000

Notes : *** Statistically significant at the 0.01 level; ** at the 0.05 level; * at the 0.10 level; [a] Native is the reference group; [b] Non-zero income family is the reference group; [c] Male is the reference group.

Table 5. Robustness Check - Median Regressions

	Sweden	Norway	France	Belgium	USA
Non-EU	0.29***	0.35***	0.36***	0.17* (0.09)	-0.29***
EU	0.05 (0.11)	0.19*** (0.05)	-0.08 (0.12)	0.11 (0.09)	

Source : The data is from the Luxembourg Income Study for 2000

Notes : The table presents immigrant-dummy (native is the reference group) estimates from a series of regressions controlling simultaneously for individual and family characteristics; *** Statistically significant at the 0.01 level; ** at the 0.05 level;* at the 0.10 level.

Table 6. Decomposition of Non-EU Immigrants and Natives' Social Income Gap[a]

	Sweden	Norway	Belgium	France	USA
Raw Social Income Gap[b]	0.501	0.309	0.520	0.361	-0.524
Unexplained Gap	0.220	0.230	0.191	0.145	-0.230
Explained Contribution	0.285	0.078	0.328	0.206	-0.290
Relative Contribution (%)	57	25	63	58	55
Effect of Household and Individual Characteristics					
Household	0.334	0.133	0.151	0.168	-0.063
Number of Earners	0.192	0.054	0.157	0.076	-0.024
Number of Children	0.090	0.067	-0.016	0.087	-0.015
No-Wage Dummy	0.057	0.018	0.001	0.005	-0.018
Individual	-0.050	-0.054	0.176	0.04	-0.229

Notes: [a] The table reports the Oaxaca-Blinder decomposition of the log annual social income gap. The effect of age, age squared, gender, education and region is not reported; [b] The positive gap indicates that the non-EU immigrants' social income is higher than that for natives.

Table 7. Decomposition of EU Immigrants and Natives' Social Income Gap[a]

	Sweden	Norway
Raw Social Income Gap[b]	0.220	0.090
Unexplained Gap	0.140	0.070
Explained Gap	0.080	0.018
Relative Contribution (%)	36	20
Effect of Household and Individual Characteristics		
Household	0.066	0.088
Number of Earners	0.061	0.039
Number of Children	0.000	0.057
No-Wage Dummy	0.015	0.005
Individual	0.011	-0.067

Notes: [a] The table reports Oaxaca-Blinder decomposition of the log annual social income gap. The effect of age, age squared, gender, education and region is not reported; [b] The positive gap indicates that EU immigrants social income is higher.

Definition of variables

AGE—The number of head years at the moment of interview. Only heads of family between 18 and 60 years old are included.

GENDER—Indicates whether the head of the family is male or female.

HOUSEHOLD SIZE—It gives the total number of persons in household (includes children or any other individuals not included in individual-level survey).

EDUCATION LEVEL—Whenever possible this variable gives the highest attained level of education. We have created a dummy variable taking value of one whenever the individual has college or university degree.

REGION—Includes the region of residence (state, province, district, etc.). For countries within the EU, the NUTS-classification is used whenever the coding in the original dataset allows for it (usually NUTS 2 or 3).

ETHNICITY—The content of this variable is not uniform. Preferably it includes ethnicity or nationality, but if this information is not available in the original survey, it can also contain country of birth, race, ancestry or mother tongue.

IMMIGRATION STATUS—Shows whether an individual is born in the country or has an immigrant background, how recently he/she arrived or other immigration status information as available.

NUMBER OF CHILDREN UNDER AGE 18—The LIS avoids to include married children under age eighteen. The head and spouse under eighteen are also excluded.

NUMBER OF EARNERS—An individual is considered an earner if he/she receives any labor income.

FAMILY WAGE INCOME—Includes any cash wage and salary income including employer bonuses, 13th month bonus, etc. It is recorded gross of employee social insurance contributions/taxes but net of employer social insurance contributions/taxes. In our study we create a dummy variable which takes value of one if the family wage income is zero.

SOCIAL INCOME—Includes all of the following variables:

Social Retirement Benefits (cash social security benefits for old age an/or survivors, i.e., widows/widowers)

Child or family Allowances (cash payments for child or family allowances not relating to maternity/paternity)

Unemployment Compensation (non-means tested cash social insurance benefits in case of unemployment where severance pay is excluded)

Sick pay (cash benefits due to short-term sickness or non-occupational injury, and related medical benefits and services)

Accident pay (cash accidents or injury payments)

Disability pay (cash benefits for partial or total permanent disability, i.e. long term illness)

Maternity pay (cash payments for maternity or paternity)

Military/Veteran/War Benefits (cash veteran's benefit or military benefits for old age, military disability and war separations)

Other Social Insurance (other cash or near cash benefits that are not included in the more specific cash benefit variables)

Means-Tested Cash Benefits (means-tested benefits or so called "emergency" benefits. LIS includes also mandatory cash transfers NOT tied to some form of in-kind benefit, e.g. not tied to food or education)

Near-Cash Benefits (all forms of transfers that are, in a strict sense, in-kind payments, i.e. they are tied to a specific requirement such as school attendance, but have a cash equivalent value equal or nearly equal to the market value, including near-cash housing benefits) **Alimony or Child Support** (alimony received from non-household members)

Other Regular Private Income (regular cash private transfers)

Chapter 2

Are Immigrants Paid Less for Education? *

2.1 Introduction

The relationship between education and its impact on earnings has been explored extensively by many economists. Accounting for the earning differential between migrant and native workers based on their schooling, however, is still relevant and an interesting research topic for both practitioners and policy makers given the flexible and highly competitive labour markets of the developed economies. Different educational systems across countries pose a real challenge for policy makers in recognizing the educational degrees and technical skills of foreign-born workers in their countries. This may lead to foreign-born workers being employed in occupations where the average level of education across employed workers is higher or lower than their own education level, which could translate into a potential mis-match in earnings between natives and migrants.

Duncan and Hoffman (1981) started the literature by distinguishing between an individual's actual years of schooling and the 'typical' years of schooling prevailing in a certain job. Studies based on US data (e.g., Chiswick, 1980; Duncan and Hoffman, 1981; Cohn and Khan, 1995) suggest that the rate of return (impact on earnings) to 'typical' schooling is positive across occupations and exceeds that of over-education, while the return to under-education is negative.

This type of an analysis has been also applied to understanding why immigrants typically face lower returns to education compared to natives. Chiswick & Miller (2005) imply that the partial effect of an additional year of schooling on earnings for foreign-born workers in the USA is 2.5 percentage points lower than that for natives. Potential

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explanations for this phenomenon are that either human capital skills are not fully transferable across borders or that a year of schooling has a different human capital content across countries. Alternatively, migrants may face barriers in the labour market that result in fewer opportunities to find a job and thus may receive wages below their marginal productivity. One such example is work permits linked to specific job positions or geographical areas as in the case of the temporary restricted free movement of labour with respect to the countries that joined the European Union in 2004 and 2007.[23]

A number of studies confirm the above premises and document an increase in the dispersion of labour market outcomes across immigrants examining data for Canada, Germany, Portugal and UK.[24] However, recent evidence from large EU economies is not available, which makes further research on the topic necessary and important in view of recent and future EU expansions and in view of recent large migration flows towards the developed Western labour markets. Furthermore, gathering evidence on the extent to which potential educational mis-matches occur between years of schooling and the 'typical' years of schooling prevailing in a certain occupation and its impact on earnings across natives and migrants in different countries could shed further light on the effectiveness of immigration policies across countries. A comparison between the educational returns to earnings of migrants versus natives subject to the conservative immigration policy of France, Germany, and Austria (analysed in this paper) on the one hand and the less restrictive immigration and integration policy of the UK and US (data and estimates based on already existing but comparative research) on the other will provide valuable insight into the success of these immigration policies and how well integrated migrants are across countries.[25]

In this paper, I therefore extend the existing evidence of educational returns to earnings for natives and immigrants, by focusing on three European economies, Germany, France and Austria, which are characterized by substantial immigration flows during the last 40 years. By 1993, the total number of non-EU residents in the

[23] See Refugees, Recent Migrants and Employment, Challenging Barriers and Exploring Pathways (2008), edited by Sonya McKay, Routledge Economics

[24] See Baker and Benjamin (1994); Chiswick (1980); Kiker & Santos (1991); and Dustmann (1993). Groot and Maasen van den Brink (2000) provide a survey of the literature.

[25] See "Immigration policy and the welfare system" (2002) edited by T. Boeri, H. H. Hanson, and B. McCormick ; and see also Entorf & Minoiu (2005).

Community had reached 12 million. Of these migrants, one-quarter were Turks, who mainly resided in Germany and another quarter from North Africa were residing in France. In 2003, the number of legally resident foreigners in Germany was 7.3 million, who comprised 8.9 percent of the total population, while France had 4.9 million immigrants representing roughly 8.1 percent of its population. The analysis (regression estimates) on France, Germany, and Austria, characterised by a rather conservative labour market access to immigrants, is compared further to those by previous studies on migrants' earnings in the USA (Chiswick & Miller, 2007) and in the UK (Lindley & Linton, 2006), exhibiting a more flexible labour market access.[26]

The data are drawn from the Luxembourg Income Study (LIS), which transforms the original data files into a harmonized LIS data format, synchronizes definitions and labour market concepts, and makes all dataset variables comparable across different countries. This allows for an easy and robust comparison of the impact of years of education on the earnings of native and immigrant workers across the economies of Germany, France, and Austria[27], which differ both in the size and composition of their migrant populations as well as in their migration policies over time. The decomposition of the actual years of schooling variable into 'typical' education (the actual years of schooling match the years of schooling prevailing usually across occupations); over-education (the actual years of schooling higher than those typical across occupations); and under-education (the actual years of schooling lower than those typical across occupations) will provide an insight into the overall gap in payoffs to schooling.

I find no significant difference in the impact of 'typical' education on earnings between native and migrant workers in all countries of analysis, which shows that there is no additional reward in earnings in the case of natives compared to foreign workers. However, foreign-born workers find it slightly more difficult to find employment in occupations matching their level of education. Furthermore, the return to usual years of schooling that prevail amongst workers across different occupations is higher and statistically different than that for actual years of education for both native and foreign-born workers in all countries. However, compared to natives, foreign-born workers have

[26] See Boeri *et al.* (2002) and M. Caldeira, J. Castello, A. Esteves, A. Ferrer, M. Fonseca, J. Jamin, H. Koff, A. Lostia, J. Malheiros, I. Molina, E. Tricada and J. van der Leun (1999).
[27] The choice of countries is based on availability of data

lower returns to over-education, which drive the gap in earnings between natives and the foreign-born. This could potentially be the evidence for differences in the 'quality' of education between native and foreign-born employees. Foreign-born workers find it more difficult to find jobs matching their education and may also face lower earnings than natives for similar levels of education beyond the prevailing level in a given occupation.

Differences in immigration policies with respect to labour market access do not play a role while comparing the educational returns of native and migrant workers who have found a position perfectly corresponding to their education. The gap between educational returns of natives and workers across all countries in this case is non-existent. However, France, Germany, and Austria reward their native workers more than they reward immigrants in the case where these workers have more years of schooling than that typical of workers in their occupation. In contrast, the UK and the US do not differentiate between migrant and native workers in rewarding over-education.

2.2 Theoretical Background

2.2.1 Over-education/Under-education Theories

Hartog (2000) and Kiker, Santos, and Mendes De Oliveira, (1997) outline four different interpretations of the over/under-education phenomena: (i) a search and match framework in an environment of imperfect information, (ii) the human capital framework, (iii) the hedonic/assignment framework and (iv) the technological change framework.

Search and Match theory focuses on the existence of an 'educational mis-match' due to imperfect labour market information. This mis-match is only a temporary phase since it is directly related to the individual's age and experience on the labour market. Workers with a given level of education search to improve their job level and move in cases where the offer is better than their current position overtime. Thus, the incidence of over-education falls with increasing age and experience and the incidence of under-education at the same time decreases. The searching and matching interpretation is very

likely to explain the initial educational mis-match of migrants whose qualifications were not recognized by the host country and who progress into better jobs over time.

Human Capital theory suggests that over-education results from the individual's choice of accepting a lower-level job in his early years of experience since it is a good investment opportunity. Sicherman (1991) shows that workers who have higher education than that 'typical' for the job are more likely to move to higher level occupations. This theory is supported by Alba-Ramirez (1993) who finds that over-educated workers are more likely to move to better occupations, while under-educated workers move to a similar job position within their occupation. The lack of international transferability of skills and the fact that a year of schooling for migrants could be different than a year of schooling for natives are among the reasons of why migrants could appear to be over-educated or under-educated, while in fact they are correctly matched with respect their actual schooling.

The Assignment Theory represented by the Sattinger (1993) paper for example, focuses on measuring the match between assigned heterogeneous workers to heterogeneous jobs. Within the general hedonic model, a job is characterized by a fixed level of 'typical' education, and individuals with varying levels of education might be assigned to this job. Equilibrium could be achieved by the free interaction of the demand for labour expressed as job requirements and the supply for labour expressed as workers applying for a particular job. For a given job level, the reward to attained education reflects the value of this particular education to the employer in the shape of an iso-profit curve. This curve is expected to be concave, or, in other words, the negative impact on earnings (penalty) of under-education should be larger than the positive impact on earnings (reward) of over-education. In general, returns to education depend on the specificities of the job, and the earnings difference between workers with different education varies due to the success of the assignment or the match.

The Technological Change Framework is to be found in Kiker *et al*. (2000) and suggests that the skills an individual acquires at school should be constantly improved so that they match and keep up with the technological changes in a country. Thus, these graduates will be more educated than their co-workers once they find a job. The employers are not able to hire immediately all those better educated workers, and hence, the existing workers will become in reality under-educated. Once the job requirements

evolve, however, so that they reflect the skills and education of the newly hired graduates, these graduates will be considered over-educated with respect to those who are already on the job. According to this theory, for a given level of education immigrants from less-developed countries have an education that is based on a more distant technology than the developed economies and therefore are more likely to report that they are over-educated compared to immigrants from developed economies in an attempt to secure a job position.

In summary, according to both the *Search and Match* theory and the *Human Capital* theory, the incidence of under- and over-education diminishes over time with higher age and accumulated experience by individuals. While the first theory predicts that both over- and under-education occur less with the increasing of an individual's age and experience, the latter suggests that over-educated workers are likely to progress to better occupations compared to under-educated workers, who often move across similar positions within the same occupation. The *Assignment* theory predicts a higher earnings penalty of under-education compared to the over-education reward on earnings, while the *Technological Change* theory claims that immigrants from less-developed economies are more frequently over-educated compared to immigrants from developed economies.

2.2.2 Over-education/Under-education measurement and the existing literature

The positive relationship between education and earnings is well acknowledged by the economics literature. While the human capital models of Becker (1964) and Mincer (1974) assume that the education of a worker is fully utilized by his current occupation, the job competition model developed by Thurow (1975) suggests a more complicated relationship between education and earnings, which still advocates, however, a rigid structural view of jobs. Proponents of the latter view claim since the job market allocation is based on existing surpluses/shortages between individuals and jobs, some workers are likely to possess higher or lower education and skills than those typical in their job. Under this assumption, each occupation is characterized by a 'typical' level of education that is needed for a satisfactory job performance (see Kiker *et al*., 1997; Hartog, 2000). Any worker's education above this 'typical' level is known as "over-

education" and any education below the 'typical' level of education is "under-education".

An important issue in the literature on over-education and under-education is how the 'typical' schooling is measured. There are three possible approaches regarding that issue depending on the perspective of defining the 'typical' education for a certain job: the job analysis approach, the worker self-assessment approach, and the realized-matches approach.[28] According to the job analysis approach, the 'typical' level of education is specified for the different job titles across occupations by professional job analysts. Rumberger (1987) provides the empirical evidence for the above approach by using the *US Dictionary of Occupational Titles* and finds that over-educated workers in the US have lower rates of return than workers with the 'typical' level of education.

The worker self-assessment approach uses the information provided by the worker himself on what level of education is 'typical' in a certain occupation, or what is the typical minimum level of education required to perform the current job satisfactorily. This approach is used by Duncan and Hoffman (1981), who confirm the results of Rumberger (1981) based on US data. Daly, Buchel and Duncan (2000) also employ the worker self-assessment approach in comparing the returns to over-education and under-education between the US and Germany and find that for both countries, surplus education receives a wage premium, while deficit education suffers a wage penalty.

The third method of realized matches, which I use in this paper, postulates that 'typical' education is indicated by the actual schooling of the workers in a particular occupation measured by the mean or the mode of that distribution. Any schooling that is above the mode/mean years of schooling for a certain occupation is considered to be over-education, and any schooling below the 'typical' education is respectively under-education. A comparison of the benefits and drawbacks of all three approaches is given by Hartog (2000).[29] He performs analyses using all three approaches and concludes that the results are not sensitive to the approach employed to measure 'typical' education.

[28] For a detailed explanation of the three approaches see Hartog (2000).

[29] Though the realized matches approach has its drawbacks, the job analysis approach could give biased evaluations if the actual years of schooling of workers across occupations are used, rather than the typical education for a particular type of job.

Verdugo and Verdugo (1989) use the mean and the standard deviation of schooling based on the 1980 US census as a benchmark for the 'typical' level of education. They find that over-educated workers earn less than their either adequately educated or under-educated counterparts and claim that the returns to over-schooling are negative. Cohn and Kahn (1995) replicate the analysis by Verdugo and Verdugo (1989) and Sicherman (1991) using the 1985 wave of the Panel Study of Income Dynamics. While Verdugo and Verdugo (1989) claim that the returns to over-education are negative, Cohn and Kahn (1995) conclude that the returns to over-education are positive and those to under-education are negative.

Daly *et al.* (1998) analyze American and German data over the 1970s and 1980s in an attempt to compare structural differences between countries regarding labour markets and the educational mis-match. They find that workers who have more schooling than typical for their job are rewarded, and those who have insufficient schooling are penalized with regards to earnings. Despite the fact that Germany has a much more structured educational system and labour market than the United States, the data show more similarities across countries than over time.

Kiker *et al.* (1997) use the mode of the years of education as a reference for the required or 'typical' level of education of workers in Portugal. Chiswick and Miller (2008) use the U.S. 2000 Census and the mode of years of education to analyze the extent of matching educational attainment among native and foreign-born workers of working age. They find that migrants who have entered the labour market recently tend to be overeducated, while immigrants who have stayed longer in the country are more likely to be under-educated.

Lindley & Lenton (2009) use UK Quarterly Labour Force Survey 1993–2003 to explore the incidence of over- and under-education and among natives and immigrants with UK degrees, and the impact of the educational mis-match on earnings. The authors find that compared to Whites, Black African, Other Non-White, and Indian men are more likely to be over-educated, whilst for women it is Indians and Pakistani/Bangladeshi's who are more likely to be over-educated.

The mode of years of schooling, which I use in this paper, is a different measure of the 'typical' education which does not suffer from some of the drawbacks in using the mean value (for example the frequency of the actual years of education required to

perform a certain job might substantially differ from the occupational mean). However, as a robustness check of defining the 'typical' education I use also the mean and the standard deviation of the actual years of schooling and compare the results to those when the mode of schooling has been used.

While exploring the differences in returns to education among workers has initially driven research forward, concentrating on possible educational differences and their impact on earnings between natives and immigrants makes an additional contribution to the existing literature, given the recent and future EU expansion and the recent large migration flows towards the developed Western labour markets.

2.3 Data Description and Empirical Strategy

In this paper, I consider three European countries – France, Germany and Austria and compare a standard Mincerian specification using actual years of education to a Realized-Matches Approach specification, where the 'typical' education is defined by the mode of the education of workers in each occupation. The analysis is based on Luxembourg Income Study (LIS)[30] data and covers France (2000); Germany (2000); and Austria (2000). The LIS is a micro-database compiled from labour force surveys from different countries. It provides demographic background information, work status and employment characteristics, at both the household and individual level. At the individual level, the LIS includes such demographic variables as age, marital status, the highest degree of education attained, ethnicity, migration status, and labour force status. The advantage of the LIS data is that they are comparable across countries because the original data files are transformed into a harmonized LIS data format.

The aim of this paper is to compare the value of immigrant education systems (years of schooling) to the host country with respect to earnings across different economies. Since the seminal work of Becker (1964), economists view the choice of education in the context of a utility maximizing individual, who invests in education as long as the present value of the costs of investment equals the present value of the returns to this investment. The Mincerian wage equation (Mincer, 1974), which has

[30] www.lisproject.org

been applied extensively in a multitude of studies, allows for a straightforward cross-country comparison in calculating the return to education.

I analyze employed male[31] individuals of working age. The main specification employed in the analysis is as follows:

Y = f (*Education, Experience, Control Variables*)

The monthly average earnings of the workers are expressed as a function of workers' education, experience, and different control variables, which characterize the workers and have a potential impact on their wages. In an attempt to take account of a potential mis-match on education in the labour market for each country, I estimate both Mincerian and Realized-Matches Approach specifications:

1 (Mincerian) $ln\ Yi = \beta_0 + \beta_1 Education_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \beta_4 Married_i + \ldots + u_{i,}$ and

2 (Realized-matches) $ln\ Yi = \beta_0 + \beta_1 Typical\ Education_{ij} + \beta_2 Over\text{-}Education_i + \beta_3 Under\text{-}\ Education_i + \beta_4 Exp_i + \beta_5 Exp_i^2 + \beta_6 Married_i + \ldots + u_{i,}$

where *ln Yi* is the natural logarithm of the monthly earnings per worker; *Education*[32] is the actual worker's years of schooling[33]; '*Typical' Education* is the mode value of workers' years of schooling prevailing in the occupation[34]; *Over-Education*[35] equals the years of schooling above the 'typical' education and *Under-Education* are the years of schooling below the 'typical' education; i=worker and j=occupation.

[31] The analyses is restricted to male individuals only so that it can be compared to the existing UK and US studies which are based on male workers only. Female earnings are known to be lower than males' earnings and therefore important to be considered separate. Furthermore, the large majority of immigrants are male and restricting the sample to females only does not yield meaningful results due to the low number of observations.

[32] There is no perfect measure of education, and formal years of schooling are often used to approximate a given 'skill set' acquired by the individual. Therefore, the education variable is subject to a measurement error and is to be treated with caution.

[33] The years of schooling have been imputed from the highest completed level of general education. For further details see Robustness Checks in section IV Mincerian vs. the Realized-Matches Approach.

[34] The occupational variable across all countries is at a two-digit level based on the 4-digit ISCO-88 standard classification. Originally, Germany had 4-digit occupational information, which had to be aggregated to a two-digit level so that it would be comparable to the occupational information available in France and Austria.

[35] Both over- and under- education are not exogenous variables; they approximate unobserved ability such as language skills. These variables are subject to a higher measurement error than the 'typical' education variable due to the fact that individuals in these categories exhibit a-typical levels of education.

The main difference between the two specifications is the education variable. In the standard Mincerian equation, earnings and education are correlated in a log-linear fashion.[36] The Realized-Matches Approach allows, however, for a more flexible approach, whereby returns (earnings) to education vary depending on whether the individual has a 'typical' education, over-education, or under-education. Therefore, each worker would be either over-educated, under-educated, or have adequate education (correctly-matched) similar to the usual years of education prevailing among the workers in his current occupation, which means that for every employee, either over-education or under-education or both must be zero.

Alongside the education variables, both specifications allow for a range of control variables to explain the outcome: potential labour experience (approximated by the standard formula of ([Age - Years of Schooling – 6]); a dummy variable for marital status; a geographical dummy for different regions; a company ownership dummy indicating whether the worker is employed in a state or private enterprise; and a sectoral dummy indicating whether the sector of employment is industry, services, or agriculture.[37] Two additional control variables in each specification indicate whether the worker has a permanent fixed-term contract of employment, and whether he has a supervisory role which involves managing other co-workers or not.

Table 1 presents the incidence of educational mis-match among employed workers aged 16-60/64, according to the criteria of the Realized-Matches Approach, i.e. how many of them are correctly educated (have the 'typical' education), over-educated or under-educated. When the actual years of education of a worker are higher than the mode of years of schooling among workers in a certain occupation, he is considered to be over-educated, and when his years of education are lower than the same mode, he is under-educated. Equality between the education of an employee and the modal years of schooling across different occupations qualify him to be correctly educated (matched), which means that he has the usual years of education typical for his occupation.

[36] Tables A.1, A.2, and A.3 present the different educational levels in Austria, France, and Germany and their corresponding years of schooling.
[37] One disadvantage of the data is that there is no information on years since migration for the foreign-born workers though in Chiswick and Miller (2005), this variable has a minor impact on earnings.

The average years of schooling[38] across native and foreign-born[39] workers in each country are presented in the first column of Table 1. In Austria the average years of schooling are 12 independently from the worker's country of birth. The foreign-born workers in both France and Germany have on average 9 years of schooling, while the French native workers have studied on average for 11 years as opposed to 10 years in the case of German native workers. This could also be illustrated by distributional charts (Chart 1, Chart 2, and Chart 3) of actual years of schooling for each of the three countries of analysis. More than 60 percent of all workers in Austria have 12 years of schooling, which is equivalent to having a high school diploma. In France and Germany, the dispersion is higher given that in France 25 percent of the workers have 11 years of schooling (graduated secondary school), and 45 percent of workers have 9 years of schooling (general high school education) in Germany.

Taking into account the modal value of the actual years of schooling for each worker's occupation, Austria has the highest proportions of correctly matched native and foreign-born workers across all countries of analysis: 73 percent correctly matched native workers and 62 percent correctly matched immigrants. In Germany, there are an almost equal proportion of correctly matched natives (50 percent) and correctly matched immigrants (46 percent), whereas in France, 37 percent of native workers are correctly matched as opposed to 27 percent for the foreign-born workers.

The incidence of over-education is quite significant and equally distributed among native and immigrant workers in Germany (35 percent), while in France, workers are less frequently over-educated (26 percent of native and 21 percent of foreign-born workers). The lowest levels of over-education among workers are in Austria, where only 5 percent of native workers are over-educated compared to 11 percent of foreign-born workers. The incidence of under-education is highest in France, where almost 52 percent of foreign-born workers are under-educated as opposed to 38 percent across native workers.

A further indication of a potential mis-match is provided by the ratio of over-educated workers in low-skilled occupations or under-educated workers in highly

[38] The average years of schooling have been calculated as the average of the modes across all occupations in a country.

[39] Foreign-born workers are defined as all workers born outside the country of analysis. The terms foreign-born workers and immigrant workers are used interchangeably throughout the paper.

skilled occupations[40]. In Germany, the proportions of over-educated native and foreign-born workers in low-skilled occupations are similar at 36 percent, while in France there are more over-educated native workers in low-skilled occupations (25 percent) compared to foreign-born workers (20 percent). Under-educated foreign-born workers in high-skilled occupations are in higher proportion than their native counterparts across all three countries of analysis. The highest proportion of foreign-born under-educated workers in highly skilled occupations is in France where 44 percent of foreign-born workers have the above characteristic.

More than 50 percent of all native and foreign-born workers are married where the presence of a spouse is higher across foreign-born workers in all three countries. Similarly, more than half of all workers in France, Germany, and Austria are employed on a permanent contract basis, and a substantial percentage of native and foreign-born workers in France (60 percent) and Austria (50 percent) have a supervisory position.

Table 2a presents a comparison of the differences between native and immigrant workers' educational mis-matches across countries. The data from Austria, France, and Germany are contrasted to the UK (1993-2003) and the USA (2000) data presented by Lindley and Linton (2006) and Chiswick and Miller (2005) respectively.[41] In all countries, the percentage of correctly matched native workers is higher than that for immigrant workers, but the gaps in the UK and the USA are larger than in their continental European counterparts. In France, Germany, and the USA, over-educated immigrant workers are less frequently over-educated than their native co-workers that share similar characteristics. The UK and Austria are the two countries where over-educated foreign-born employees are more frequent than over-educated native workers. In all countries of analysis, immigrants are more frequently under-educated than natives with the exception of the UK. The gap between under-educated foreign-born and native workers is highest in the USA (18 percentage points), followed by France, where the corresponding gap is 14 percentage points.

If the distribution of correctly matched-, over- and under-educated is normalised by the native-foreign-born distributions, a clearer picture emerges in Table 2b. In this

[40] Highly skilled occupations are defined here as those occupations where the majority of workers have a post-secondary education (more than a high-school diploma), or highly educated workers have a 10% wage premium with respect to less educated workers. For details see Gottschalk and Hansen (2003).
[41] The UK data focuses only on white male natives versus white male immigrants, while the data for the U.S. is restricted only to males.

table, any ratio above 1 indicates that the proportion of natives in realised-matches (or over-/under-education) is higher than the proportion of natives in the entire sample, i.e. natives are over-represented. Conversely, a ratio below one indicates that natives are under-represented (or foreign-born workers are over-represented). In all three countries, native workers are substantially over-represented in jobs with a correct match of education. In France and Germany, there are proportionally more native over-educated workers, and in all three countries, foreign-born workers are proportionately more under-educated. Similarly to incidences for the US and the UK, these statistics suggest that there is a structural difference between native and foreign-born workers.

2.4 Mincerian vs. the Realized-Matches Approach

Tables 3, 4, and 5 present the regression estimates of the standard Mincerian Approach as opposed to the Realized-Matches Approach for natives and the foreign-born in France, Germany, and Austria for the year 2000. The first two columns in each table refer to native workers, while the last two columns pertain to foreign-born workers.

Natives

The Mincerian specification for natives across the three countries of analysis confirms the positive and significant relationship between actual years of schooling and earnings. Each additional year of schooling accounts for a 6.2 percent increase in the earnings of a native French worker; 6.5 percent for every German worker; and 7.8 percent in the case of a native Austrian employee.

The partial effect of labour experience on earnings varies with years of experience and is given by accounting for both coefficients for experience and experience^2/100 and taking the first derivative with respect to experience. Thus, the fifth year of potential employment experience after finishing formal education for a French native worker, for example, yields a 2.7 percent increase in his earnings; 4 percent increase in the earnings of a German employee; and a 1.5 percent increase for a native Austrian worker.

Amongst many control variables (region, industry, type of contract) present in the Mincerian specification for native workers, three variables are of interest and have a

significant impact on earnings. Employment on a permanent contract basis benefits the earnings of native workers across all three countries in the range of 30-35 percent on average. Work-positions which have a supervisory role and involve managing people are also a significant driver of wage earnings and contribute by an average of 20 percent to higher wages across France and Austria, and a 35 percent increase in earnings in the case of Germany.[42] The ownership of the worker's company, i.e. whether the company is private or state-owned is a significant variable and somewhat surprisingly suggests that working for a private company will have a 10-15 percent negative impact on the earnings of workers across France, Germany, and Austria.

Once we use the Realized-Matches Approach and account for the prevalent years of education across the workers of a certain occupation, the impact of the 'typical' education on earnings among native workers in all countries of analysis is higher than that for the actual years of education. These results are in full accordance with other studies on the American and Canadian economies (Chiswick and Miller, 2009 and Vahey, 2000). The returns to 'typical' education range from 8 per cent to 8.8 per cent, some 2 percentage points higher than that for the actual years of education in the case of native workers in France and Germany and 1 percentage point in Austria. A year of over-education among native workers contributes to a 6.8 percent increase in earnings for the French worker, 3.6 percent for the German worker, and 7.7 percent for the Austrian worker, which is substantially less than the return to 'typical' education. In contrast, a year of education less than the usual years of education among workers in a certain occupation has a negative impact on native workers' earnings as follows: -4.2 percent in France, -6.7 percent in Germany, and -7 percent in Austria.

Foreign-born

Employing both Mincerian and the Realized-Matches Approach analysis for foreign-born workers (the last two columns of tables 3, 4, and 5) shows similar dynamics in the earnings function for foreign-born workers across the countries of analysis. The actual years of education have a 5 percent positive impact on earnings of foreign-born workers in France; 3 percent for immigrants in Germany; and 4 percent for

[42] Note that this is equivalent to the average wage premium for supervisory positions, but the data do not allow for a more granular distinction between the various supervisory or management positions.

those in Austria. In contrast, once the Realized-Matches Approach is used and the usual years of education prevailing among the workers across occupations are taken into account, the impact of the 'typical' education on earnings increases to 7 percent in France; 9 percent in Germany; and exceeds 10 percent in Austria[43]. Given that this tendency is observed among both native and foreign-born workers across all three countries suggests that earnings are explained better by the usual years of education typical in a given occupation, rather than by the actual years of schooling pertaining to each individual worker. Thus for a given occupation the individual's level of education in relation to the prevailing 'typical' level of education in that occupation is the most relevant driver of earnings. The best returns are for the education years precisely up to the 'typical' level, with a smaller premium for each additional year of over-education. The occupation and the prevailing level of education amongst workers in this occupation are more important in defining one's earnings than his diploma and actual years of study. However, the actual years of study partly influence the choice of occupation and successful employment.

The positive impact of over-education on earnings varies between 1 percent for Germany and 4 percent for France, while under-education penalizes foreign-born workers by 3.6 percent of their earnings in France; 5 percent in Germany; and 4 percent in Austria. All other explanatory variables in the Realized-Matches Approach for foreign-born workers share a similar magnitude to their equivalents in the Mincerian specification.

Foreign-born vs. Natives

The standard Mincerian specification in tables 3, 4, and 5 allows for the comparison of actual years of education and their impact on earnings between native and foreign-born workers. The native-immigrant gap in returns to actual years of education is 3 percentage points in favour of native workers in Germany and Austria, and 1 percentage point in France.

Table 6 provides the Realized-Matches Approach education estimates on earnings and allows for a comparison between native and foreign-born workers across

[43] The slope coefficients of actual years of education and those for 'typical education' are significantly different across all countries of analysis (France p=0.03, Germany p=0.05, and Austria p=0.06).

countries. The native-immigrant gap in 'typical education' in France and Germany is 1 percentage point, 2 percentage points in Austria, 1.5 percentage points in the UK (Lindley & Linton, 2006), and does not exist in the USA (Chiswick and Miller, 2007). When accounting for the usual years of schooling across occupations, the gap of the 'typical' education estimates between the correctly matched native and foreign-born workers across all countries is not statistically significant. This finding suggests that if a migrant succeeds in finding a job requiring his actual years of schooling, then the impact of her education on earnings is similar to that of a native worker independent of how strict the immigration policy is in the country.

The years of education above the usual years of education of workers across occupations have a greater positive impact on the earnings of natives than on the wages of foreign-born workers. The gap of over-education estimates between native and foreign-born workers is significant in France and Germany at around 2.5 percentage points in favour of native workers. An additional year of over-education among native workers in the UK and the USA has on average, a greater impact on earnings than that for foreign-born workers with a gap in over-education estimates of 1.5 percentage points for the UK and 1.1 percentage points in the United States. The same tendency is valid for Austria, where the native-immigrant over-education gap is 5 percentage points but, however, is not significant. Over-educated native workers in the EU countries (France, Germany, and Austria) with stricter immigration policies are rewarded significantly more than foreign-born workers in comparison to the more liberal US and the UK.

When the education of a worker is less than the usual level of years of education of his occupational colleagues, this under-education has a negative impact on earnings. Foreign-born workers, however, are penalized less[44] than their native co-workers across all countries of analysis with the exception of the UK[45]. The native-immigrant under-education gap is the highest in the USA and is 4.4 percentage points in favour of foreign-born workers, followed by Austria with 3.1 percentage points, 1.6 percentage points in Germany, and almost 1 percentage point in France and the UK. The less conservative immigration policy in the US, results in penalizing under-educated migrants less than their native counterparts.

[44] Note that the migrant population may be subject to a selection bias.
[45] The native-immigrant gap in under-education is not significant for the UK.

Tables 3, 4, and 5 provide further information when comparing the rest of the control variables in the Realized-Matches Approach specification between native and foreign-born workers. The experience of foreign-born workers has a smaller impact on their earnings, in comparison to native workers, but has however a positive and significant impact on earnings across all three countries. Workers with permanent contracts or taking supervisory positions are likely to have similar higher earnings than those who have fixed-term contracts, and do not supervise other workers regardless of whether they are native or foreign-born workers across all the countries of analysis.

Combining the results from table 6 together with table 2b provide some interesting insights into the native-migrant gaps in educational impact on earnings across countries. On the one hand, table 6 shows that the relatively liberal with regards to immigration policy[46], UK and US economies value the over-education of migrants and natives equally (the over-education gap being approximately zero), while France, Germany, and Austria, countries that pursue a more conservative immigration policy, reward over-educated natives more than over-educated migrants. On the other hand, table 2b shows that the efficiency of the labour markets in the UK and the US is lower than that in the other three countries with respect to typical education and over-education in the case of the UK. In the case of Austria, the incidence of the over-education of migrants is higher than that for natives with respect to the corresponding total numbers of natives and migrants due to the relatively small number of over-educated migrants and the overall low variability in years of education for both natives and migrants, which requires additional caution when interpreting the regression results.[47]

The combination of the selection on quality (high-education, high skills) through immigration policy and of the matching efficiency of the labour markets (see Table 2b) could potentially explain the fact that the UK and the US attract some of the best educated and highly skilled immigrants despite the flaws in the matching mechanism in their labour markets.

[46] Liberal immigration policy refers to easier access to the labour market for immigrants as opposed to a conservative immigration policy referring to a more difficult access to the labour market in the host country.

[47] Please note that the immigrants' sample for Austria is substantially smaller than for the other countries of analysis.

Robustness checks

One drawback of the data is that the years of schooling have been imputed from the highest completed level of education for each individual, an approach known for having a downward bias on the returns to schooling.[48] The imputation was rather straightforward given that the highest completed degree by each individual corresponds to certain years of education typical for the educational system in each country. Despite the differences in educational systems across Austria, France, and Germany, in all countries the high-school diploma corresponds to 12 years of education on average, while a university degree corresponds to 18 years of education. A further concern with regards to imputing the years or schooling from the highest completed level of education is the degrees in different countries could have a different meaning, which makes the comparison between them a challenging task. For example, the fact that most of the foreign-born workers in France come from North Africa (Morocco, Algeria, and Tunisia) is not that alarming given that all these countries were French colonies in the past, and their educational systems are based on the French educational system, which facilitates the comparison between the educational degrees of their workers. While the years of schooling required for getting a degree might not be that different between countries, the quality of education and the educational institutions across countries do differ and make employers more sceptical of the skills and experience based on degrees held by foreign-born workers compared to natives. To tackle this issue, I conducted robustness checks of the returns to education of immigrants coming from a certain geographic area (e.g. Eastern Europe, Northern Africa). The coefficients are very similar and not significantly different from the ones received when all immigrants were considered as one group, which might suggest that the extent of imputation bias between these two regions is similar or the differences in the human-capital context in these areas work in opposite directions.

A potential concern is that the immigrant variable does not make a distinction between EU and non-EU immigrants. Workers from EU-member countries can move freely within the European Union as a matter of right, while non-EU members will be at least partially selected by the receiving country (visa, working permits, etc.) In the case of Austria and Germany, once the EU/non-EU split is made, the size of the immigrant

[48] See Munich, Svejnar and Terrell (2005)

sample is too small for any meaningful analysis to be made. However, in France there are 504 migrants born in other EU counties, and 1100 non-EU migrants. The regression analysis shows that there is no significant difference in the educational coefficients between the EU migrants and the non-EU migrants[49] both for the Mincerian and the Realised-Matches Approach.

The information on occupations varies across countries. In Germany the occupational variable is based on a 4-digit ISCO-88 standard classification. This variable had to be aggregated to a two-digit level, so that it is fully comparable with the other two countries of analysis: France and Austria. As a sensitivity-check of the German occupational data, different regressions were run, where the occupational variable was at three digit-level and the resulting coefficients were not significantly different from those acquired when using occupations at a two-digit level.

In this paper all estimations are based on defining the 'typical' education as the mode of the actual years of schooling prevailing across occupations. Considering the caveats related to the measurement of education, robustness checks were employed to test the sensitivity of the results to the definition of the 'typical' education. Defining the 'typical' education as either one year less or more than the data derived, the mode of education in each occupation yields very similar results. Thus under these sensitivity scenarios[50] the coefficient estimates are slightly different compared with the standard estimation in all three country datasets, which translates into negligible differences in terms of the effects of education on earnings. Furthermore, I use also the mean and a range of one standard deviation of the actual years of schooling when defining the 'typical' education, and compare the results to those when the mode of schooling has been used. There are no significant differences in the impact of education on earnings when the mean of actual years of schooling is used as a benchmark for 'typical' education.[51]

High-skilled vs. Low-skilled occupations

[49] Results are available upon request.
[50] Given the potential correlation between the education variable and other regressors such as permanent contract or supervisory position dummies, both Mincerian and Realised-Matches regressions were run omitting those variables. The coefficients for education are not significantly different from those when these regressors are included. Results are available upon request.
[51] Results are available upon request.

In recent decades, the labour markets in the developed economies have been characterised by a constantly growing demand for 'college'-educated or highly skilled workers due to the increasing importance of the strong skill-biased technological change experienced by these economies. Therefore, the distinction between high-skilled occupations (those that demand predominantly highly skilled or college workers) on the one hand and low-skilled occupations (those that demand predominantly low-skilled or non-college workers) on the other and how they differ with regards to educational returns is important in analysing the native-migrant educational impact on earnings.

There are multiple definitions of 'college' and 'non-college' occupations, which in essence focus on explaining the concept of over-education (see McGuiness 2006 for a review) but the Gottschalk and Hansen (2003) approach provides the most useful insight into the educational impact on earnings of natives as opposed to immigrants since it is based solely on economic outcomes. Gottschalk and Hansen (2003) define automatically college and non-college occupations when one type of worker (highly-educated or a college worker with more than a high-school diploma or a less-educated or non-college worker with a high-school diploma) is strongly prevailing. The authors define college (high-skilled) occupations as those occupations where more than 90% of the workers have higher or college education, and non-college (low-skilled) occupations as those occupations where more than 90% of the workers have a lower or non-college education. For those occupations where there is no clear majority of workers with college or non-college education, a 10% college wage premium threshold applies, i.e. an occupation is classified as a college (high-skilled) occupation when it pays at least a 10% premium to highly educated (college) workers. In this paper, I use the same thresholds as those used by Gottschalk and Hansen (2003). Table 7 shows the regression estimates of returns to education based on the Mincerian and Realized-Matches specifications for France and Germany.

Focusing on the Realized-Matches specification and comparing Table 6 to Table 7, the estimates for the correctly matched, over-educated and under-educated natives working in high-skilled occupations in Table 7 are similar to their equivalents in Table 6 in both France and Germany. However, comparing the regression estimates for French migrants shows that if a migrant manages to get a job in a high-skilled occupation that accurately reflects her educational skills, she will be rewarded substantially more than

otherwise (12 percent as opposed to 7.1 percent). While for Germany, the evidence of the above tendency is not that strong; the penalty for under-educated migrants working in high-skilled occupations (-15.6 percent) is significantly larger than that of the pooled occupational sample (-3.6 percent).

Focusing on low-skilled occupations, the penalty for natives being under-educated in Germany (-11.8 percent) is substantially higher than its equivalent in Table 6 (-6.7 percent). In France, the returns to education of correctly matched natives and immigrants working in low-skilled occupations are substantially lower than those of the pooled occupational sample. Comparing further the estimates between the correctly matched French native and immigrant workers in low-skilled occupations in Table 6 shows that French migrants have a significantly lower returns to education compared to natives (3.8 percent as opposed to 6.3 percent) in the case where their education matches the one prevailing in a certain low-skilled occupation.

Overall, contrasting the regression results obtained using the Mincerian and Realized-Matches Approach regarding the educational attainment of native and foreign-born workers in Austria, Germany, and France, highlights the importance of accounting for potential mis-matches due to the over- or under-education of workers. Using the Realized-Matches Approach and accounting for the usual years of schooling across different occupations rather than just actual years of schooling, better explains the variation in earnings and allows for a more nuanced explanation of why foreign-born workers have lower rates of return to education than natives. While returns to 'typical' education are similar between native and immigrant workers, over-educated immigrants have significantly lower returns to education compared to natives. There is some weak evidence that foreign-born workers are penalized less for being under-educated than natives.

2.5 Conclusion

This paper attempts to explain the relationship between education and wages among native and foreign-born workers in Austria, France, and Germany. While a standard Mincerian specification suggests a significant gap in returns to education between natives and workers, this study investigates to what extent these differences result from a potential mis-match between the actual and the 'typical' years of schooling typical for

a certain occupation. The results of the Realised-Matches Approach provide an explanation, suggesting a more nuanced picture: returns to the 'typical' education are very similar for natives and the foreign-born, while natives are over-compensated compared to foreign-born workers for each over-educated worker. Natives tend to be over-represented among over-educated workers (e.g. in France and Germany), which explains why in the standard Mincerian specification natives appear to have higher returns to education. There is limited evidence that foreign-born workers are less penalised for being under-educated compared to native workers although a significant difference is only observed in Austria.

Due to data limitations and methodology changes of variable definitions across and within countries, it was not possible to carry out a regression analysis over time and therefore verify or disprove the *Search and Match* theory or the *Human Capital* theory, which both require a time dimension in the data. However, the regression analysis confirms the *Assignment* theory hypothesis of under-educated workers being penalized more than the rewarded, over-educated workers in Germany and Austria. The *Technological Change* theory is confirmed in the analysis for France where the incidence of over-educated migrants from non-EU countries is triple the one for over-educated migrants from EU countries.

The main conclusions can be summarised as follows: Foreign-born workers find it slightly more difficult to find employment in occupations matching their level of education. When they do find employment in such occupations, their earnings are on par with those of natives of similar educational attainment. However, compared to natives, foreign-born workers have lower returns to over-education, which drives the gap in earnings between natives and the foreign-born. This is evidence for the difference in the 'quality' of education among natives and foreign-born employees. That is foreign-born workers both find it more difficult to find jobs matching their education and may also face lower earnings than natives for similar levels of education beyond the prevailing level in a given occupation.

When distinguishing between highly skilled and low-skilled occupations, France rewards over-educated and correctly educated migrants in highly skilled occupations substantially more than natives. While the same is valid for Germany in the case of the 'typical' education of migrants across highly skilled occupations, the penalty for being

an under-educated migrant working in a highly skilled occupation is significantly higher than that for natives.

Focusing on low-skilled occupations, it is worth noting that in France the returns to education for correctly matched natives and immigrants are substantially lower than those for the pooled occupational sample. Furthermore, French migrants in low-skilled occupations have significantly lower returns to education compared to natives in the case where their education matches the one prevailing in a certain low-skilled occupation.

Differences in immigration policies (access to labour markets) do not play a role while comparing the educational returns of native and migrant workers who have found a position perfectly corresponding to their education. The gap between educational returns of natives and workers across all countries in this case is non-existent. However, migrant-conservative labour markets in the EU countries of France, Germany, and Austria reward native workers more than they reward immigrants in the case these workers have higher education than that 'typical' for their occupation. In contrast, the more migrant-friendly labour markets in the UK and the US do not distinguish between natives and immigrants in rewarding over-education. The fact that the UK and the US pursue relatively liberal immigrant labour market policies and do not punish migrants for being over-educated, compared to the rest of the EU, could potentially explain the fact that the UK and the US attract some of the best educated and highly skilled immigrants despite the uncertainties of the matching mechanism in their respective labour markets.

The findings of this paper are generally in accordance with previous studies for the US and the UK, which also find little difference in remuneration for correctly matched native and foreign-born employees coupled with an over-representation of native workers in correctly matched positions and for those over-educated in their positions. Furthermore, in the absence of mis-matches across occupations (over- and under-education), the returns to 'typical' education using the Realized-Matches Approach for both groups of employees are substantially higher than their returns to education in the Mincerian Framework in all countries.

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2.A Appendix

A.1. Highest Educational Degree Achieved by Workers and Years of Schooling (Austria, 2000)

Highest Educational Degree	Years of Schooling
Less than 1st stage of secondary level	5
1st stage of secondary level	8
2nd stage of secondary level	12
3rd level other than university degree	13
Initial university degree or equivalent	16
Higher university degree or post-doctorate	18

Source: Luxembourg Income Study

The education variable in the Luxembourg Income Study is constructed according to the ISCED 97 international standard classification of education; calculations are done by the author.

A.2. Highest Educational Degree Achieved by Workers and Years of Schooling (France, 2000)

Highest Educational Degree	Years of Schooling
BEPC, Brevet des Colleges	9
Degree lycee	11
A-E baccalaureat	12
Baccalaureat Professionel	13
CAP, BEP	11
Technical	12
1st cycle	14
2nd cycle	16
3rd cycle	18

Source: Luxembourg Income Study, calculations are done by the author.

A.3. Highest Educational Degree Achieved by Workers and Years of Schooling (Germany, 2000)

Highest Educational Degree	Years of Schooling
Secondary education (Hauptschule)	9
Secondary education, 1st stage (Realschule)	10
Secondary education, 2nd stage (Abitur)	13
Academy (Fachoberschule)	12
Technical college (Fachhochschule)	13
University	18
Foreign university	18
Technical school (GDR)	13
University GDR	18
Other diploma	12

Source: Luxembourg Income Study, calculations are done by the author.

Table 1. Distribution of Key Statistics by Country and Status (%)

	Average years of education	Correctly educated	Over-educated	Under-educated	Over-educ. in a low-skilled occ.	Under-educ. in a highly skilled occ.	Married	Permanent Employee	Supervisor
Austria									
Natives	12	73.33	4.86	21.82	3	7	60.1	50.7	64.9
Foreign-born	12	61.54	10.99	27.47	9	22	74.0	43.6	61.2
France									
Natives	11	36.92	25.58	37.49	25	38	56.8	54.2	48.7
Foreign-born	9	27.22	21.27	51.5	20	44	71.2	50.8	50.1
Germany									
Natives	10	50.11	36.24	13.65	36	23	60.6	50.4	14.1
Foreign-born	9	45.54	35.78	18.67	36	29	76.8	48.2	8.1

Chart 1. Distribution of Years of Schooling, Austria (2000)

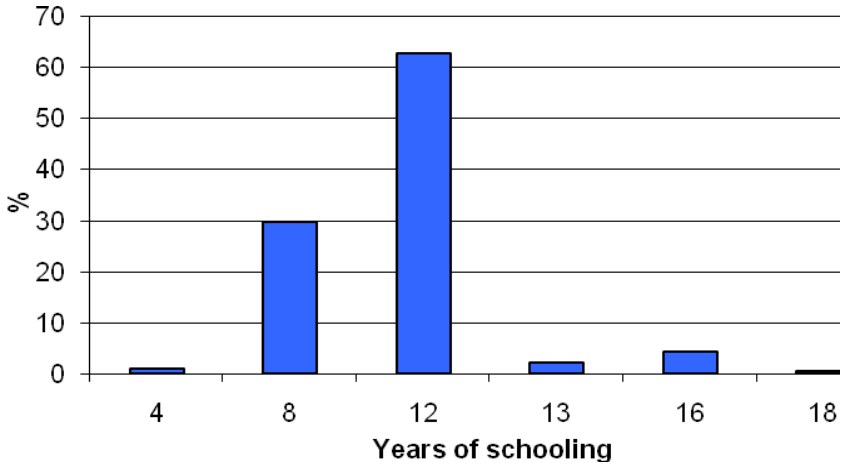

Chart 2. Distribution of Years of Schooling, France (2000)

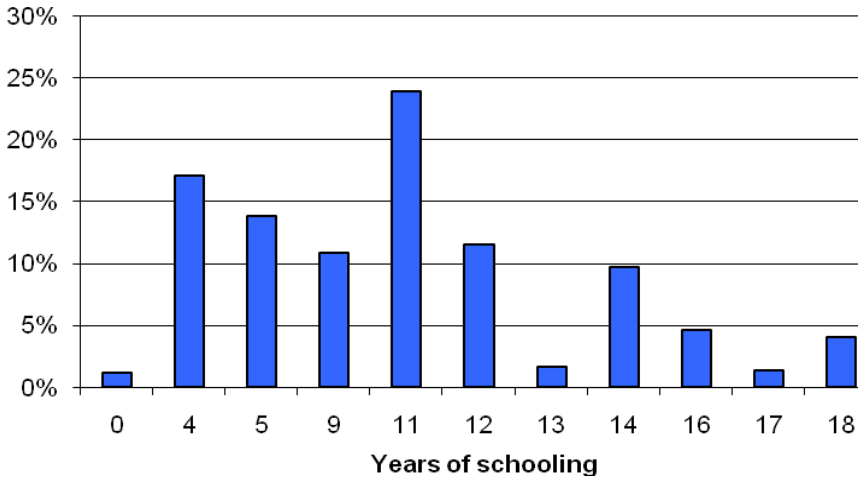

Chart 3. Distribution of Years of Schooling, Germany (2000)

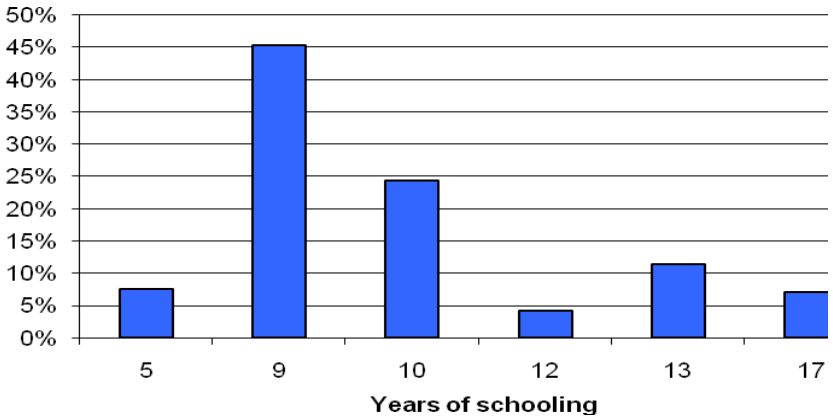

Table 2a. Difference between Native and Foreign-Born Workers' Education across Countries (percentage points)

	Correctly educated	Over-educated	Under-educated
Austria	11.79	-6.13	-5.65
France	9.70	4.31	-14.01
Germany	4.57	0.46	-5.02
UK*	15.00	-19.00	3.00
USA**	14.60	3.99	-18.65

* Lindley & Linton (2006) Estimates for white male natives vs. white male immigrants between 1993-2003.

** Chiswick & Miller (2007) estimates are for males only based on the 2000 Census data.

Table 2b. Ratio of Native to Foreign-Born across Realised Matches and Countries (%)

	'Typical' education	Over-education	Under-education	Over-educated in a low-skilled occup.	Under-educated in a highly skilled occup.
France	1.32	1.19	0.73	1.25	0.86
Germany	1.07	1.09	0.66	1	0.79
Austria	1.19	0.44	0.79	0.33	0.32
UK*	1.71	0.66	1.13	n/a	n/a
US^	1.53	1.14	0.58	n/a	n/a

Source: LIS Project and the author's calculation.

* White males only, based on Lindley & Linton (2006).

^ Males only, based on Chiswick & Miller (2007).

Table 3. OLS Estimates of Earnings: Mincer vs. the Realized Matches Approach France, (2000)

	Natives		Foreign-born	
	Mincerian	Realized Match	Mincerian	Realized Match
Education	0.062*** (0.001)	(b)	0.051*** (0.005)	(b)
'Typical' Education[(a)]	(b)	0.080*** (0.002)	(b)	0.071*** (0.006)
Over-education	(b)	0.068*** (0.004)	(b)	0.042*** (0.011)
Under-education	(b)	-0.042*** (0.002)	(b)	-0.036*** (0.006)
Experience	0.031*** (0.001)	0.032*** (0.002)	0.026*** (0.006)	0.023*** (0.005)
Experience^2/100	-0.038*** (0.004)	-0.044*** (0.004)	-0.025*** (0.010)	-0.023*** (0.009)
Married dummy	0.006 (0.011)	0.001 (0.011)	-0.009 (0.041)	0.006 (0.040)
Private/State Dummy	-0.101*** (0.011)	-0.074*** (0.011)	-0.120*** (0.049)	-0.065 (0.052)
Permanent contract dummy	0.352*** (0.018)	0.327*** (0.018)	0.288*** (0.051)	0.262*** (0.050)
Supervisory role dummy	0.238*** (0.013)	0.212*** (0.012)	0.337*** (0.043)	0.304*** (0.043)
Controls	yes	yes	yes	yes
Constant	7.528*** (0.045)	7.291*** (0.049)	7.571*** (0.141)	7.333*** (0.146)
R^2	0.42	0.44	0.38	0.40
Number of Observations	9143	9143	921	921

Notes: (a) Computed by using the modal value of years of schooling across occupations
(b) Variable not included
Huber-White standard errors are in parentheses.
*** denotes significance at the 1 percent significance level; ** denotes significance at the 5 percent significance level; * denotes significance at the 10 percent significance level.
Married dummy – reference group is not married, divorced or widowed
Private/State dummy – reference group is state-owned company
Permanent contract dummy – reference group is fixed-term contract
Supervisory role dummy – reference group is no supervisory role of the worker
Controls – region, industry (reference groups are services and agriculture)
Source: Luxemburg Income Study: www.lisproject.org

Table 4. OLS Estimates of Earnings: Mincer vs. the Realized Matches Approach Germany, (2000)

	Natives		Foreign-born	
	Mincerian	Realized Match	Mincerian	Realized Match
Education	0.065*** (0.003)	(b)	0.031*** (0.005)	(b)
'Typical' Education[(a)]	(b)	0.086*** (0.004)	(b)	0.096*** (0.011)
Over-education	(b)	0.036*** (0.006)	(b)	0.012* (0.007)
Under-education	(b)	-0.067*** (0.009)	(b)	-0.051*** (0.018)
Experience	0.049*** (0.004)	0.049*** (0.004)	0.038*** (0.007)	0.039*** (0.007)
Experience^2/100	-0.086*** (0.007)	-0.085*** (0.007)	-0.056*** (0.014)	-0.058*** (0.013)
Married dummy	-0.030* (0.017)	-0.032* (0.018)	-0.031 (0.052)	-0.020 (0.051)
Private/State Dummy	-0.157*** (0.018)	-0.132*** (0.019)	-0.117*** (0.047)	-0.051 (0.047)
Permanent contract dummy	0.352*** (0.024)	0.358*** (0.024)	0.346*** (0.051)	0.363*** (0.051)
Supervisory role dummy	0.355*** (0.019)	0.351*** (0.019)	0.478*** (0.062)	0.408*** (0.061)
Controls	yes	yes	yes	yes
Constant	5.866*** (0.080)	5.660*** (0.082)	6.192*** (0.178)	5.633*** (0.199)
R^2	0.42	0.44	0.50	0.53
Number of Observations	9069	9069	1333	1333

Notes: (a) Computed by using the modal value of years of schooling across occupations
(b) Variable not included
Huber-White standard errors are in parentheses.
*** denotes significance at the 1 percent significance level; ** denotes significance at the 5 percent significance level; * denotes significance at the 10 percent significance level.
Married dummy – reference group is not married, divorced or widowed
Private/State dummy – reference group is state-owned company
Permanent contract dummy – reference group is fixed-term contract
Supervisory role dummy – reference group is no supervisory role of the worker
Controls – region, industry (reference groups are services and agriculture)
Source: Luxemburg Income Study: www.lisproject.org

Table 5. OLS Estimates of Earnings: Mincer vs. the Realized Matches Approach Austria, (2000)

	Natives		Foreign-born	
	Mincerian	Realized Match	Mincerian	Realized Match
Education	0.078*** (0.006)	(b)	0.041*** (0.018)	(b)
'Typical' Education [a]	(b)	0.088*** (0.009)	(b)	0.107*** (0.028)
Over-education	(b)	0.077*** (0.010)	(b)	0.025* (0.023)
Under-education	(b)	-0.072*** (0.009)	(b)	-0.041** (0.021)
Experience	0.017*** (0.004)	0.017*** (0.004)	0.057*** (0.019)	0.056*** (0.019)
Experience^2/100	-0.017** (0.009)	-0.018** (0.009)	-0.097*** (0.039)	-0.096*** (0.039)
Married dummy	-0.071*** (0.024)	-0.069*** (0.024)	-0.220*** (0.105)	-0.225*** (0.099)
Private/State Dummy	-0.074*** (0.027)	-0.069*** (0.026)	-0.244*** (0.111)	-0.195* (0.108)
Permanent contract dummy	0.320*** (0.054)	0.326*** (0.054)	0.192 (0.156)	0.255* (0.162)
Supervisory role dummy	0.204*** (0.21)	0.206*** (0.021)	0.152 (0.203)	0.174* (0.108)
Controls	yes	yes	yes	yes
Constant	7.824*** (0.133)	7.691*** (0.162)	8.272*** (0.376)	7.463*** (0.511)
R^2	0.46	0.46	0.44	0.47
Number of Observations	1747	1747	152	152

Notes: (a) Computed by using the modal value of years of schooling across occupations
(b) Variable not included
Huber-White standard errors are in parentheses.
*** denotes significance at the 1 percent significance level; ** denotes significance at the 5 percent significance level; * denotes significance at the 10 percent significance level.
Married dummy – reference group is not married, divorced or widowed
Private/State dummy – reference group is state-owned company
Permanent contract dummy – reference group is fixed-term contract
Supervisory role dummy – reference group is no supervisory role of the worker
Controls – region, industry (reference groups are services and agriculture)
Source: Luxemburg Income Study: www.lisproject.org

Table 6. Regression Estimates of the Returns to Education on Earnings by the Realized Matches Approach across Countries

	Correctly Educated			Overeducated			Undereducated		
	Natives	Immigrants	Native-Imm. Gap	Natives	Immigrants	Native-Imm. Gap	Natives	Immigrants	Native-Imm. Gap
France	0.08	0.071	**0.009**	0.068	0.042	**0.026*****	-0.042	-0.036	**-0.006***
Germany	0.086	0.096	**-0.01**	0.036	0.012	**0.024*****	-0.067	-0.051	**-0.016**
Austria	0.088	0.107	**-0.019**	0.077	0.025	**0.052**	-0.072	-0.041	**-0.031****
UK [1]	0.069	0.054	**0.015**	0.025	0.009	**0.016**	-0.036	-0.044	**0.008**
USA [2]	0.153	0.153	**0**	0.056	0.045	**0.011**	-0.066	-0.022	**-0.044*****

Note: 1. Lindley & Linton (2006) Estimates for white male natives vs. white male immigrants are presented for the years 1993-2003
2. Chiswick & Miller (2007) estimates are for males only based on 2000 Census data.

Table 7. Regression Estimates of Highly Skilled vs. Low-Skilled Occupations

	Highly skilled occupations				Low-skilled occupations			
	Natives		Immigrants		Natives		Immigrants	
	Mincerian	Realized Match	Mincerian	Realized Match	Mincerian	Realized Match	Mincerian	Realized Match
France								
Education	0.081*** (0.005)		0.101*** (0.025)		0.044*** (0.002)		0.024 *** (0.006)	
'Typical' education		0.088*** (0.005)		0.120*** (0.024)		0.063*** (0.003)		0.038*** (0.007)
Over-education		0.056*** (0.008)		0.073*** (0.030)		0.059*** (0.005)		0.031 ** (0.014)
Under-education		-0.051*** (0.009)		0.031 (0.052)		-0.035*** (0.002)		-0.015** (0.007)
Number of Observations	2866	2866	235	235	6277	6277	686	686
Germany								
Education	0.075*** (0.007)		0.036*** (0.014)		0.102* (0.027)		0.016 (0.016)	
'typical' education		0.085*** (0.007)		0.108*** (0.017)		0.138 (0.039)		0.059 (0.040)
Over-education		0.054*** (0.010)		0.020 (0.013)		-0.001 (0.023)		-0.019 (0.105)
Under-education		-0.079*** (0.015)		-0.156*** (0.043)		-0.118*** (0.019)		0.016 (0.016)
Number of Observations	2914	2914	490	490	6155	6155	843	843

Note: Austria is not considered due to insufficient observations

Chapter 3

Productivity Differences and Agglomeration across Districts of Great Britain*

3.1 Introduction

Regional differences in economic performance within countries are often large and usually persistent. In developed countries, average labour productivity or workers' income in the richest regions is double and sometimes triple that of the poorer regions. For example, the average hourly earnings in Great Britain in year 2003 are 22 pounds in some London boroughs and only 8.3 pounds in the county of Northumberland in the North East of Britain. The discrepancies are even higher in developing countries.[52] Understanding the fundamental causes of these persistent inequalities is crucial in speeding up the development of those regions which are lagging behind.

A key culprit among the possible explanations for regional differences in average labour productivity is the existence of spatial externalities and other sources of increasing returns such as transportation and coordination costs. Ciccone and Hall (1996) are the first to empirically analyze the agglomeration effects in Europe as a result of spatial externalities due to employment density. In their study, the density of economic activity is defined as the number of people employed per square kilometre.[53] The main assumption of the paper is that in a world with constant returns to capital, where transportation costs are negligible due to well-developed infrastructure, employment density is a potential source of increasing

* I would like to thank Štěpán Jurajda, Randall Filer, Alexandru Chirmiciu and Brett Langston for their valuable suggestions and comments.

[52] For a detailed description of the regional income differences within a number of countries see Aten and Heston (2003).

[53] The terms agglomeration and employment density will be used interchangeably throughout the paper.

returns resulting from stronger knowledge and technological spillovers in areas of dense economic activity.

The main problem when estimating the strength of agglomeration effects is the potential reverse causality running from productivity to employment density: if high productivity regions tend to attract more workers then the estimated coefficient would be biased upwards. The presence of endogeneity is plausible since productivity or income can increase due to higher employment density as explained above, but it is also possible that higher productivity and wages may attract more workers and firms to a given area. Such reverse-causality can lead to overestimating of the effect of agglomeration on productivity and therefore should be carefully addressed. Ciccone and Hall (1996) contribute to the existing literature by credibly instrumenting the employment density by the total land area of the regions.

There is extensive empirical literature on agglomeration-productivity relationship based on US data,[54] and more recently a number of empirical studies on European countries.[55] These studies estimate an elasticity of the average labour productivity with respect to the employment density in the range of 0.02 to 0.05. The usual geographic level of analysis is county level (NUTS 3), and all existing studies use a maximum of one variable to instrument for employment density. Thus, the literature leaves several important questions to be answered such as what is the optimal geographic level at which the analysis should be conducted or how can agglomeration be best instrumented. My goal in this paper is to shed more light on the mechanism of the agglomeration effects by comparing results based on different levels of spatial division - NUTS 3 (county level) vs. NUTS 4 (district level), where a county is composed of more than one district. Furthermore, this study extends the existing literature by instrumenting for employment density simultaneously with two variables, which provides higher precision of estimates and is also important in the light of the current local average treatment effect (LATE) literature. Instrumenting agglomeration by total land area and population size at the same time corrects the estimates

[54] See Rosenthal and Strange (2001) for the determinants of agglomeration and thorough analysis of agglomeration different geographic levels. See also Moomaw (1985), Henderson (1986) and the survey provided by Rosenthal and Strange (2004).
[55] Ciccone (2002), Combes et al. (2004), Duranton and Monastiriotis (2002), Kanbur and Venables (2003).

since the two instruments weight the potentially heterogeneous effects across the population differently – more weight is given to those individuals for whom the given instrument has more predictive power (Angrist and Imbens, 1995).

Specifically, this paper uses UK local authority district level (LAD) data provided by the Official Labour Market Statistics for the years 1998 and 2003. The analysis covers districts in England, Wales and Scotland, countries which are known for their large regional diversity and income differences.[56] I adopt the specification used by Hall and Ciccone (1996) and Ciccone (2002), and examine the effect of agglomeration (employment density) on the average hourly earnings of UK workers across these districts.

The total land area of districts and the population density which prevailed across districts in 1801 are used as instruments. Both types of instruments are commonly used in the existing literature (Ciccone and Hall, 1996; Ciccone, 2002; Rice and Venables, 2004; Combes et al., 2004) since they are correlated to the employment density but not to productivity or income. However, all the studies use the above instruments separately, while I instrument agglomeration using jointly the total land area and the population density across regions. Furthermore, I also distinguish between Metropolitan and non-Metropolitan areas in an attempt to see whether the observed differences in productivity are driven mainly by the big cities and in particular by London.[57] Finally, unlike most other studies, this paper provides rigorous testing of the validity of the employed instruments and the presence of endogeneity using various specification tests.

The findings of the paper are generally in accordance with the existing research,[58] since the estimated elasticity of hourly earnings with respect to employment density is about 4 percent and there is no major difference between the district and county-level results. The agglomeration effects in Metropolitan areas are significantly higher than those exhibited by both non-Metropolitan areas and the sample as a whole. One possible reason

[56] See Blackaby and Murphy (1995), Monastiriotis (2004), Rice and Venables (2004) .
[57] The focus of many agglomeration studies in the past has been on the potential relationship between city size and productivity (Moomaw, 1985; Henderson, 1986). These studies cover the US but suffer from output measurement error due to census miscalculation. Currently, the issue of size-specific agglomeration effects has gained popularity again (Strange, 2003).
[58] Existing research in trade and economic growth theories has estimated increasing returns to scale stemming from differences in human capital skills using alternative approaches and have reported similar estimates, e.g. Antweiler and Trefler (2002), Charles Jones (2005).

for the presence of such non-linearity might be that the current Metropolitan areas of the UK are characterized by high employment in the prevalent financial and business services sectors which benefit from clustering of businesses together and information spillovers as opposed to other sectors such as manufacturing.

3.2 Empirical and Theoretical Background

The foundation of the recent literature on agglomeration (approximated by employment density) is provided by Ciccone & Hall (1996), who consider density as a source of aggregate increasing returns and define it as the intensity of labour, human and physical capital relative to physical space. Their results suggest that doubling employment density across US states would raise the average labour productivity by 6 percent. Rosenthal & Strange (2001) further analyze U.S. industries at three different aggregation levels: by zip code, county and state levels. The authors claim that agglomeration is positively affected by manufacturing inputs, shipping costs and natural resources on the state level, but these have little relevance at lower geographical levels.

Extending the model of Ciccone and Hall (1996), Ciccone (2002) develops a theoretical model which is used to motivate the empirical estimates in this study. One of the assumptions of the model is that the density of economic activity is the source of spatial externalities responsible for average labour productivity differences across regions.

The estimation of agglomeration effects using regional data stems from the following definition of the production function on an acre of land in region s, which belongs to a country or larger region c:

$$q = \Omega_{sc}\ f\,(\,nH,\ k,\ Q_{sc},\ A_{sc})$$

where q is the output per acre of land, n is the number of workers employed on the acre, H the average level of human capital of workers on the acre, and k the amount of physical

capital used on the acre; Ω_{sc} is the index of total factor productivity in the region; Q_{sc} and A_{sc} stand for the total production and total acreage in the region. The density of production Q_{sc} / A_{sc} represents the spatial externality associated by physical proximity. The model is developed further (see Ciccone, 2002) and as a result the estimation equation at the regional level is given by

$$log\ Q_{sc} - log\ N_{sc} = Large\ Region\ Dummies + \theta\,(log\ N_{sc} - log\ A_{sc}) + \sum_{e=1}^{E_c} \delta_{ec} F_{esc} + u_{sc} \qquad (1)$$

where N_{sc} is the total employment in the region; E_c is the number of different education levels existing in the large region c; δ_{ec} is the effect of the education level e on the productivity in large region c; F_{esc} is the fraction of employed people with certain type of education in region s in large region c and u_{sc} captures the differences between total factor productivity in region sc and a larger region.[59]

The left-hand side of equation (1) represents the logarithm of the output or earnings per worker in a region and the term log (N_{sc} / A_{sc}) is the log employment density or the agglomeration variable showing the number of workers employed per square kilometre.

According to Ciccone (2002), in order to have a meaningful measure of the density of economic activity, one should estimate externalities at a 'fine level of geographic details'. Therefore, in my analysis, I use regional data at the lowest possible geographic level (NUTS 4). One of the main disadvantages of working at this level is that there is no information of the quantity of physical capital across regions. Therefore, another important assumption of the model is that the rental price of capital is equal across large regions (here

[59] See Ciccone (2002) and Ciccone and Hall (1996) for a detailed derivation of the estimated equation.

counties or bigger regions) which helps to overcome the problem with the missing data on the quantity of physical capital at such a detailed geographic level.[60]

Similar effects have been estimated in Europe as well. Ciccone (2002) examines five European economies (France, Germany, Italy, Spain and the UK) and estimates the effects of agglomeration on spatial differences of income to be 4.5 percent. The author instruments employment density by the regional total land area. Combes et al. (2004) base their research on a large panel of French workers for the period 1976-1996, and find that the elasticity of earnings with respect to employment density is 0.02. The endogeneity problem is addressed by instrumenting the employment density using the regional population density in 1936.

Rice and Venables (2004) focus on regional income inequalities and their determinants. The authors consider the NUTS 3 sub-regions of Great Britain and explore the hypothesis that the proximity to economic mass, measured by driving time between regions, raises earnings. The authors instrument the proximity to economic mass by the population of the British counties in 1851, and find that the impact on productivity is the highest for economic centres within a driving time of 40 minutes. These findings are in full accordance with the existing literature which claims that the interaction effects that result in increasing returns are mostly due to local employment density.

This paper uses UK regional data to study agglomeration effects at both county and district level and has two key features that distinguish it from the existing literature. First, I estimate agglomeration effects using two alternative instruments: total land area of the district and the population density of districts in 1801 (long before the industrial revolution took place in Great Britain). This allows for higher precision of estimates since the two instruments give different weights to the population depending on their predictive power. The second main difference with regards to the existing agglomeration studies is that the sample is split into Metropolitan areas (greater London and the metropolitan counties) and non-Metropolitan areas in order to allow for potential non-linearities in the agglomeration/earnings relationship. It is important to note that it is beyond the scope of the

[60] See Ciccone (1996) and Ciccone (2002) for a detailed derivation of the rental capital price assumption.

present paper to focus on industry-specific agglomeration effects. The main assumption is that the spatial variation in hourly earnings arises from knowledge spillovers and highly employee-dense regions rather than differences in wages across occupations.

3.3 Data and Descriptive Analysis

This study is based on data available from the Official Labour Market Statistics in the UK.[61] The unit of analysis is the Local Authority District (LAD) which corresponds to NUTS 4 level and covers districts in England, Wales and Scotland. The basic building block for these areas is the electoral ward/division. The data is cross-sectional and consists of the two time periods of 1998 and 2003, because this reflects the possible change in the size of the effect of agglomeration and education on regional wages over time.

There are 407 districts in the data and Table 1 shows that the variation of their areas is substantial. This is mainly due to the fact that the LADs are a mixture of single-tier and two-tier local government including metropolitan and non-metropolitan areas and boroughs. The local government structure in Great Britain underwent a substantial change in 1974-1975[62] which resulted in abolishment of the county boroughs, reduction of the number of upper-tier county councils and replacement of the 1250 lower-tier councils with 369 district councils. In 1986, the government decided to promote London Boroughs and the Metropolitan District Councils from second-tier to single-tier authorities similar to the old county boroughs in the pre-1974 arrangements. The most recent changes have affected different parts of Great Britain and in many areas these have effectively reversed the 1974/75 changes. Despite the fact that the areas of the current 407 LADs in the data were defined by the 1974-75 reform, the majority of them have shaped their current areas according to their pre-1974 local authority borders. For the sake of comparative analysis at different levels of aggregation I hereby present the same data on the county level. Once the districts are aggregated to local government counties the number of observations falls to 200.

[61] See www.nomisweb.co.uk where Nomis is a web-based database of labour market statistics.
[62] See www.statistics.gov.uk/geography or www.genuki.org.uk

The usual practice in estimating differences in productivity is to look at the gross value added per worker across regions. The UK National Labour Market Statistics do not offer data on value added at district level and although it could be approximated by different measures, it would still have the disadvantage that within small areas it is highly sensitive to local profits allocation and other non-wage income. In my analysis I focus on other commonly used proxy for productivity – the average hourly earnings of full-time employees. The average hourly earnings are taken from The New Earnings Survey, which is an annual survey based on a sample of one percent of employees in employment excluding self-employed workers.[63] While the use of average hourly earnings may have some shortcomings, such as distortions due to differences in labour intensity of local production or local employment opportunities (e.g., unemployment), the labour market in Great Britain is highly competitive, ensuring mobility of labour and capital across regions, such that differences in earnings are expected to reflect differences in productivity.

Table 2 presents the summary statistics for the average hourly earnings of the employed population between 18 and 60 years of age at district and county levels. The average hourly wage varies from 9 pounds in 1998 to 11 pounds in 2003. Workers in rich regions receive almost three times higher wages compared to those in poor regions, a fact that confirms the importance of spatial differences in income across UK districts and counties. These characteristics of the hourly earnings at county level are very similar to those displayed by Rice and Venables (2004).

Agglomeration is measured by employment density which equals the average number of full-time employed workers per square kilometre in a given district. Table 3 shows the main characteristics of the agglomeration where the magnitude of the coefficient of variation takes values of 1.3 up to 1.49 and indicates large employment diversity across

[63] The hourly payments made to the employee are before any statutory or other deductions. They include all payments which related to that period regardless of when particular payments within the total were made or whether they were all paid at the same time. Where bonuses or similar payments are not paid in each pay-period, they include the proportionate amount for the reported pay-period based on the last payment, or next payment if known (for example, one-quarter of a monthly bonus for a weekly pay-period).

districts and counties with an increasing share of people employed per square kilometre over time.

Education is one of the most important characteristics to control for when studying wage differences. The data on education comes from regional Labour Force Surveys and covers the percentage of economically active workers with different types of education: NVQ4, NQV3, NQV2, NQV1, trade apprenticeships, other and no qualifications. I have grouped the educational levels in three groups: high education (NQV4 and NQV3), low education (NQV2, NQV1, trade apprenticeships and other qualifications) and no formal qualifications.[64]

Evidence of the positive upward trend of the relationship between agglomeration and earnings across regions is provided by figure 1, which is based on raw data for hourly earnings and employment density across UK NUTS 4 districts for the years 1998 and 2003.

3.4 Estimation Results

In this section, I account for the effect of agglomeration on average wages across regions in Great Britain. Firstly, table 4 and table 5 present the results of three different OLS specifications at both district and county level for the years 1998 and 2003. Looking at the district level results in both tables, specification 1 considers the pure effect of agglomeration on the average regional earnings. Specification 2 includes large region dummies[65], and specification 3 provides the richest equation offered by Ciccone (2002) where the corresponding proportion of workers at a certain education level plays a role in explaining regional wage inequalities.[66] There is a strong positive relationship between the

[64] NQV4 – first and higher degree; nursing and teaching qualification; NQV3 – A-level; GNVQ Higher level, Advanced certificate of Vocational Education; NVQ2 – GCSE qualifications at grade B or higher, GNVQ Intermediate level; NVQ1 – GSCE qualifications below grade C, GNVQ Foundation level.

[65] There are 11 large regions dummy variables: North East, North West, Yorkshire and the Humber; East Midlands, West Midlands, East, London, South East, South West, Scotland and Wales.

[66] As a robustness check in the regressions I control also for NUTS 2 dummies in case the regional dummies are not present. The results are not significantly different.

average proportion of workers with high education and the corresponding average regional earnings. Regardless of the employed specification, the elasticity of hourly earnings with respect to employment density is around 0.04 for both years.[67] The results reported here confirm the findings of existing studies (e.g., Ciccone, 2002; Rice and Venables, 2004) and demonstrate a robust OLS relationship between agglomeration and average labour income.

Next, the aggregation of the regional data to the next geographic level, i.e. county level, is performed with the main goal of comparing the results at district and county levels.

While there is no a priori optimal geographical level to detect agglomeration effects, these are normally found to rapidly decay with distance. Interestingly, aggregating district level data to the county level yields very similar results. Tables 4 and 5 present the OLS estimates at county level, which suggest no major difference in agglomeration related to the level of aggregation. The coefficient of agglomeration falls from 0.04 (district level) to 0.03 (county level) for both years based on the richest specification. It appears that agglomeration effects do not depend on whether the geographical unit of analysis is district or county.[68]

As Fig. 1 suggests, a group of districts (Metropolitan areas) may exhibit substantially higher employment density and wages than the rest of the regions. Metropolitan areas (London in particular) are known to have high employment densities and wages, which lead to the question of the existence of possible non-linearities in the earnings/agglomeration relationship. Therefore, in order to find out whether the agglomeration effects on wages are not mainly driven by London and other big metropolitan areas, I split the sample into two groups - Metropolitan and non-Metropolitan areas.[69] In the case of Great Britain, Metropolitan areas consist of 71 districts.[70]

[67] The agglomeration effects were confirmed to be 0.06 at large regions' aggregation level though the result is not statistically meaningful due to the low number of degrees of freedom.
[68] All specifications include large region (NUTS 1) dummy variables.
[69] The dummy variable for Metropolitan areas in the OLS specification of the whole sample is significant at the 1% significance level.
[70] Metropolitan areas include greater London, greater Manchester, Merseyside, South Yorkshire, Tyne and Wear, West Midlands, West Yorkshire, Glasgow city and Cardiff.

Tables 6 and 7 show the OLS regression results at district and county levels for all three samples: the whole sample, the Metropolitan, and non-Metropolitan areas for the years 1998 and 2003. Overall, the tables show no difference between the OLS results at district and county levels. Focusing on the district level, we notice that for both years the coefficients of agglomeration for the whole sample and that for non-Metropolitan areas are the same. However, there is a significant difference in the magnitude of the agglomeration estimate for Metropolitan areas where the coefficient is 0.10 in 1998 and 0.09 in 2003 in comparison to 0.04 in the other two samples for both years.[71] The effect of education is similar for all samples in that average wages are higher in areas with a higher proportion of workers with high education, and consequently lower if there is high proportion of workers with low education in the region. All specifications include dummy variables for the presence of large regions at the higher aggregation level.[72]

The results suggest a new feature of the agglomeration-productivity relationship. While there is no significant difference between county and district level of aggregation, agglomeration effects soar in case of big densely populated Metropolitan areas. The high concentration of employees per unit of land seems to foster productivity growth. However, the presence of potential endogeneity between agglomeration and productivity may lead to different results and provide new insights on the mechanism of this relationship.

3.5 Endogeneity

In case regional dummy variables do not capture exogenous differences in incomes across regions, then areas with high exogenous incomes attract more workers and have subsequently higher employment density. As a result, OLS yields inconsistent estimates.

[71] The coefficient of agglomeration for Metropolitan areas is significantly different from those in non-Metropolitan areas and the whole sample at the 5% significance level.
[72] Looking at externalities not only within but also across districts, I controlled in the regressions for neighboring regions. The agglomeration coefficient did not change significantly.

The potential reverse causality between wage income and employment density calls for a different estimation approach involving instrumental variables.

The instrumental-variables approach requires that valid instruments are applied. In this case, potential instruments are certain characteristics of districts that are correlated to agglomeration (employment density) but not correlated to the current incomes of employees across districts. This analysis uses two instruments for agglomeration: the total land area of the district and the population density which dates back to 1801. The total land area of the region is commonly used as an instrument for employment density in the literature (Ciccone, 2002; Ciccone and Hall, 1996). The total land area of the districts in the data has been shaped by the administrative reform of 1974, though the majority of districts have naturally converged to their pre-1974 borders.[73] However, total land is significantly negatively correlated with employment density across districts which could be explained by possible historical equalization of population size across districts.[74] Another explanation for that negative relationship is through the price of land influenced by potentially better consumption amenities (Wheaton and Lewis, 2002; Combes et al., 2004) which make the agglomeration coefficient biased downwards.[75]

The second instrument for employment density is the population density in 1801, which is positively correlated to agglomeration and not related to productivity or income across districts.[76] This historic instrument reflects the way population was distributed in the past regardless of productivity incentives, long before the industrial revolution took place in Great Britain. Data on the population inhabiting the current borders of the districts in 1801 has been reproduced using the published statistics of the registration districts existing at

[73] Changes in the boundaries of administrative units were manly based on political and administrative decisions rather than on productivity developments across regions

[74] The coefficient of variation of the population in 1901 (which is similar to that of 1801) compared to that in 2003 has decreased from 1.06 to 0.68 which indicates that currently the population is substantially more equalized across areas than in 1901.

[75] Better consumption amenities imply higher land prices which have negative effect on local wages. Since land prices are omitted from the regression equation, their negative effect enters the residual which is negatively correlated to employment density since better consumption amenities attract more workers in the region.

[76] See Rice and Venables, 2004; Combes et al., 2004.

that time. The very nature of estimating the historical inhabitants of nowadays districts makes the population density a credible instrument for agglomeration.

Table 8 shows the two-stage least squares estimation of agglomeration effects on average earnings in 2003 using the two instruments: the modern total land area of a region and the population density of a district in 1801. Focusing on the full specification and accounting for both education and regional effects, I examine the instrumental estimation for all three samples. The tendency of agglomeration to have a larger impact on earnings in Metropolitan areas is preserved and the agglomeration coefficient falls from 0.09 in OLS to 0.08 when instrumented.

This fact confirms the hypothesis of potential endogeneity which appears also in non-Metropolitan areas. There the agglomeration effect decreases from 0.04 to 0.02, once the instrumental-variables approach is applied. However, when looking at the results for the sample as a whole, the agglomeration coefficient does not change its value from 0.04, which casts doubts over the reverse causality between agglomeration and wages across regions, and calls for rigorous testing of endogeneity presence and instruments' validity. Comparing tables 7 and 8 suggests the same tendency at county level and therefore presented below are robustness checks of results at district level only.[77]

Model tests

The key to any instrumental-variable (IV) approach is to find valid instrumental variables which are exogenous (correctly excluded from the main equation) and which are not weak. In case the instruments are weak, then the presence of even slight correlation between the instruments and the error term in the original equation can lead to large inconsistencies of the IV estimates. The problem of 'weak instruments' arises either when the instruments are only weakly correlated with the endogenous regressor, or their number is too large (Angrist and Krueger, 2001). Once valid instruments are employed, the final step is to find out whether endogeneity is present in the first place (Hausman, 1978). In case of no evidence

[77] Model tests at county level are available upon request.

of endogenous relationship, the use of instrumental-variables approach becomes unnecessary.

Exogeneity of instruments is tested by regressing the endogenous variable on the potential instruments, which in this case should be correlated with employment density and not correlated with wages. The first two OLS specifications in table 9 present the results of testing the exogeneity of the two instruments at district level for 2003. We can note from the table that the coefficients of both the total land area and the population density are significant at the 1% significance level in case agglomeration is the dependent variable, and they are not significantly different from zero when wages are estimated. Table 9 presents also specifications 3 and 4 where agglomeration is instrumented with only one instrument at a time, while the other instrument is included directly in the main equation (Card, 1993). We observe that in both cases the instrumental variables which are included directly in the main equation are not significant. Therefore, these two instruments are exogenous and are properly omitted from the initial regression equation.

In order to examine the assumption of whether the instruments are weak, a common approach is to look at the F-statistic for the joint significance of the instruments in the first stage equation (Bound et al., 1995). In case the F-statistic is larger than 10 the instruments are not considered to be weak (Staiger and Stock, 1997, Stock, Wright and Yogo, 2002). We can see from table 8 that the first stage F-statistics for the two instruments in use, are well above 10 for all the three samples under consideration, which shows that the instruments are jointly highly relevant and predict well the endogenous variable.

In case the endogenous variable is instrumented by more instruments, an over-identification test for the mutual consistence of the available instruments can be used. One of the most commonly applied tests is the Hansen (1982) / Sargan (1958) test, whose null hypothesis is that the excluded instruments are valid instruments and uncorrelated with the error term.[78] The first row of table 10 shows the Hansen-Sargan statistic for all the samples under analysis and the p-values in the parenthesis which are 0.29 for the whole sample,

[78] Under the null hypothesis the Hansen-Sargan statistics is distributed as chi-square in the number of over-identifying restrictions which are two in this case.

0.16 for the Metropolitan areas and 0.48 for non-Metropolitan areas show that we cannot reject the null hypothesis and therefore the instruments are jointly valid. However, there are studies that show that this test may have low power in case of general misspecification (e.g. Newey, 1985).

Hahn and Hausman (2002) developed a new overidentifying restriction test which takes a general specification approach and examines the relevance of the application of conventional first order asymptotics. They claim that in the case of valid first order asymptotic inference, a change in normalization would yield similar forward and inverse coefficient estimates. Specifically, the *forward* (orthodox) two stage estimate of the coefficient of the right-hand side endogenous variable should be very similar to the inverse estimate from the *reverse* (the right hand side endogenous variables becomes the dependent variable and the dependent variable from the forward regression becomes the right-hand side variable) two stage regression using the same instruments. In case the two estimates are too different, the Hahn/Hausman test sees whether this difference in estimates satisfies the results of second order asymptotic theory.

The second and third rows of table 10 show that the forward estimate for the whole sample is 0.038 while the inverse one is 0.041, the Metropolitan areas forward estimate is 0.082 while the inverse one is 0.11, and finally for non-Metropolitan areas the forward coefficient is 0.026 and in inverse one is 0.028. The inverse estimates for all three samples are significant at the 1% significance level and are almost the same as the forward estimates, which proves that the first order asymptotics is relevant and the main equation is correctly specified.

Given that the instruments are valid, the last specification test is the Durbin-Wu-Hausman test, which is widely used in applied research to test the presence of endogeneity. The null hypothesis of that test is that the specification is proper and all the explanatory variables are exogenous. Table 10 shows that for all three samples endogeneity is present. The strongest case for endogenous relationship between agglomeration and wages across regions is the one for the Metropolitan areas where the p-value of 0.75 indicates endogeneity at the 1% significance level.

Overall, the use of the instrumental-variables approach is justified for all three samples, though for the full sample the agglomeration effects do not change once employment density is instrumented by the total land area of the regions and the regional population density. Splitting the sample into Metropolitan and non-Metropolitan areas reveals the presence of endogeneity in the non-Metropolitan sample where agglomeration estimates fall from 0.04 to 0.02. Despite the fact that the Metropolitan areas agglomeration coefficient decreases by only 1 percentage point due to the endogenous earnings/agglomeration relationship, these areas still exhibit much higher agglomeration effects than non-Metropolitan areas (0.08 compared to 0.02). The lower aggregation level (NUTS 4) enabled a detailed analysis of the endogeneity problem which appears to have new dimensions once Metropolitan areas are accounted for.

3.6 Conclusion

The main goal of this paper is to shed more light on the agglomeration effects on wages across districts of Great Britain. The empirical analysis for the two years of observation, 1998 and 2003, shows that there is a stable positive relationship between agglomeration as measured by employment density and the average earnings at the regional level. Doubling agglomeration would raise wages by 4% at both district and county level. Since counties are larger territorial units than districts and so capture agglomeration spillovers in-between districts, one may expect the agglomeration effects on productivity measured across counties to be higher than that estimated off district data. On the other hand, measuring wages and agglomeration at the county level may introduce measurement error as it may obscure important differences within counties. Hence, a possible explanation for the similar agglomeration effect at county and district level is that these two opposing forces cancel each other.

Estimating agglomeration effects separately for Metropolitan and non-Metropolitan areas, reveals that the density-productivity relationships is much stronger among the former. Metropolitan areas exhibit higher levels of employment density and wages across

regions which could potentially result in a different agglomeration-productivity relationship in major cities as opposed to the one observed in non-Metropolitan areas. One possible reason for the presence of such non-linearity might be that the current Metropolitan areas of the UK are characterized by high employment in the prevalent financial and business services sectors which benefit from clustering of businesses together and information spillovers as opposed to other sectors such as manufacturing.

Therefore, allowing for non-linearities, in the next step of the analysis I separately re-estimate the preferred specifications for the Metropolitan and non-Metropolitan sub-samples. While non-Metropolitan areas exhibit similar coefficients to those prevailing when the whole sample is under consideration, comparing wages and agglomeration within Metropolitan areas shows significantly higher agglomeration effects. The high concentration of employees per unit of land in Metropolitan areas seems to have a much stronger positive effect on productivity than the effect of employment density on productivity in non-Metropolitan areas.

I address the potential reverse causality issues by means of two-stage least squares estimates. Differently from other studies, two instruments are used in the analysis: the total land area of the district and its population density in 1801. Both instruments proved to be valid and to explain agglomeration well. The instrumental-variable results confirm the OLS tendency of Metropolitan areas to exhibit the highest agglomeration effects on productivity though the estimates are slightly lower due to upward biasness of the original estimates. Reverse causality between agglomeration and productivity is present also in the non-Metropolitan areas sample where the agglomeration effect decreases by 2 percentage points. These results prove even further that agglomeration has a weaker impact on wages in non-Metropolitan areas in comparison to the effect it has across densely populated Metropolitan areas.

3.7 References

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3.A Appendix

Table 1. Area of Districts and Counties (square kilometres)

	Districts	Counties
	Area 2003	Area 2003
Mean	605.11	1349.899
Variance	2420356	6426088
Coefficient of Variation	2.57	1.88
Minimum	21	27
Maximum	25784	25784
Number of Observation	407	200

Source: Office for National Statistics, UK

Table 2. Average Hourly Earnings (in British Pounds)

	Districts		Counties	
	Average Hourly Earnings 1998	Average Hourly Earnings 2003	Average Hourly Earnings 1998	Average Hourly Earnings 2003
Mean	9.40	11.24	9.58	11.41
Variance	2.36	4.21	2.43	4.46
Coefficient of Variation	0.16	0.18	0.16	0.18
Minimum	6.47	8.03	7.57	8.95
Maximum	16.4	21.54	16.4	21.43
Number of Observation	407	407	200	200

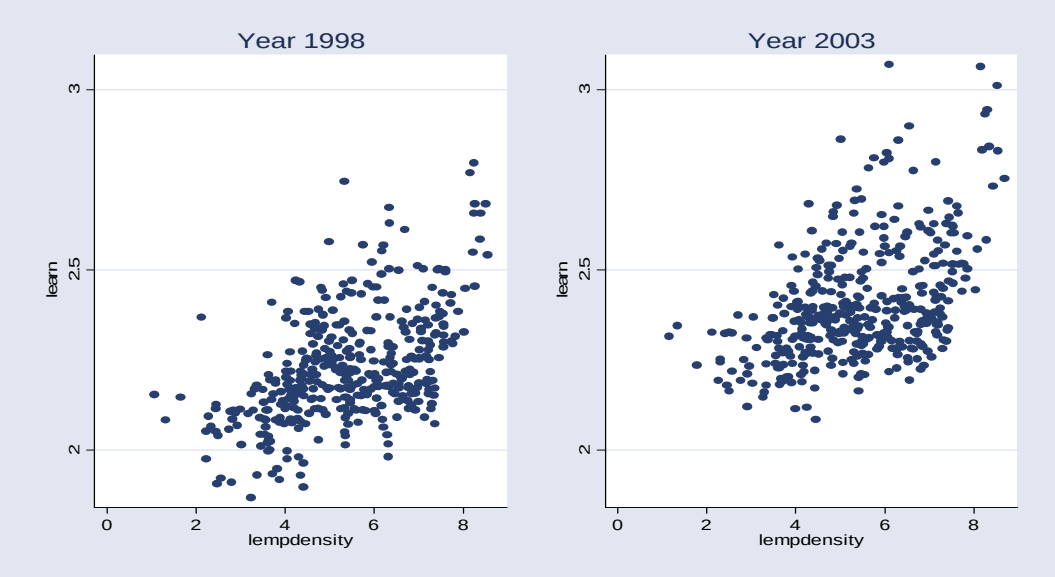
Source: Office for National Statistics, UK

Table 3. Employment Density (number of full-time employees per square km.)

	Districts		Counties	
	Empl. Density 1998	Empl. Density 2003	Empl. Density 1998	Empl. Density 2003
Mean	557.62	571.96	800.01	828.80
Variance	665378.7	730103.7	1075032	1198368
Coefficient of Variation	1.46	1.49	1.30	1.32
Minimum	2.87	3.19	2.87	3.19
Maximum	5166.67	6000	5166.67	6000
Number of Observations	407	407	200	200

Source: Office for National Statistics, UK

Fig.1. The Wage-Agglomeration Relationship



Source: Office for National Statistics, UK

Table 4. OLS Estimates of the Effect of Agglomeration on Earnings: Districts vs. Counties (1998)

	Districts Average Earnings 1998			Counties Average Earnings 1998		
	1	2	3	4	5	6
Agglomeration	0.054*** (0.005)	0.043*** (0.005)	0.036*** (0.006)	0.053*** (0.006)	0.041*** (0.006)	0.032*** (0.006)
High Education[a]	No	No	0.217*** (0.044)	No	No	0.194*** (0.043)
Low Education	No	No	-0.072 (0.058)	No	No	-0.060 (0.047)
Regional Dummies	No	Yes	Yes	No	Yes	Yes
R^2	0.27	0.46	0.60	0.34	0.56	0.68
Number of Observations	406	403	254	200	199	151

Note: Huber-White standard errors are in parentheses. *** denotes significance at the 1 percent significance level

[a] The base case is no formal education. When looking at district level standard errors are clustered by counties.

Table 5. OLS Estimates of the Effect of Agglomeration on Earnings: Districts vs. Counties (2003)

	Districts Average Earnings 2003			Counties Average Earnings 2003		
	1	2	3	4	5	6
Agglomeration	0.053*** (0.005)	0.045*** (0.006)	0.036*** (0.007)	0.054*** (0.006)	0.042*** (0.007)	0.029*** (0.007)
High Education[a]	No	No	0.140*** (0.058)	No	No	0.186*** (0.070)
Low Education	No	No	-0.191*** (0.055)	No	No	-0.142*** (0.044)
Regional Dummies	No	Yes	Yes	No	Yes	Yes
R^2	0.22	0.40	0.51	0.30	0.52	0.64
Number of Observations	406	404	292	200	198	175

Note: Huber-White standard errors are in parentheses. *** denotes significance at the 1 percent significance level; ** denotes significance at the 5 percent significance level; * denotes significance at the 10 percent significance level.

[a] The base case is no formal education. When looking at district level standard errors are clustered by counties.

Table 6. The Effect of Agglomeration on Earnings at district and county level (1998)

	Districts			Counties		
	1 OLS: Whole Sample	2 OLS: MetroAreas	3 OLS: No-MetroAreas	4 OLS: Whole Sample	5 OLS: MetroAreas	6 OLS: No-MetroAreas
Agglomeration	0.036***	0.101***	0.034***	0.032***	0.094***	0.033***
	(0.006)	(0.024)	(0.005)	(0.006)	(0.028)	(0.007)
High Education	0.217***	0.176**	0.239***	0.194***	0.181**	0.207***
	(0.044)	(0.063)	(0.052)	(0.043)	(0.078)	(0.051)
Low Education	-0.072	-0.076	-0.023	-0.060	-0.070	-0.055
	(0.058)	(0.117)	(0.067)	(0.047)	(0.102)	(0.045)
Regional Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.60	0.65	0.54	0.68	0.65	0.59
Number of Observations	254	65	189	151	65	86

Note: Huber-White standard errors are in parentheses. *** denotes significance at the 1 percent significance level; ** denotes significance at the 5 percent significance level; * denotes significance at the 10 percent significance level. The coefficient of agglomeration in (2) is significantly different from the one in (3) at the 5% significance level.

Table 7. The Effect of Agglomeration on Earnings at district and county level (2003)

	1 OLS: Whole Sample	2 OLS: MetroAreas	3 OLS: No-MetroAreas	4 OLS: Whole Sample	5 OLS: MetroAreas	6 OLS: No-MetroAreas
Agglomeration	0.036***	0.091***	0.042***	0.029***	0.091***	0.032***
	(0.007)	(0.025)	(0.005)	(0.007)	(0.025)	(0.007)
High Education	0.140***	0.01	0.185***	0.186***	0.124***	0.208***
	(0.058)	(0.124)	(0.064)	(0.070)	(0.006)	(0.061)
Low Education	-0.191***	-0.278***	-0.097	-0.142***	-0.203***	-0.055
	(0.055)	(0.072)	(0.080)	(0.044)	(0.072)	(0.045)
Regional Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.51	0.62	0.45	0.64	0.62	0.59
Number of Observations	292	68	224	175	68	107

Note: Huber-White standard errors are in parentheses. *** denotes significance at the 1 percent significance level,; ** denotes significance at the 5 percent significance level; * denotes significance at the 10 percent significance level. The coefficient of agglomeration in (2) is significantly different from the one in (3) at the 5% significance level.

Table 8. The Effect of Agglomeration on Earnings using Population Density 1801 and Area as Instruments (2003)

	Districts			Counties		
	1 IV: Whole Sample	2 IV: MetroAreas	3 IV: No-MetroAreas	4 IV: Whole Sample	5 IV: MetroAreas	6 IV: No-MetroAreas
Agglomeration	0.038***	0.083***	0.026***	0.043***	0.084***	0.022***
	(0.010)	(0.023)	(0.010)	(0.015)	(0.023)	(0.011)
High Education	0.130***	0.011	0.165***	0.156***	0.153***	0.213***
	(0.058)	(0.126)	(0.066)	(0.075)	(0.085)	(0.066)
Low Education	-0.199***	-0.289***	-0.116	-0.159***	-0.291***	-0.049
	(0.055)	(0.075)	(0.082)	(0.048)	(0.075)	(0.046)
Regional Dummies	Yes	Yes	Yes	Yes	Yes	Yes
First–stage F–statistic for both instruments	221.22	71.01	125.78	183.84	71.01	84.25
R^2	0.51	0.62	0.44	0.63	0.61	0.59
Number of Observations	290	68	222	175	68	107

Note: Huber-White standard errors are in parentheses. *** denotes significance at the 1 percent significance level; ** denotes significance at the 5 percent significance level; * denotes significance at the 10 percent significance level. The coefficient of agglomeration in (2) is significantly different from the one in (3) at the 5% significance level. The results for 1998 are similar to those for 2003 and are available upon request.

Table 9. Reduced Form and Structural Estimates of the Earnings and Agglomeration Models (year 2003)

	1 Agglomeration OLS	2 Earnings OLS	3 Earnings 2STLS	4 Earnings 2STLS
Population Density 1801	0.66***	0.05	0.01	-----
	(0.08)	(0.08)	(0.02)	
Area	-0.02***	-0.00005	----	0.005
	(0.01)	(0.00006)		(0.008)
Regional Dummies and other control variables	Yes	Yes	Yes	Yes
R^2	0.60	0.48	0.51	0.51
Number of Observations	401	290	290	290

Note: Huber-White standard errors are in parentheses. *** denotes significance at 1 percent significance level; ** denotes significance at 5 percent significance level; * denotes significance at 10 percent significance level.

Table 10. Over-identifying Restrictions and Endogeneity Tests

		Whole sample	MetroAreas	Non-MetroAreas
		IV: Population Density 1801 and Area		
Hansen-Sargan test p-value		$\chi 2(1)=1.10$ (0.29)	$\chi 2(1)=2.82$ (0.16)	$\chi 2(1)=0.49$ (0.48)
Agglomeration (Forward Estimate)		0.038^{***} (0.010)	0.082^{***} (0.023)	0.026^{***} (0.008)
Agglomeration (Reverse estimate)	Inverse reverse estimate	0.041^{***}	0.11^{***}	0.028^{***}
	Reverse estimate	24.66^{***} (7.17)	9.05^{***} (2.96)	34.81^{***} (8.93)
Durbin-Wu-Hausman test		0.14 (0.70)	0.10 (0.75)	2.77 (0.11)
Education		Yes	Yes	Yes
Regional Dummies and Other control variables		Yes	Yes	Yes
Number of Observations		290	68	222

Note *** denotes significance at 1 percent significance level. Standard errors are in parentheses with the exception of Hansen-Sargan test and Durbin-Wu-Hausman test where p-values are reported in the parentheses.