

*Immigration, Wage Inequality and unobservable skills in the U.S. and the UK*

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**Abstract**

Over the last few decades immigration has increased significantly in both the U.S. and the UK; both countries have also experienced notable increases in the degree of wage inequality.

Unlike previous studies this paper focuses on the effects of immigration on the residual wage inequality in the UK and US between 1994 and 2008; it seeks to assess whether and how much of immigration contributed, along with technology, institutions and traditional explanations, to widening inequality. To do so this work re-assess Lemieux's hypothesis (composition effects exert an upward mechanical force on the residual wage inequality) by adding to the original analysis the immigration dimension.

The empirical analysis reveals that residual wage inequality among immigrants is higher than among natives. However those differences do not contribute (much) increasing residual wage inequality observed in the two countries.

*Keywords:* wage inequality, immigration, composition effects, residual  
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## 1.Introduction

Over the last few decades immigration has increased significantly in both the U.S. and the UK; both countries have also experienced notable increases in the degree of wage inequality. According to the Outgoing Rotation Group- Current Population Survey and Labour Force Survey data respectively, in 2008 nearly 14 percent of the U.S. and 15 percent of the UK labour force population<sup>1</sup> had been born abroad. The same data also document that from 1994 to 2008 wage inequality measured by the standard deviation of the natural logarithm of hourly wage for male workers, increased by 2,2 percentage point in the U.S. and by 1,3 percentage point in the UK.

Overall the increase in wage inequality has been stronger in the upper tail than the lower tail of the wage distribution (Machin and Van Reenen, 2007). Since the 1980s both countries experienced an increase in the upper tail inequality (90-50) whereas the 50-10 shrinks. Autor, Katz, Kearney (2007) document that for the US between 1979 and 1987 the male 90/50 log hourly earnings rose by 8.5 log points; between 1987 and 1995 it rose by an additional 5.2 and by 9.7 log points between 1995 and 2003. By contrast between 1979 and 1987 the 50-10 gap increased by 13.0 log points while compressed between 1987 and 2003.

There is a huge empirical debate on the social and economic consequences of international migration, one of the core concerns relates to the impact of immigration on wages of native workers. Despite the common sense intuition behind the theoretical implications of the laws of the supply and demand, the international migration literature has found it difficult to arrive to a consensus on the impact of immigration on wages of workers in the receiving countries.

Abdurrahman and Borjas (2006) for example investigate the effect of the immigration-induced supply shifts on the cross-country evolution of relative wages experienced in Canada, Mexico and United States. They find that the impact of migration on the wage structure differs significantly across the three countries. International migration reduced wage inequality in Canada while it contributed to increase wage inequality in the United States. International migration in Mexico increased the relative wages of workers in the middle of the skill distribution, but lowering the wages of workers at the bottom of the distribution. Assuming that similarly educated workers with different experiences are not perfect substitutes Borjas (2003) confirms the main predictions of the simplest theoretical model of competitive labour market reporting that in the U.S. a 10 percent increase in immigrant flow in the skill reduces weekly earnings by about 4 percent. In contrast Card (2006), Dustmann, Fabbri and Preston (2005) give evidence that the effect of immigration on U.S. and UK native wages is almost negligible.

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<sup>1</sup> Sample includes full time workers, not self-employed, main job only, with positive potential work experience; whose hourly wage is less than 100pounds for the UK and 100 Dollars for the U.S.

A consensus emerging from a recent stream of the empirical literature is that not only immigration has little impact on natives' wages but also that on average immigration exerts a positive effect rather than negative ones on natives' wage (Ottaviano and Peri 2006; Manacorda, Manning and Wadsworth 2006 (MMW hereafter); Dustmann, Frattini, Preston 2008 (DFP hereafter)). As proved by Ottaviano and Peri (2006) for the U.S. and by Manacorda et al. (2006) for the UK natives' wage loss from immigration is mitigated because of incomplete substitutability of immigrants and natives within age and education groups. Ottaviano and Peri (2006) claims that imperfect substitutability may arise, among other aspects, from different abilities or unobserved characteristics of workers. Recently Borjas, Grogger and Hanson (2009) re-examining the Ottaviano-Peri empirical exercise show that their finding of imperfect substitutability is sensitive to the construction of the two key variables-relative wages and relative supplies but particularly to the inclusion of young students in the sample. Under conventional classifications of workers by education and experience, the data fail to reject the hypothesis that immigrant and natives are perfect substitutes. Even allowing for long-run adjustments in the capital stock, immigration appears likely to lower the wages of those natives most affected by immigration-induced supply shifts.

The existing literature investigating the effect of immigration on native-born wages has only addressed the role of observable characteristics (education and experience) of workers while less attention has been devoted to their unobservable skills<sup>2</sup>. Lemieux (2006) shows that residual (within-group) wage dispersion among workers with the same education and experience "...is generally believed to account for most of the growth in overall wage inequality".

Recently Card (2009) offers an overview of existing understanding on the relationship between immigration and inequality, focusing on evidence from cross-city comparison in the U.S. Based on the fact that within-group wage inequality has risen substantially he shows that across major cities the level of residual wage inequality is strongly correlated with immigrants' densities. In particular a 10 percentage point increase in the immigrant share is associated with a 0.025 point rise in the residual variance of high school equivalent men's wages and a 0.027 point rise in the residual variance of college equivalent men's wages. However the effects of immigration on within-group inequality are small: immigrants account only for a share of 5% of the increase in U.S. wage inequality between 1980 and 2000, albeit immigrants tend to have higher residual inequality than natives.

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<sup>2</sup> Gould and Moav (2008) for example empirically investigating how the emigration rate of Israeli workers in the U.S depends on their unobservable skills measured with residual wage from a standard Mincer equation.

There are many reasons to believe that immigrants and natives with similar observable skills may report differences in wages because of differences in unobservable skills that are relevant in the labour market. Immigrants are a particular group of their original population with motivations and tastes that may locate them separately from natives (Ottaviano and Peri 2006). In manual and intellectual works they have cultural-specific skills as well as limits (language) that might translate into advantages or disadvantages (Peri and Sparber 2008); foreign-born workers have different abilities pertaining to language, quantitative skills, and relational skills for which they choose occupations that are different from natives, even in the same education and experience group.

Klark and Lindley (2005) using LFS data document the impact of economic conditions of year of arrival and assimilation on the labour market outcomes immigrants to the UK from 1993 to 2002. They find positive earnings assimilation for all immigrant groups and strong employment assimilation for those who completed their education in the UK. After arrival in the host country, immigrant labour market outcomes will adjust towards those of non-immigrants or natives workers. Assimilation is thought to take place through human capital enhancement: immigrants acquire skills that are specific to the destination country, including knowledge of the labour market and language proficiency. Preliminary finding by Cheswick (1978) for the United States found that while immigrants earned significantly less than natives upon their arrival, they caught up with natives in terms of earnings as they integrated in the host country.

Another key fact that contributed to feeding the debate of both wage inequality and immigration is the changes in characteristics of workers. The labour force has been growing older and more educated (Autor, Katz and Kearney, 2005; Lemieux 2006); Lemieux (2006) argues that these secular changes in the education and age structure may increase mechanically residual wage inequality; he shows that a large fraction of the 1973-2003 growth in the residual wage inequality in the U.S. is a “spurious” consequence of composition effects. The methodology requires taking the actual residual variance of the log hourly wage OLS regressions and re-weighting it holding the characteristics of labour force constant at a base year.

However this influential contribution does not account for the fact that over the last decades not only the share of immigrants in the labour force has been increasing but also that changes in characteristics (education and experience) also involve immigrants. Extensive literature (Dustmann, Preston, Fabbri 2005; Wadsworth 2007; MMW 2006; Wadsworth and Schmitt 2006; DFP 2008) shows that compared to people born in the UK, immigrants are on average better educated. Similarly for Canada Boudarbat and Lemieux (2008) explain that looking at years of completed education, immigrants are more educated than the Canadian born and that the education gap is growing over time.

This paper aims to adapt in the immigration context one of the main challenges of the 1990s wage literature: namely that wage dispersion is not fully explained by variables linked to standard human capital model like education and experience; the residual or within-group wage inequality<sup>3</sup> – wage dispersion among workers with the same education and experience- accounts for most of the growth in overall wage inequality (Juhn, Murphy and Pierce 1993; Acemoglu 2002; Autor, Katz and Kearney 2005, 2007; Lemieux 2006).

Unlike previous studies this paper focuses on the effects of immigration on the residual wage inequality in the UK and US between 1994 and 2008; it seeks to assess whether and how much immigration contributed, along with technology, institutions and traditional explanations, to widening inequality. To do so this work re-assess Lemieux's hypothesis (composition effects exert an upward mechanical force on the residual wage inequality) by adding to the original analysis the immigration dimension.

The methodology used by Lemieux (2006) and that is implemented in this chapter, is based on a simple approach having the advantage to analyse changes in the distribution of wages that are economically interpretable using the standard tools of human capital theory. Unlike other methodologies (Juhn, Murphy and Pierce 1993; Autor, Katz and Kearney 2005- 2007; Melly 2005) the procedure controls for changes in distributions of observables and share of immigrants in the labour force, by holding the skill distribution of the work force and the supply of foreign-born workers constant at a base year; this requires taking the actual residual variance of the log hourly wage OLS regressions and re-weighting it according to a weight that holds the characteristics of labour force constant at a base year. In addition to the original methodology this paper controls for increasing supply of immigration by constructing another weight that holds fix the share of immigrants at a base year.

The paper also illustrates the evolution of upper and lower tail distribution, when controlling for both composition effects and for the increasing supply of immigrants. To account for the fact that immigrants perform differently<sup>4</sup> according to the time they have already spent in the receiving country (Wadsworth and Schmitt, 2006; DFP 2008) and to account for any cohort effects the analysis is re-run separately for recent and other immigrants, define respectively as those who spent 5 years or less in the country and those who have been in the U.S. or UK for more than 5 years<sup>5</sup>.

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<sup>3</sup> Intuitively, years of schooling and experience, do not capture returns to other skills. By contrast regression-based residuals include unmeasured aspects of human capital such as school quality, ability, effort or innate skills.

<sup>4</sup>DFP (2008) demonstrate that immigrants downgrade considerably upon arrival within educational categories; in particular because of their lack in complementary skills-like language. Recent immigrants may not be able to make use of their educational background to its full potential.

<sup>5</sup> The existing literature defines earlier and new immigrants in different ways; Dustmann, Frattini and Preston (2008) define earlier and recent immigrants in the UK respectively as those who have been in the UK two years or more and as those who arrived over the last two years. Chiquiar

The structure of this paper is as follows. Next section provides an explanation to why unobservable components might be crucial in analysing the impact of immigrants on natives' wage inequality and what is the plausible link between the increase in educational attainments of labour force and the increase of residual; part three presents the econometric methodology; part four describes the two datasets used in this paper, part five discusses the results, the final section concludes.

## **2. Immigrants and natives: Imperfect substitutability, unobserved skills and composition effect.**

The textbook model of a competitive labour market has unambiguous implications about migration-induced supply shifts effects on wages and employment opportunities of natives. Labour inflow should lower the wage of competing workers. However a key determinant of the positive or negative effect of immigration inflow on natives' wages is the degree of substitution or complementarities between immigrant and native workers. Holding capital constant and assuming constant return to scale production technology, an increase in labour supply due to immigrants inflow will lower wages if immigrants and natives are substitutes. In contrast if immigrants and natives are complement in production then the increase in labour supply due to immigration will boost natives' wages.

The lack of any negative effect of immigration on wages of natives in the U.S. and the UK drawn by Ottaviano and Peri (2006) and MMW (2006) is built up on the evidence that immigrants do not fully compete and substitute with natives even within a given education-experience group. As highlighted by Ottaviano and Peri (2006) the imperfect substitution between immigrants and natives may be due, among other aspects to their differences in unobservable skills that are relevant in the labour market. Immigrants are a particular group of their original population with motivation and tastes that may locate them separately from natives. In manual and intellectual works they have cultural-specific skills as well as limits (language) that might translate into advantages or disadvantages; foreign-born workers have different abilities pertaining to language, quantitative skills, and relational skills for which they choose occupations that are different from natives, even in the same education and experience group.

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and Hanson (2002) define recent Mexican in the US as those who migrated in the last 10 years. Schmitt and Wadsworth (2006) consider recent immigrants as those who already spent from 0 to 5 years the U.S. or UK.

Not dissimilar in the spirit of Ottaviano and Peri (2006), Gould and Moav<sup>6</sup> (2008) argue that unobservable skills are a mixture of “general” skill (like education) that can be easily transported to another country and other skills “country-specific” that cannot be easily transported to another country; “country-specific” skills include personal connection, local knowledge of the labour market, language-specific communication skills, luck in the labour market. A significant proportion of an individual’s total human capital is likely to be country specific for several reasons; language and cultural barriers may prevent an individual from transferring their skills to a country where they lack a commanding knowledge of the local languages, consumer tastes and so on.

The idea that there might be crucial unobservable skills component in the immigration process is consistent with a recent consensus of the wage inequality literature: unobservable skills, measured by the residual of a Mincer equation, explain most of the variation in the observed increasing wage inequality (Acemoglu 2002, Juhn, Murphy, Pierce, 1993; Autor & Katz 1999; Autor, Katz and Kearney, 2005, 2007, Lemieux 2006).

Evidence from the U.S. (Autor and Katz 1999) shows that residual wage inequality started increasing in the 1970s, continued rising considerably in the 1980s and then at a slower pace in the 1990s; the residual log weekly wage inequality for full-time, full year workers increased by 27 log points for men and 25 log points for women from 1963 to 1995. Juhn, Murphy and Pierce (1993) for the U.S. show that unobserved components affect with different magnitude the wages of workers at the top and at the bottom of the distribution. Over the period 1964-1988 changes in unobservable quantities account for 65 percent of the increase in inequality for workers below the median but less than half of the increase in inequality for those above the median.

More recently Lemieux (2006) outlines the main patterns observed in the United States using Current Population Survey (CPS) data: the residual variance for full time, full year men workers from 1973 to 2003 grows by about 0.04 log points; most of that growth is concentrated in the 1980s, remains essentially unchanged during the 1990s but grows again between 1999 and 2003.

Leading existing explanations on wage inequality such as declining unionization, the falling real minimum wage and the SBTC<sup>7</sup> do not then seem to help explain the main recent trends in wage

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<sup>6</sup> They show that a higher ratio of individuals with a higher transferability rate of unobservable skills exists in the middle of the distribution of the total unobservable skills. They argue that those at the bottom of the unobservable skills distribution have little of both types of skills, while those at the top have high levels of both. Individuals are more likely to have high levels of unobservable general skills versus country specific skills if they are in the middle of the distribution rather than the tails.

<sup>7</sup> Similarly Lemieux (2007) discusses why the SBTC explanation presents several limitations; one reason is that it could not help to explain some diverging pattern of inequality across advanced countries; SBTC was depended on the weak fact that the residual inequality was increasing since the 1970s. The failure of the SBTC for develop countries

inequality, since they find it harder to predict increasing upper-tail inequality and compressing lower tail inequality (Autor, Katz and Kearney 2005). As documented by Lemieux, there are two main different reasons affecting the increase in residual wage inequality over the last decades:

- i) The “price” or return to unobserved skills may be increasing over time because of the increase in the demand for skills;
- ii) Dispersion in the residual could be increasing because of composition effects.

Changes in characteristics<sup>8</sup> affect both the demand and supply of observed and unobserved skills and can alter wage and employment outcomes (Autor and Katz, 1999). Movements in within-group inequality may reflect market forces changing the returns to (unmeasured) skills. Therefore the rise in within group inequality can be interpreted as reflecting a rise in the returns to unobserved skills. Holding market prices constant, changes in labour force composition can mechanically raise or lower overall earnings dispersion by increasing or reducing heterogeneity in observed skills (education and experience).

The link between composition effects and the residual can be explained by the fact that when the level of education of the labour force increases, there are more and more “marginal“ workers added to high-education workers group, creating more unobserved heterogeneity in that group and increasing within-group inequality. Therefore an increase in the supply of more educated workers will immediately benefit those workers with more unobserved skills and will also depress returns to schooling, while raising within-group inequality. The more skilled workers within each education group also benefit from skill-biased technical progress. Technical change spurred by the increase in the supply of educated workers will immediately benefit workers with more unobserved skills, raising within-group inequality. Therefore, an increase in the supply of educated workers will depress the returns to schooling, while increasing within-group inequality<sup>9</sup>.

An increase in the proportion of the workers with more education and experience can mechanically raise residual wage inequality also because earnings variation is higher for those with college education relative to high school education (Machin, Van Reenen 2007).

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can be explained by the fact that because those countries are subject to the same technological change, they did not experience an increase in inequality, as we should instead expect. They did not vary in a similar way over time.

<sup>8</sup> Acemoglu (2001) explains that composition effects cannot by themselves explain the recent changes in wage dispersion; but it suggests that inequality among more educated and less educated workers should move in opposite directions.

<sup>9</sup> Mincer (1996) applies a human capital analysis to intra-group wage inequality, measured by variances in log-wages, and their changes over time reveal to the U.S. wage structure changes from 1970-1990. In similar vein to Acemoglu, he provides evidence that within-group inequality is not directly or closely related to between group variances, therefore we can expect difference in movements in the two components of inequality.



A number of influential studies (Juhn, Murphy and Pierce (1993) Autor, Katz and Kearney (2005)) focus on this interplay between changes in educational and experience characteristics of the labour force and the evolution of the residual to evaluate how much of the overall increase in wage inequality can be attributed to wage dispersion among workers with the same education and experience; and how much of the increase in residual wage inequality is due to changes in the composition of the work force. The evidence provided is sometimes different, due presumably to different methodologies applied.

Lemieux (2006) concludes that a large fraction of the 1973-2003 growth in residual wage inequality in the United States is due to composition effects, affecting both the upper and lower tails of the distribution. In particular he demonstrates that the increase in within wage inequality appears to be a spurious consequence of the fact that work forces became older and more educated over time; in other words the increases in educational level and experience act as a mechanical force on the residual such that the increase in the variance of the residual follows the same sign as the change in the composition of work force. This means that changes in education and experience characteristics of the work force determine more variation in wage due to unmeasured aspects of human capital.

There is no theoretical model explaining how the increasing supply of immigration could affect changes in residual wage inequality of the labour force. However because immigrants and natives differ in their unobservable skills if they are imperfect substitutes within education and experience group, we might expect immigrants to have more heterogeneous unobservable skills than natives even within the same education group; when the share of immigrants in the labour force increases we could expect this to determine even more variation in the overall residual wage inequality.

One may be tempted to think that the increase of immigrants over time in the U.S. and the UK might be somehow connected to the increase in residual wage inequality observed. This is what this paper attempts to test.

There is little existing research on the overall impact of immigration on natives within-group inequality. The only contribution has been recently provided by Card (2009) who shows that the relative level of residual wage inequality for natives in different skill groups is uncorrelated with the relative fraction of immigrants, however suggesting that immigration has a relatively small causal effect even when looking at the effect of immigration on the within-group variation.

### 3. Econometric Methodology and reweighted approach à la Lemieux.

Since this work mainly seeks to test Lemieux's findings in the immigration context, the methodology and the identification strategy, largely adhere to his original work, although some modifications and adjustments of data sets have been necessary. To assess the contribution of observable and unobservable components of wage dispersion to changes in overall wage inequality, I follow part of the existing literature (Juhn, Murphy and Pierce 1993, Autor and Katz, 1999 Lemieux 2006) which applies the variance decomposition. In addition immigrants and natives are treated as two separated groups.

The econometric methodology of this work is based on two simple steps: the analysis of inequality in the residuals and a reweighting approach to control for both composition effects and increasing supply of immigration in both the U.S. and the UK.

The residuals are obtained from a standard OLS regression, having the following specification:

$$(3) \quad y_{it} = X_{it}B_t + \varepsilon_{it}$$

Where  $y_{it}$  is the log hourly wage of individual  $i$  in year  $t$ ,  $X_{it}$  is a vector of observed individual characteristics (education, age and a set of interaction terms between education and age),  $B_t$  is a vector of estimated returns to observable characteristics at time  $t$ , and  $\varepsilon_{it}$  is the log wage residual depending on unmeasurable skills.

Given the orthogonality of the predicted values and the residuals in an OLS regression, the variance of  $y_{it}$  can be written as:

$$(4) \quad \text{Var}(y_{it}) = \text{Var}(X_{it}B_t) + \text{Var}(\varepsilon_{it}).$$

In other words the change in the variance of log wages can be decomposed into the change in the variance in the predicted values (between-group inequality) reflecting the contribution of observable prices and quantities; and the change in the residual variance (within-group inequality) measuring the role of unobserved skills.

Changes in the residual variance can be attributed to changes in prices for unobserved skills ( $p_t^2$ ) and changes in unobservable skills ( $\text{var } e_{it}$ ) if  $\varepsilon_{it} = p_t e_{it}$  then

$$(5) \quad \text{var}(\varepsilon_{it}) = p_t^2 \text{var}(e_{it}).$$

This dispersion can be disaggregated across time and education and experience groups. Because the information and structure of the data sets used in this work (ORG/CPS, LFS) are somewhat comparable, it is possible to divide workers into 12 education and experience cells based on a group of 3 (similar) education categories (lower, intermediate and high) and 4 potential experience categories 1-10, 11-20, 21-30 and 31+ years.

To control for composition effects, i.e. to assess if and how much changes in the educational level and experience of labour force account for the increase of wage inequality for the whole labour force, as well as for natives and immigrants separately, the variance of the residual is recomputed assigning workers observed at the actual year the same characteristics of workers observed at a given base year; in other words the technique holds the skill composition of the work force ( $\theta_{jt}$ ) constant over time in order to reflect the distribution of characteristics of labour force at a given year.

Assuming<sup>10</sup> that observed skills,  $x_{jt}$ , can be divided into a finite number of education-experience groups  $j$ ; then the (unconditional) variance of the residual  $\text{Var}(e_{it})$  is directly affected by changes in  $\theta_{jt}$  (share of workers in experience-education group  $j$  at time  $t$ ) and is linked to the conditional variance  $\sigma_{jt}^2$  by the following:

$$(6) \quad \text{var}(e_{it}) = \sum \theta_{jt} \sigma_{jt}^2$$

where  $\sigma_{jt}^2$  represents the conditional variance ( $\text{Var}(e_{it}|x_{it})$ ) so changes in the education-experience cell shares will correspond to changes in the residual variance. Since the conditional variance in wages  $V_{it}$  is linked to the conditional variance of unobserved skills by the following:

$$(7) \quad V_{it} = p_t^2 \sigma_{jt}^2$$

Where  $p_t$  captures the returns to unobserved skills ( $e_{it}$ ) it follows that  $\sigma_{jt}^2$  also increases as a function of experience and education. Only when the variance of unobserved skills remains constant over time, can changes in residual variance be interpreted as evidence of changing skill prices  $p_t$ .

Holding the characteristics of the labour force constant at a base year, can be done by constructing a counterfactual weight, expressed as  $(1-\omega_i)/\omega_i$ , where  $\omega_i$  is the predicted probability for each worker observed at time  $t$  to be in the base year  $s$ . This probability is obtained by applying a logit model conditioning on the characteristics (education and age) of the workers. The magnitude of the weight depends therefore on the characteristics of workers observed at the year  $t$  compared to the characteristics of workers observed at a given base year  $s$ . For example the predicted probability of lower educated workers observed in a year characterized by a higher level of education of workforce, will be small therefore the counterfactual weight  $(1-\omega_i)/\omega_i$  will give more to lower educated workers in the later years. Similarly the weight would give less weight to observations of higher educated individuals in the later sample years.

In this way, by holding the distribution of skills constant over time, it is possible to compute a counterfactual variance i.e. the variance of the residual that would prevail if the distribution of skills of workers remained constant at their base year value. The difference between the counterfactual

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<sup>10</sup> This part follows Lemieux (2006).

variance and the actual variance shows how much the composition of the labour force accounts for the evolution of the observed residual. By applying this methodology to natives only, the counterfactual variance will take into account not only changes in characteristics of the labour force but it will also consider what would have happened did immigration not occur.

Formally the residual variance needs to be written as a function of the variance of wages,  $V_{jt}$  within each skill group  $j$ :

$$(8) \quad \text{Var}(\varepsilon_{it}) = \sum \theta_{jt} V_{jt}$$

holding constant the skill distribution of workers ( $\theta_{jt}^*$ ), the counterfactual residual variance can be written as:

$$(9) \quad V_t^* = \sum \theta_j^* V_{jt}$$

Working in this way will help understand whether the composition effect is driving changes in the residual variance; in particular when the composition of the work force is held constant, any increase in the residual variance can be interpreted as an increase in skill prices  $p_t$ .

If one assumes that the causal effect of higher immigration depends on the fraction of immigrants in the labour market, controlling for the increasing supply of this share should help to disentangle the effect of immigrants on the residual wage inequality.

Defining  $\delta_m$  the fraction of immigrants in the labour force, the residual variance defined in (8) can be re-written as:

$$(10) \quad \text{Var}(\varepsilon_{it}) = \sum \delta_m V_{jt}$$

where the residual variance is now a function of variances of wages accounting not only for the skill characteristics of the labour force, but also for the share of immigrants in the labour force.

In similar vein to (9) holding fix the share of immigrants in the labour force ( $\delta_{mt}^*$ ), the counterfactual residual variance can be written as:

$$(11) \quad V_t^* = \sum \delta_{mt}^* V_{jt}$$

working in this way will help to understand whether increasing share of immigrants in the labour force can help to account for the increasing residual wage inequality observed.

Controlling for increasing supply of immigration can be done by following the same methodology, constructing a weight that in the spirit of DiNardo, Fortin and Lemieux (1996), adds a dummy variables for the state of immigrant as well as interactions terms. This would allow constructing

another counterfactual: “what would have happened to the residual wage inequality of the labour force had the share of immigrants remained constant at a base year”.

#### **4. Data**

The analysis is based on two pooled time series, cross-sectional micro data sets: the Outgoing Rotation Group (ORG CPS) for the U.S. and the Labour Force Survey (LFS) for the UK. Both data sets cover the same period (1994 to 2008) containing similar information of interest on wage and immigration, and are sufficiently large to analyse minority population.

The CPS is a monthly household survey conducted by the Bureau of Labor Statistics to measure the labour force participation and employment. The survey provides individual data for about 30,000 individuals each month. Every household that enters the CPS is interviewed each month for 4 months, then ignored for 8 months, then interviewed again for 4 more months. Usual weekly hours/earning questions are asked only at households in their 4<sup>th</sup> and 8<sup>th</sup> interview. These outgoing interviews are the only ones included in the extracts. New households enter each month, so one fourth of the households are in an outgoing rotation each month.

One of the main advantages of the ORG CPS is that it provides point-in-time measures of usual hourly wage for 60 per cent of the sample; the remaining non-hourly wage can be easily calculated as the ratio of earnings to hours. I kept real hourly wage between \$1 and \$100. One of the main issues addressed when working with ORG CPS dataset, relates to the top coded earnings. In the release of data available to public, the Census Bureau restricts the top of the earnings distribution at \$99,999 a year. This means that all earnings above that level appear in the CPS public use as \$99,999, whatever their actual earnings are. This top coding can lead to bias in the measurement of trends in earnings inequality if the proportion of earning so affected changes over time, in particular will lower the mean and the variance of the wage data relative to the true mean and variance. I adjust for the top coding issue by using the log-normal approach recommended by Schmitt (2003). Contrary<sup>11</sup> to the existing procedure usually applied, the log-normal procedure models the entire distribution, not just the “top” portion of interest, under the assumption that the entire distribution of earnings is log-

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<sup>11</sup>Great part of existing literature on wage inequality (Lemieux 2006, Katz and Autor 1999, Autor, Katz and Kearney 2005,2007) address the top coding issue adjusting it by multiplying top coded wages by a factor of 1.3 or 1.4 which is believed to provide estimates of the mean and the variance that are closer to their true values.

normally distributed. The properties of the log-normal allow for the straightforward estimation of the mean and variance of the “true” distribution, even though the estimates of the mean above the top-code that are consistently below those generated by these versions of the pareto approach.<sup>12</sup>

The LFS is very similar to the U.S. Current Population Survey in terms of its purpose- measuring labour market activity and unemployment on a timely fashion-; sample size and because, similarly to CPS, LFS provides point-in-time hourly wage for the great part of the sample.

The Labour Force Survey (LFS) is the largest survey of household living at private addresses and in NHS accommodation in the UK, conducted by the Office for National Statistics (ONS).

Information is recorded in four quarters; each quarter’s LFS sample of 53,000 UK households is made of five “wave” each of approximately 11,000 private households. Each wave is interviewed in five successive quarters, earnings information are only recorded in wave 1 and 5. A single stage sample of addresses with a random start and constant interval is drawn from the Postcode Address File (PAF) sorted by postcode. To limit the effect of outliers, following the existing literature in the UK (Manacorda, Manning, Wadsworth 2006), only observations with an hourly wage between one and hundred pounds in 2008 pounds are kept. In the same manner as for the CPS for individual whose wage is only recorded weekly, hourly wage is derived by dividing weekly wage by the usual amount of paid hours worked per week.

Real wages for the UK are obtained by deflating nominal wages with Retail Price Index. For the sake of comparability with the United Kingdom, wages measures for the United States are inflated using Consumer Price Index.

The samples used for estimations are men and female, separately in the labour force, meaning men and women aged 16-64 for the U.S. and aged 16-59 and 16-64 respectively for English women and men. I limit the analysis to workers, who are employees, full time<sup>13</sup> considering only their main job. I define as an immigrant someone who was born outside the United States and United Kingdom, irrespective of the time of age on arrival.

All results derive from separate regression for men and women, respectively all workers, natives, immigrants, by using the log hourly wage on a set of dummies for age, education and interactions between education and a quadratic in age.

One of the main issues arising when aggregating immigrants and natives using same level of education is that, due to the heterogeneity educational systems there is not a one-to-one

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<sup>12</sup> For details see John Schmitt (2003): “*Creating a consistent hourly wage series from the Current Population Survey’s Outgoing Rotation Group, 1979-2002*”

<sup>13</sup> The use of full time workers only is meant to eliminate variation associated with hours per week or weeks per year (Katz and Murphy, 1992; Lemieux and Card, 2001).

correspondence in years of schooling<sup>14</sup>. In the ORG/CPS data education is reported in years for all workers, meaning that immigrants report their level of education in years of schooling. One problem arising for LFS is that foreign educational qualifications are classified in the “other” category. As explained by MMW (2006), there is a good reason to believe that many of immigrants in the “other” category actually have quite high levels of educations. The LFS has another alternative definition of educational level: age at which individuals left full time education; to create comparable educational categories for the UK data I combine both information on “age left school” and “other”.

The similarity between U.S. and UK schooling system allows us to create 3 educational categories which are broadly comparable:

The lower education group includes workers who have completed compulsory qualification i.e. less than a lower secondary education; for both the U.S. and the UK this group corresponds to 0 to 11 years of schooling. The intermediate category gathers workers with qualifications that are in between the high school dropout and the degree (both excluded). In both countries analysed this corresponds to any qualification with years of schooling equal or greater than 12 and less than or equal to 15 years of schooling. The educational group “high” in all cases refers either to graduate or postgraduate earned qualification and correspond to 16 or more years of schooling.

However using years of education in the regression rather than level of qualification, this should not affect the results.

The variable years of potential labour market experience is conventionally derived as Age – Years of completed Education- the age at which children start school. Workers are aggregated into four-year experience intervals (0 –10; 11-20; 21-30, 31+). Based on the three education categories (lower, intermediate and high) and the four experience categories, workers can be classified into one 12 skill groups<sup>15</sup>.

## **5. Results**

### **5.1 Characteristics of immigrants and natives.**

Tables 1 to 3 outline the composition of the workforce and changes over time in the UK and U.S.As documented in table 1 during the period analysed in both countries the number of immigrants

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<sup>14</sup> Preliminary runs indicated that changes in the years of schooling as measure of education would not produce substantial change to the results.

<sup>15</sup> In the original data Lemieux defines 20 education and experience group based on 5 education groups and 4 experience groups. The education groups are high school dropouts; college; some college; post graduate and high school college. These 5 groups have been clustered into 3 to generate 3 educational groups consistent through the three countries. The substantial results do not change: residual increases for higher educated workers and decreases for less educated ones.

increased; in the UK, the share of immigrants in the labour force more than doubled between 1994 and 2008; for example the presence of immigrants in the UK male labour force increased from 6% in 1994 to 14% in 2008; similarly for female the share of immigrants increased by 8% points. In the US the corresponding increase ranges from 10% to 15% for male workers and by 4% points for female. One of the reasons for the resurgence of interest in immigration is not only because of its size but also because of its composition. Table 2 documents changes in the area of origins of immigrants: rising immigration is also associated with a change in the origin mix. In the U.S. the trend is for more immigrants from the Americas at the expense of Europe; for the UK the reverse is true with almost half of immigrants coming from Europe while the share of Americans decreased over the sample period. The increase in 2008 of Europeans in the UK largely reflects the arrival of A8 accession countries were given free movement of labour after 2004.

Table 3 compares the educational characteristics of natives and immigrants in the labour force, for men and women in the US and UK. A couple of facts immediately emerge from the table: compared to the UK, the U.S. labour force is on average characterized by the lowest share of low educated workers. Considering natives in 2008 only 5% and 4% for men and women respectively have a lower level of education; while the UK counterparts these shares increase to 27% (men) and 31% (women). More differences arise in the US when comparing less educated natives with equivalent immigrants: as the existing literature widely documents most immigrants to the U.S. are relatively less educated; in 2008 29% of male immigrants in the US have a lower level of education, this share is 10% higher than male immigrants to the UK. The situation is better for female immigrants in the US in fact 18% of them have a low level of education. This fraction shows same pattern for female immigrants in the UK.

In contrast the mix of immigrants to the UK has become much more educated over time compared not only to immigrants in the US but also to natives in the same country. In 2008 almost half of the immigrants, both men and women, to the UK hold a high level of education compared to 25 and 32 percent for male and female natives respectively. This gap is less evident when comparing higher educated natives and immigrants in the US; 33% of natives male have a degree or postgraduate degree compared to 29% of immigrants; there is even less difference between natives' and immigrants women.



## 5.2 Wage dispersion for immigrants and natives

The pattern and the evolution of wage dispersion in the two countries are shown from Figure 1a, 1b, 2a to 2d, together with table 4a and 4b; the results are displayed for all workers as well as immigrants and natives separately.

Figure 1a and 1b use as measure of dispersion of wage inequality the standard deviation of the log hourly real wage of workers. The first remarkable fact is that for all workers, represented by the plain line in the graphs, the level of wage inequality in the U.S. and the UK is pretty similar though slightly higher for men in the US. For women at the beginning of the sample year wage dispersion is higher in the UK than it is in the US, but in 2008 the situation is reversed with an increase for women in the US and a decrease for female in the UK.

Comparing foreign-born to natives, both figures show that on average the former experience higher level of wage dispersion. In particular immigrants in the UK undertake higher dispersion than their counterparts in the US. The reverse is true for women, except for the years 1996 and 1997, female immigrants in the European Island suffer from less inequality than their similar in the US.

Those results are confirmed by table 4a and 4b summarising different measure of wage dispersion and main trends over time. Table 4a compares standard deviation, 90-50 and 50-10 gap between US and UK, considering separately men, female, all workers, native and immigrants. Considering the 90-50 wage gap and 50-10 wage gap for male workers in the U.S. 90-50 log hourly wage gap increases over the sample period for all workers, immigrants and natives both for men and women; similarly for workers located in the lower path of the wage distribution, wage dispersion decreases from 1994 to 2008 but immigrants experience the highest decrease. Female workers located in the lower path of the wage distribution do not display any decrease in wage dispersion, in fact there is a slight increase, and it's higher for female immigrants. For the UK 90-50 log hourly wage gap, follows a different direction for men and women; the former experience an increase in wage dispersion which is higher for immigrants; the latter are instead affected by an overall decrease in wage inequality. More similarities are displayed for workers located in the lower path of the wage distribution: in all cases wage dispersion decreases, the highest decrease is displayed for male immigrants.

The top panel reports wage dispersion for men. In 1994 wage inequality for all male workers was 0.547 increased to 0.569 in 2008. Similarly in the UK standard deviation increases from 0.545 to 0.559; standard deviation of wage is higher for immigrants in the UK in 1994 (0.612) while it is lower in the US (0.600), though at the end of the sample period immigrants in the UK experience a decrease to 0.591 while following the trend for all workers, wage dispersion for immigrants in the US increased. Trends go in opposite direction for females in the two countries; in the US wage

inequality increased for all workers (from 0.509 to 0.525) and immigrants (0.552 to 0.580) while it decreases for both all workers (from 0.542 to 0.504) and immigrants (0.578 to 0.532) in the UK.

The same table also show what happens to wage dispersion when foreign-born workers are not counted in the sample: when considering natives only in all cases the level of wage inequality is slightly lower, though still increasing; meaning essentially that the presence of immigrants in the labour force does not affect too much the level and the trend of wage inequality experienced by the countries.

The same table also reports measure of dispersion looking at workers located in the upper and lower path of the wage distribution. In general wage dispersion for workers located in the upper path of the wage distribution increased over time for all natives and immigrants, male and female with the exception of female in the UK: in this case dispersion of workers in the upper path of the wage distribution decreased for both natives and immigrants, though the latter suffer from more inequality.

A more uniform pattern is observed considering workers located in the bottom part of the wage distribution: in all cases (men and women, immigrants and natives in the US and the UK) wage dispersion has been decreasing over time. Table 4b summarises changes over the sample period: immigrants located in the bottom part of the wage distribution experience the highest decrease in wage dispersion; this corresponds to 0.1 log percentage point decrease for male immigrants in the US and 0.174 in the UK. Similar trends but with lower magnitude occur for female immigrants.

Figure 2a to 2d plot the kernel distribution of log hourly wage for natives and immigrants in both countries for the years 1994 and 2008. The figures clearly show the difference in the wage distributions between natives and immigrants. Particularly in the U.S. and for male workers, the density of log hourly wage for immigrants is left-shifted compared to natives. Plots for women are qualitatively similar in the U.S. though the gap in density distribution is smaller. Results for the UK show a substantial overlap in wage densities for women in 2008, while in 1994 the density for women born abroad appears to be slightly right-shifted compared to native. This pattern is similar for male workers in the UK in 1994 though the mean log hourly wage for natives is higher than for immigrants; in 2008 consistent with the US the wage density of immigrants in the UK is left-shifted compared to the natives counterparts.

Figure 4a and 4b plot levels and trends using as a measure of dispersion the variance of the residual<sup>16</sup> hourly wage for men and women in the U.S. and the UK. The residual variance has been calculated

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<sup>16</sup>Wage residuals are obtained from a series of regression model fit separately by gender, immigrant status and year. The models include controls for education, experience, and interaction terms. When including control for countries of origin,

separately from three different regressions respectively for the whole labour force, natives and immigrants. Confirming previous results these graphs show that dispersion in wages of immigrants is higher<sup>17</sup> than natives, especially for the UK, with the bulk of the increase for foreign-born immigrants working in the UK occurring at the end of the 2000s.

This is particularly true for male while there is more of a convergence in level and pattern for male in the US: starting from 2002 there is not much difference in residual dispersion between immigrants and natives. More variation remains for immigrant female in the US and even higher for the UK.

When treating immigrants and natives as two separated groups interesting differences arise: in all cases the level of wage dispersion in the residual for natives decreases but the trends do not change that much suggesting that had immigration not occurred residual wage inequality of natives in both countries would have increased anyway, albeit at a slightly lower level. This description confirms existing results i.e. the presence of immigrants cannot be considered partially responsible for the increasing level of residual wage inequality in both U.S. and UK. In similar vein to the recent interpretation of Card (2009) this suggests that immigration can be said to have contributed to the rise of inequality in the workforce albeit for a small share and even if it has no effect on the inequality of native wages.

Figure 3a to 3d plot the variance and the 90-50 residual of log wage for all workers (male and women respectively) together with the share of immigrants in the labour force. As depicted in figure 3a the level of residual wage inequality has been (relatively) increasing during the sample year, while a higher increase occurs during last years; on the other hand both in the US and UK the share of immigrants has been constantly increasing, at a higher pace for the UK although the share of immigrants is higher in the US. Results are qualitatively similar for women, except that female immigrants in the UK are more numerous than male and even more numerous than for the US. Figure 3c and 3d compares the trends between the 90-50 residual gap and the share of immigrants over the sample years. As it has been showed in previous studies, increase in wage inequality occurred particularly at the upper part of the wage distribution. The correlation of changes in residual and changes in share of immigrants in the labour force between 1994 and 2008 is quite high; in the U.S. this is equal to 0.7616 and 0.9362 respectively for men and women; in the UK the

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the main results do not change too much. On average the residual obtained when adding the control for area of origin is 0.002 lower than the one obtained when controlling for human capital variables only.

<sup>17</sup> One concern related to the increase in the share of immigrants is the area of origin; particularly for the UK dispersion in residual could be also due to different inflows of immigrants. To address this issue I also control for area of origin both in the original regression and in the logit model; the residual variance decreases a bit for immigrants mainly while results for all workers and natives do not change significantly. Nevertheless the distance between residual variance of immigrants and natives still remains.

correlation of changes for men is 0.8798 and 0.9618 for female. Suggesting a possible positive relationship between the increase of immigrants in the labour force and the increase in residual wage inequality.

### **5.3 Residual inequality, composition effect and the increase in immigration.**

Table 5a presents the decomposition of total wage variation into different components (between and within-variance) analysing all workers, natives and immigrants separately.

Between 1994 and 2008 the positive change in total wage variance in the U.S. is higher than it is in the UK, particularly for men. In all cases over the period analysed the residual component accounts for most of the variation observed in the total wage variance. When considering natives only the overall variation in wages decreases a bit (by 0.004 log points for male workers in the U.S. and 0.002 log points for male in the UK; 0.004 log points and 0.003 for female workers respectively in the US and the UK). Despite this decrease in the total wage variation when immigrants are not counted in the labour force, the residual component still accounts for most of the variation, suggesting a relatively small role of the increase of immigration on the overall wage dispersion.

In similar vein Table 5b presents the results for natives and all workers when holding fix the characteristics of workers and in addition the share of immigrants in the labour force. On average when the characteristics of the labour force are held fix at 1994 the level of residual wage inequality decreases and is on average true for both US and UK, men and women. Confirming the main results of Lemieux. However when in addition to hold fix the characteristics of the labour force the share of immigrants remain fix at the base year 1994 this would result in an additional decrease in the residual wage inequality. For male workers in the UK the presence of immigrants accounts for about 0.005 log points while for the U.S. this accounts for only 0.001; results are qualitatively similar for female.

Figures 5a to 10d present the results of the counterfactual reweighting approach proposed by Lemieux that helps to account for the role of composition effects and the share of immigrants on changes in residual wage inequality. The figures compare for each country, separately for men and women, and for all workers and natives only, the actual residual variance from 1994 to 2008 to the counterfactual variance that would have existed if the distribution of skills had remained at the same level of the initial (1994) or the final (2008) year. The composition effect is represented in the figures by the distance between the actual variance and the counterfactual variance (residual holding skills at 1994 or 2008).

As displayed in figure 5a and 5b when the distribution of skills characteristics of the labour force is held fix at its 1994 level, the remaining growth of the residual variance accounts for a small share. The results hold both for men and women in the US and the UK. This evidence confirms the findings of Lemieux (2006) when analysing separately natives and the whole labour force. However the role of this component drops further once share of immigrants is also held fix at its 1994 level. In general once both distribution of skills and the share of immigrants are held fix at 1994, the role of the residual components ranges from 0.0002 to 0.009 for natives and up to 0.008 for all workers. Although the composition effects still explain most of the growth in the residual for natives and the total labour force, the results also suggest that the presence of immigrants also plays a role in explaining the growth in the residual variance observed, albeit for a very small share. On average the effect of immigration on residual variance ranges between 0.1% and 0.5%. Consistent with Card (2009) the effect is small but not causal.

The results are consistent with Lemieux (2006) confirming that the fact the labour force is increasing for more educated and older, which will act to increase the role of unobservable skills of workers. If 2008 workforce had 1994 characteristics, the level of the residual would have been lower, suggesting that composition effects exerted an upward force on residual inequality.

Figure 7a to 8b show the results when the reweighted approach is performed for natives only; this should give the counterfactual residual variance of natives if immigration would not occurred and the level of education of the natives only would be remained constant at the base year; the figures prove that the pattern in residual wage inequality observed for native in both U.S. and UK is mainly due to changing characteristics of natives, while the increased supply of immigrants does not account for too much.

#### **5.4 Residual wage inequality: upper and lower wage gap.**

During the 1990s wage inequality occurred mainly in the upper tails of the wage distribution. This section looks at alternative measures of wage inequality, specifically the 90-50 and 50-10 residual gap, comparing the actual residual and the residual computed holding distribution of skills and share of immigrants at their 1994 level, to understand how much change in residual as well as composition affect all workers, native and immigrants separately at different tails of the distribution.

Looking at the evolution for the 90-50 gap of male workers, figures 9a to 9d show that residual wage dispersion for workers located at the upper path of the tail distribution has been increasing for the workforce in both countries both for men and women. When, in addition to holding fix the characteristics of workers of the labour force, the share of immigrants is held constant at its 1994

level, the role of the residual component in the upper path of the wage distribution decreases even more. However there is not much effect of the share of immigrants when considering natives only. Results are qualitatively similar for women.

Looking at the lower part of the wage distribution the evolution of the residual variance is similar across groups (all workers, natives) and between the two countries; in fact the 50-10 residual gap is characterised by a general decrease over time. Consistent with the results of the previous section, the effects of composition appear to be more important: changes in share of foreign-born workers exert almost no effect. This suggests that the presence of immigrants in the labour force not only does not have much effect on the change and level of residual wage inequality, but it also does not affect much the distribution of wages in both US and UK.

### **5.5 New and old immigrants**

DFP (2008) demonstrate that immigrants perform differently according to the time they have already spent in the receiving country; immigrants downgrade considerably upon arrival within educational categories; in particular because of their lack in complementary skills-like language. Recent immigrants may not be able to make use of their educational background to its full potential.

To account for any cohort effects the analysis is re-run separately for recent and other immigrants, define respectively as those who spent 5 years or less in the country and those who have been in the U.S. or UK for more than 5 years<sup>18</sup>.

This section presents the results by separating immigrants in two groups: recent and other immigrants. Recent immigrants are defined as those who, at the year of the interview, arrived in the receiving countries in the last five years, and other immigrants as those who have been in the receiving country for 6 years or more.

Figure 11a to 14b present respectively the standard deviation, the 90-50 and 50-10 log hourly wage gap for recent and other immigrants in the U.S. and UK for men and women. The first aspect worth noting is that according to the time spent in the receiving country immigrants experience differences in wage inequality; after they spent some years in the receiving country they assimilate to immigrants who were already there. By looking at the standard deviation of male and female in the two countries analysed, recent immigrants experience more variation than longer-term immigrants; one exception is for male immigrants in the U.S. whose wage dispersion is not so different from immigrants that were already there; recent female immigrants in the U.S. experience less dispersion than previous

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immigrants. For immigrants in the UK both for men and women wage dispersion of recent immigrants is higher than other immigrants.

Different patterns are shown when considering recent and other immigrants in the upper and lower path of the wage distribution.

As shown by figures 12a and 12d on average immigrants who gain more face a worse situation upon their arrival since experiencing a higher wage variation than existing similar immigrants. And this appears to be true for men and female in both countries. When looking at immigrants located at the lower path of the wage distribution, main differences arise between U.S. and UK: in the U.S. immigrants generally earning less face a better situation since they arrive, and after spending some years in the hosting country wage dispersion increases; lower paid immigrants in the UK follows similar path than better paid ones.

Results for the actual residual (Figure 14a and 14b) are pretty similar to the patterns and trends of the standard deviation presented earlier: more similarity appears between recent and other male immigrants in the U.S.; while new immigrants in the UK experience higher variation in residual wage inequality than people who are already there since 5 years or more.

## **6. Conclusion**

This paper addressed empirically the question of whether increasing immigration in the U.S. and the UK could have been associated with rising residual wage inequality observed between 1994 and 2008. As far as I am aware, except a recent study of Card (2009), almost no attention has been devoted to the role of unobservable skills of immigrants related to wage inequality. By applying Lemieux's methodology (2006) this paper controls for changing characteristics of workers, and adds the immigration dimension in order to control for the increasing presence of foreign-born workers in the labour force. In line with recent Card's findings, results show that the presence of immigrants does not have a causal relation with the increase of residual inequality. Even when treating natives and immigrants as two separated groups, the trend of residual variance inequality for natives does not change that much, suggesting that inequality for natives is not due to the unobservable skills of immigrants acting in the same labour market.

However when the share of immigrants in the labour force is held fix at the base year, the role of the residual components ranges from 0.0002 to 0.009 for natives and up to 0.008 for all workers. Although the composition effects still explains most of the growth in the residual for natives and the whole labour force, the results also suggest that the presence of immigrants plays a role in explaining the growth in the residual variance observed, albeit for a very small share. On average the non-causal

effect of immigration on residual variance ranges between 0.1% and 0.5% of the observed change between 1994 and 2008.

This suggests that the presence of immigrants in the labour force not only does not have much effect on the change and level of residual wage inequality, but it also does not affect the distribution of wages in both US and UK. Looking at the implications in terms of public policy results suggests that the inflow of workers from abroad has no negative effect on the receiving countries, confirming that immigration should not be considered as a concern in public policy agenda.

## **APPENDIX**

One of the aims of this paper is to account for the unmeasured aspects of human capital; due to the difficulties in investigating this by following the limited literature (Lemieux 2006, Moav and Gould 2008) this paper uses as a proxy for unobservable skills the residual of a standard Mincer equation; in other words to interpret the residual as the unmeasured aspect of human capital I model the specification only on age, educational level (years of schooling) and experience.

As a sensitivity check of my results, I recomputed the results for all workers, natives and immigrants by adding other controls such as dummy variable for area of origin and years spent in the receiving country by the immigrants. As it should be expected the level of the results slightly decreases, nevertheless the trends do not change too much and even more importantly the distance in wage inequality due to residuals between natives and immigrants still remains.<sup>19</sup>

To check whether the trends and levels for immigrants are not driven by cohorts effects i.e. cohorts of arrivals in the receiving country, table 6a and 6b present the main results by looking at the wage inequality in 3 years (1994,2000 and 2008) of male immigrants in the US and UK.

The main measures used are the standard deviation of log hourly wage and the residual variance. However the analysis does not show any dominant trends of the cohorts of the arrival.<sup>20</sup>

Figures from 17 to 20 present the evolution of the residual wage inequality for all workers, natives and immigrants by looking at educational level; as discussed in the descriptive session of the data the three groups of education defined are: lower, intermediary and high.

There are several features worth noting when analysing all male workers; the level of the residual by group of education is higher in the U.S. than in the UK for both the high educational and

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<sup>19</sup> Results for the sensitivity check may be available on request from the author.

<sup>20</sup> Considering male immigrants in the U.S. about 30% of them arrived between 1978 and 1989, followed by 26% who arrived during the 1990s. Only 8% of actual immigrants working in the US arrived before 1967 and 18% arrived between 1999 and 2008. For the UK 37 % of male immigrants arrived before 1967, while about 15% of them arrived respectively during the 1970s, 1980s and 1990s. 18% of actual male immigrants in the UK arrived between 1990 and 2008.



intermediate group while lower educated workers experienced more inequality in the UK than in the U.S.; compared to the other groups in the UK lower educated workers also suffer from higher inequality. The situation reverses in the U.S. where the degree of inequality decreases with the level of education, in other words the more educated the workers are the higher is the residual wage dispersion while the less educated experience lower level of residual wage dispersion.

Comparing natives and immigrants in the same educational group, confirms the main message of the previous results: removing immigrants from the labour force does not change the leading trend observed for all workers, the only slightly difference appear in the level.

Remarkable differences arise between immigrants and natives; the former encounter a higher inequality as well as more variation than the latter in the same educational group, the only exception is for the group of lower educated immigrants in the U.S.; in this case the trend and level of residual wage inequality converges to that of natives; on the other hand their level of wage dispersion is slightly lower than natives. This convergence may suggest that lower educated immigrants and natives in the U.S. are more complement not only in the observable as it has been shown by recent literature (Ottaviano and Peri 2006) but they also appear to be substitutable in the unobservable, meaning that these workers compete for similar jobs more than others. This result may also depend on the composition of the immigrants since this group is less heterogeneous than the others in fact the lower educated group of immigrants is mainly composed by Mexican.

By contrast to the US the higher variation in wage affects low educated immigrants working in the UK while on average better educated workers experience less variation, albeit still characterised by a different trend. Considering the overall changes overtime, in the UK both high and intermediate educated immigrants experience an overall decrease in the residual wage inequality, while it increases for lower educated during the last years of the samples.

Results for female workers follow qualitatively those of male except that the level is lower in both the U.S. and the UK.

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Table1. Proportion of immigrants in the labour market (full time, employed, main job)

	<b>Men</b>	<b>Women</b>
<b>U.S.</b>		
1994	0,10	0,08
2008	0,15	0,12
<b>UK</b>		
<b>U.S.</b>	<b>1994</b>	<b>2008</b>
1994	0,00	0,07
2008	0,13	0,11
<b>Europe</b>	0,14	0,15
<b>Asia</b>	0,25	0,25
<b>Africa</b>	0,14	0,031
<b>Americas</b>	0,46	0,58
<b>Oceania</b>	0,003	0,005
<b>Other</b>	0,014	0,028
<b>UK</b>		
<b>Europe</b>	0,39	0,52
<b>Asia</b>	0,26	0,203
<b>Africa</b>	0,16	0,17
<b>Americas</b>	0,13	0,07
<b>Oceania</b>	0,05	0,036
<b>Other</b>	0,02	0,006

Notes: Samples include women and 16 to 64 for men experience; working full time, job only.

people aged 16 to 59 for with positive potential full year , employed and main

Table 2. Area of Origin of immigrants to United States and Great Britain, 1994-2008

Table 3. Educational Attainment of Natives and Immigrants

	Natives		Immigrants	
	Men	Women	Men	Women
<b>A. US</b>				
<b>Lower Ed</b>				
1994	0,08	0,06	0,30	0,22
2008	0,05	0,04	0,29	0,18
<b>Intermediate</b>				
1994	0,64	0,67	0,43	0,51
2008	0,62	0,60	0,42	0,47
<b>Higher</b>				
1994	0,28	0,27	0,27	0,27
2008	0,33	0,36	0,29	0,35
<b>B. UK</b>				
<b>Lower Ed.</b>				
1994	0,28	0,43	0,21	0,24
2008	0,27	0,31	0,19	0,18
<b>Intermediate</b>				
1994	0,55	0,30	0,37	0,34
2008	0,48	0,37	0,27	0,26
<b>Higher</b>				
1994	0,17	0,17	0,42	0,41
2008	0,25	0,32	0,54	0,56

Notes: Based on ORG/CPS and LFS. Samples include people aged 16 to 59 for women and 16 to 64 for men with positive potential experience; working full time, full year and main job only.

dispersion in  
UK

	U.S.			UK		
	Standard deviation	90-50	50-10	Standard deviation	90-50	50-10
	<i>Males</i>					
A. All workers						
1994	0.547	0.684	0.721	0.545	0.706	0.630
2000	0.543	0.724	0.674	0.549	0.738	0.616
2008	0.569	0.765	0.687	0.559	0.751	0.620
B. Natives						
1994	0.537	0.674	0.697	0.541	0.703	0.627
2000	0.529	0.693	0.694	0.544	0.734	0.610
2008	0.556	0.754	0.693	0.553	0.729	0.620
C. Immigrants						
1994	0.600	0.876	0.693	0.612	0.770	0.783
2000	0.581	0.917	0.573	0.602	0.830	0.677
2008	0.613	0.976	0.593	0.591	0.850	0.610
	<i>Females</i>					
A. All workers						
1994	0.509	0.693	0.598	0.542	0.689	0.598
2000	0.498	0.688	0.553	0.502	0.668	0.584
2008	0.525	0.722	0.597	0.504	0.671	0.558
B. Natives						
1994	0.503	0.683	0.591	0.522	0.681	0.601
2000	0.490	0.664	0.580	0.500	0.666	0.573
2008	0.513	0.701	0.607	0.499	0.668	0.554
C. Immigrants						
1994	0.552	0.787	0.580	0.578	0.690	0.661
2000	0.543	0.870	0.518	0.514	0.650	0.659
2008	0.580	0.896	0.568	0.532	0.686	0.595

Table 4a. Wage  
the U.S. and

Notes: Based on ORG/CPS and LFS. Samples include people aged 16 to 59 for women and 16 to 64 for men with positive potential experience; working full time, full year and main job only. Hourly wages are reported in 2008 dollars and pounds.

Table 4b. Change in Wage inequality for US and UK, male 1994-2008

		U.S.			UK		
	Standard Deviation	90-50	50-10	Standard Deviation	90-50	50-10	
<i>Males</i>							
<b>A. All workers</b>							
1994-2008	0.022	0.081	-0.034	0.013	0.045	-0.018	
<b>B. Natives</b>							
1994-2008	0.019	0.08	-0.004	0.012	0.026	-0.007	
<b>C. Immigrants</b>							
1994-2008	0.013	0.1	-0.1	-0.020	0.080	-0.174	
<i>Females</i>							
<b>A. All workers</b>							
1994-2008	0.016	0.029	-0.001	-0.020	-0.017	-0.040	
<b>B. Natives</b>							
1994-2008	0.008	0.037	-0.011	-0.023	-0.013	-0.047	
<b>C. Immigrants</b>							
1994-2008	0.028	0.108	-0.011	-0.005	-0.004	-0.066	

Notes: Based on ORG/CPS and LFS. Samples include people aged 16 to 59 for women and 16 to 64 for men with positive potential experience; working full time, full year and main job only. Hourly wages are reported in 2008 dollars and pounds.

Table 5a. Wage decomposition: Natives, Immigrants and All Workers

	1994-2008 UK			1994-2008 U.S.		
	Natives	Immigrants	All workers	Natives	Immigrants	All workers
<b>A. Men</b>						
Actual Residual	0,022	-0.015	0,027	0,018	0.005	0,017
Predicted Value	-0,009	-0.009	-0,012	0,002	0.011	0,007
Total wage variance	0,013	-0.024	0,015	0,020	0,016	0,024
<b>B. Women</b>						
Actual Residual	-0.002	0,009	0,005	0,008	0,006	0,009
Predicted value	-0,021	-0,013	-0,025	0,004	0,026	0,007
Total wage variance	-0,023	-0.006	-0,020	0.012	0,032	0,016

Notes: Based on ORG/CPS and LFS. Samples include people aged 16 to 59 for women and 16 to 64 for men with positive potential experience; working full time, full year and main job only. Hourly wages are reported in 2006 dollars and pounds. Residual wage variance is based on standard Mincer wage equation, fit separately by year, gender, immigration status.



Table 5b. Wage decomposition Natives and All Workers.

	UK 1994-2008		US 1994-2008	
	Natives	All workers	Natives	All workers
<b>A. Men</b>				
Actual Residual	0,022	0,027	0,018	0,017
Skills at 1994	0,006	0,008	0,010	0,009
Skills and Share of Immigrants at 1994	0,007	0,003	0,009	0,008
Predicted Value	-0,009	-0,012	0,002	0,007
Total wage variance	0,013	0,015	0,020	0,024
<b>B. Women</b>				
Actual Residual	-0,002	0,005	0,008	0,009
Skills at 1994	-0,014	-0,010	-0,002	-0,0003
Skills and share of Immigrants at 1994	-0,014	0,002	0,0002	-0,001
Predicted value	-0,021	-0,025	0,004	0,007
Total wage variance	-0,023	-0,020	0,012	0,016

Notes: Based on ORG/CPS and LFS. Samples include people aged 16 to 59 for women and 16 to 64 for men with positive potential experience; working full time, full year and main job only. Hourly wages are reported in 2006 dollars and pounds. Residual wage variance is based on standard Mincer wage equation, fit separately by year, gender, immigration status.

Figure 1a. Standard Deviation of Log Hourly Wage for Men, 1994-2008

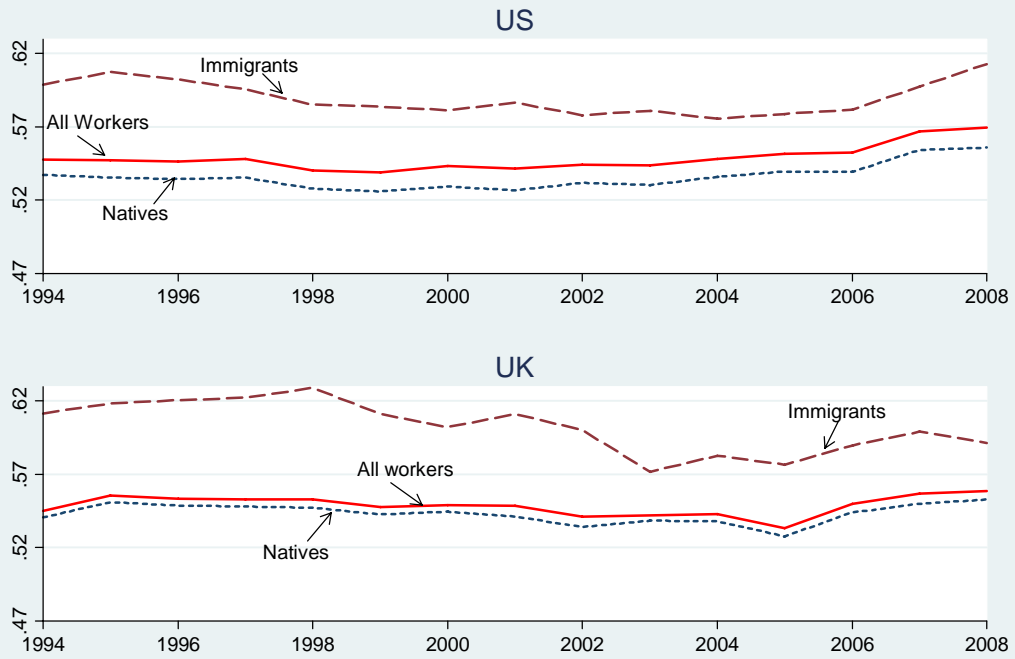


Figure 1b. Standard Deviation for Women, 1994-2008

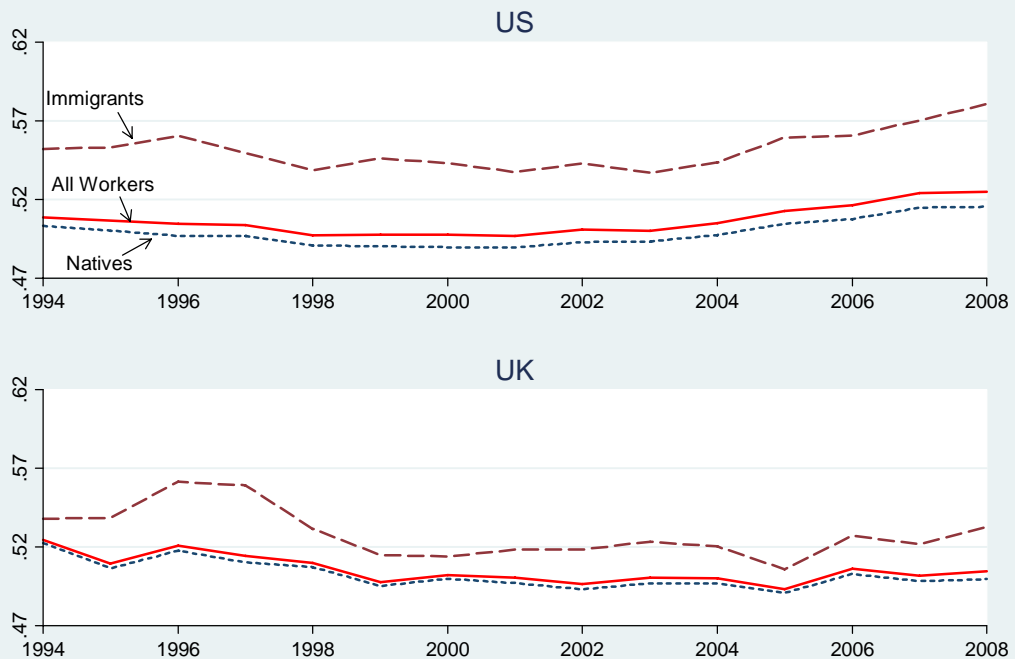


Figure 2a. Log Hourly Wage Distribution Natives and Immigrants, Male 1994

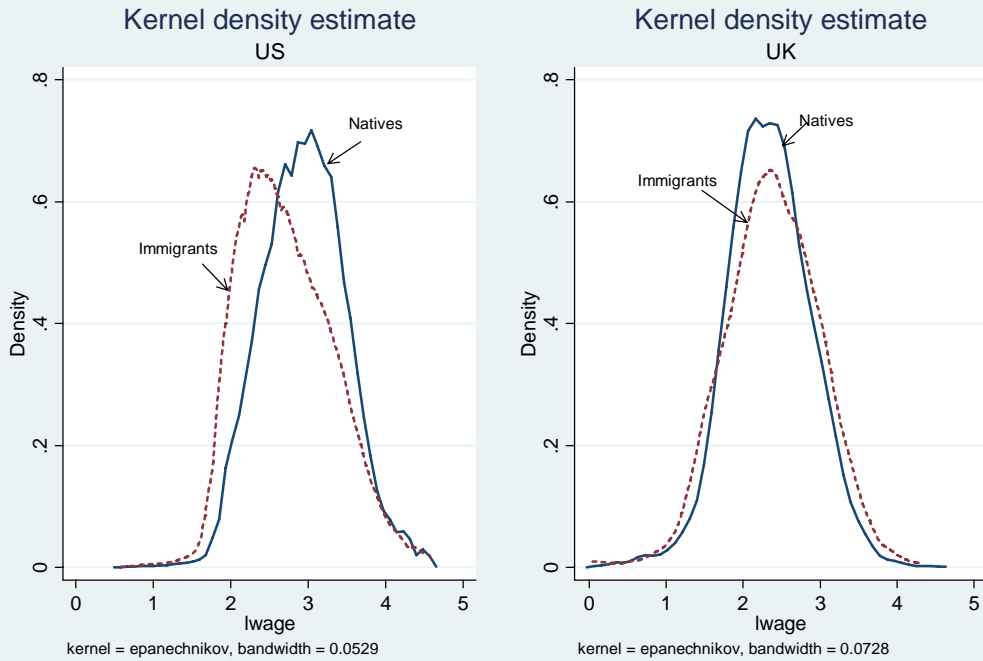


Figure 2b. Log Hourly Wage Distribution Natives and Immigrants, Male 2008

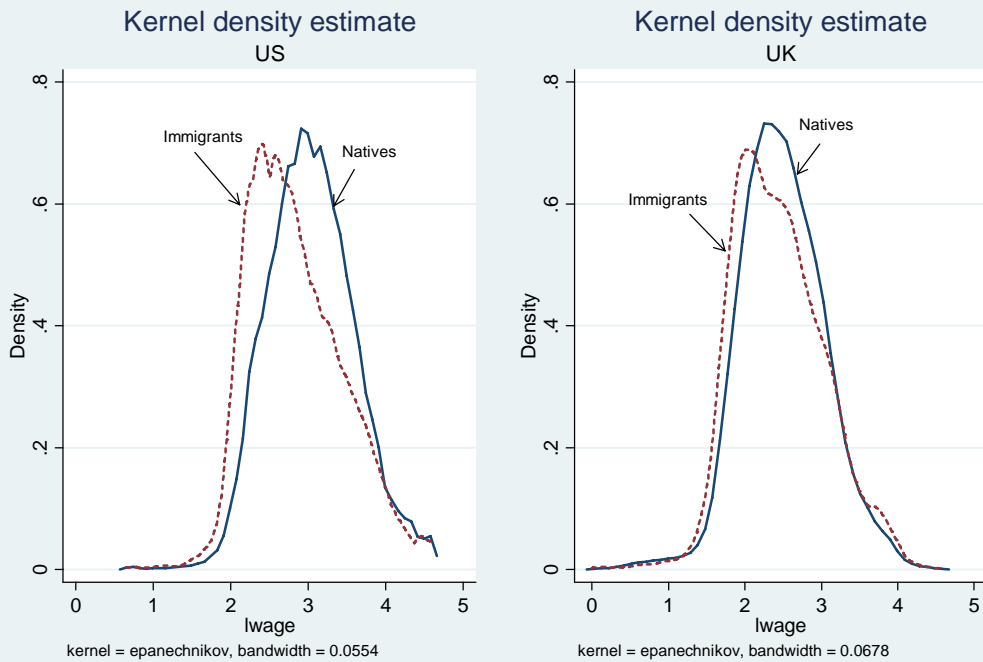


Figure 2c. Log Hourly Wage Distribution Natives and Immigrants, Female 1994

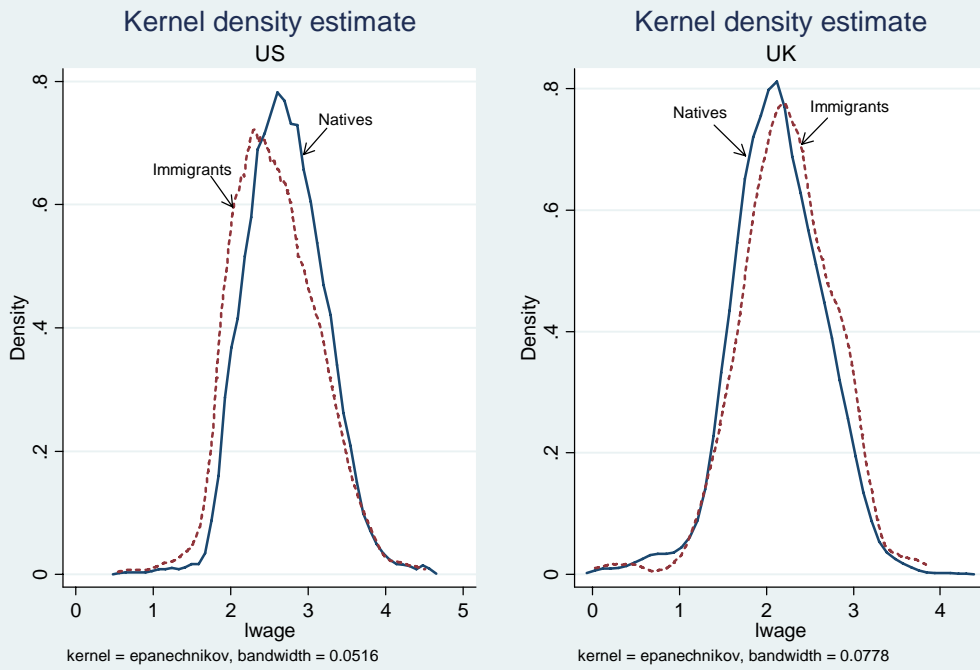


Figure 3d. Log Hourly Wage Distribution Natives and Immigrants, Female 2008

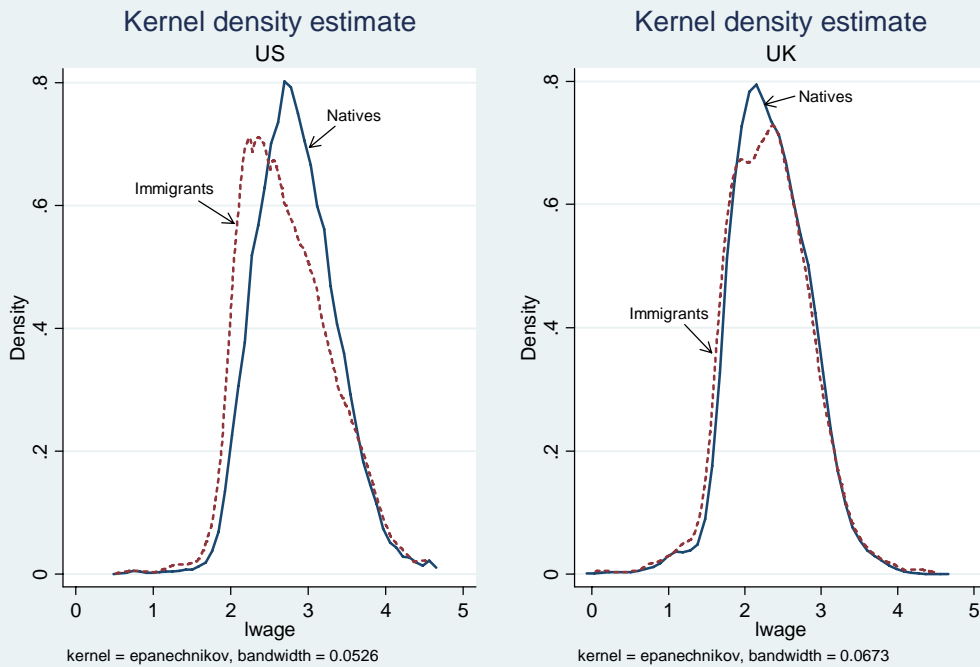


Figure 3a. Residual Variance and Share of Immigrants  
Men, 1994-2008

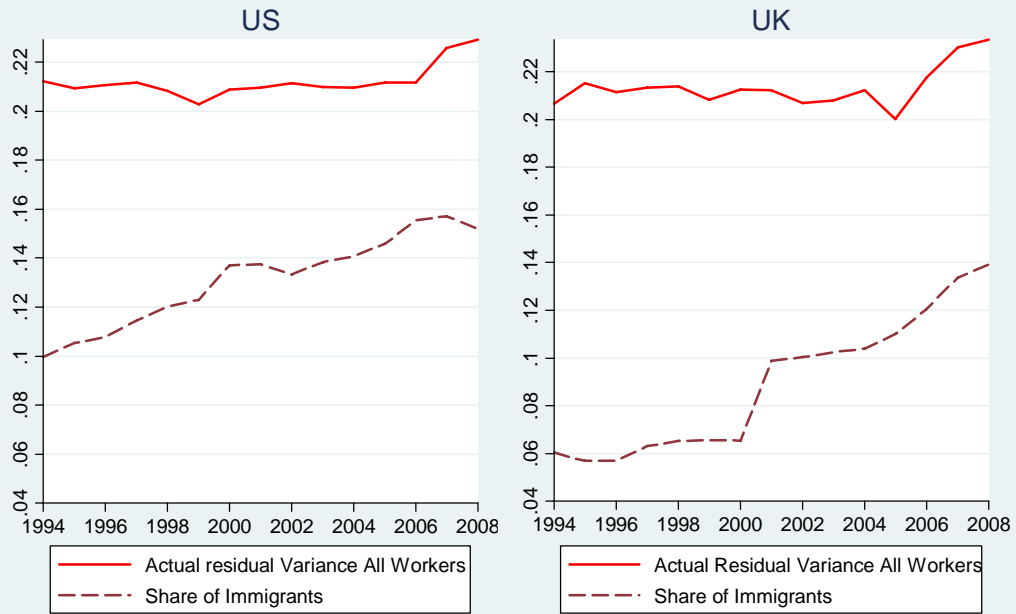
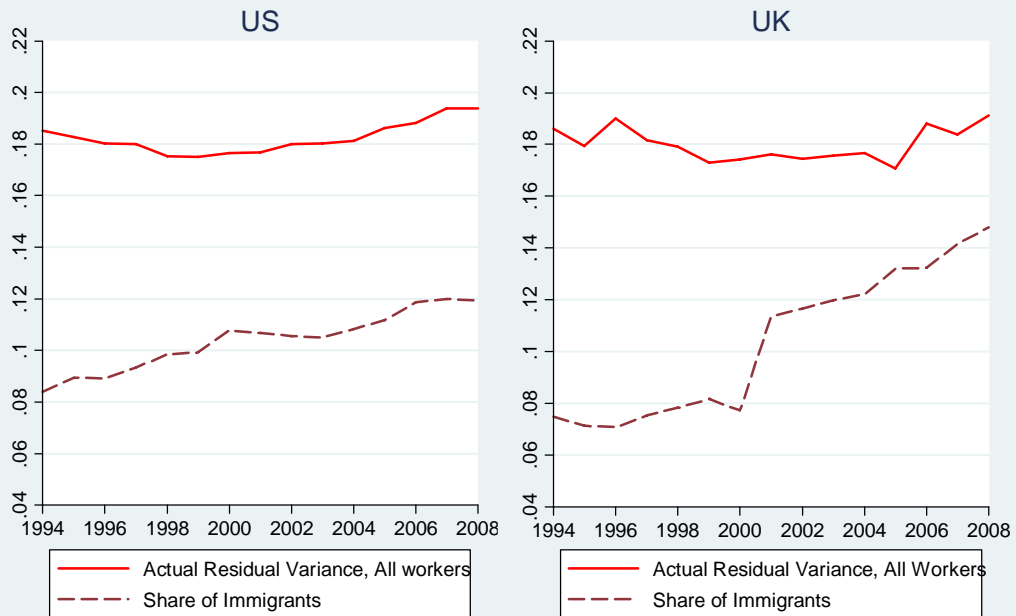


Figure 3b. Residual Variance and Share of Immigrants  
Women, 1994-2008



Notes: Based on ORG/CPS and LFS. Samples include people aged 16 to 59 for women and 16 to 64 for men with positive potential experience; working full time, full year and main job only. Hourly wages are reported in 2008 dollars and pounds. Residual wage variance is based on standard Mincer wage equation, fit separately by year, gender, immigration status.

Figure 3c. Share of Immigrants and 90-50 Residual Gap, Men 1994-2008

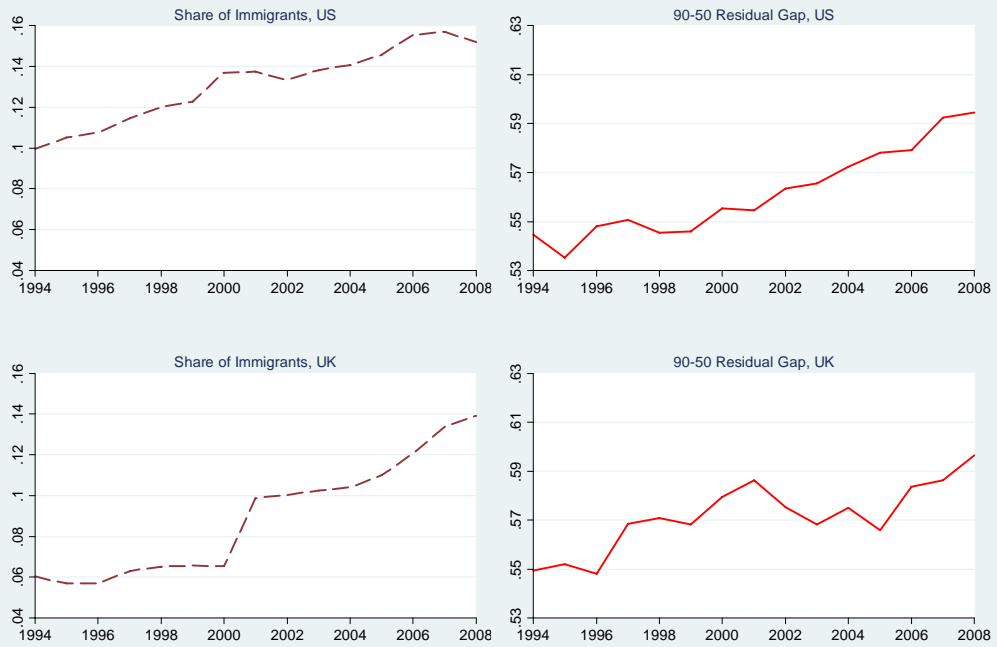


Figure 3d. Share of Immigrants and 90-50 Residual Gap, Female 1994-2008

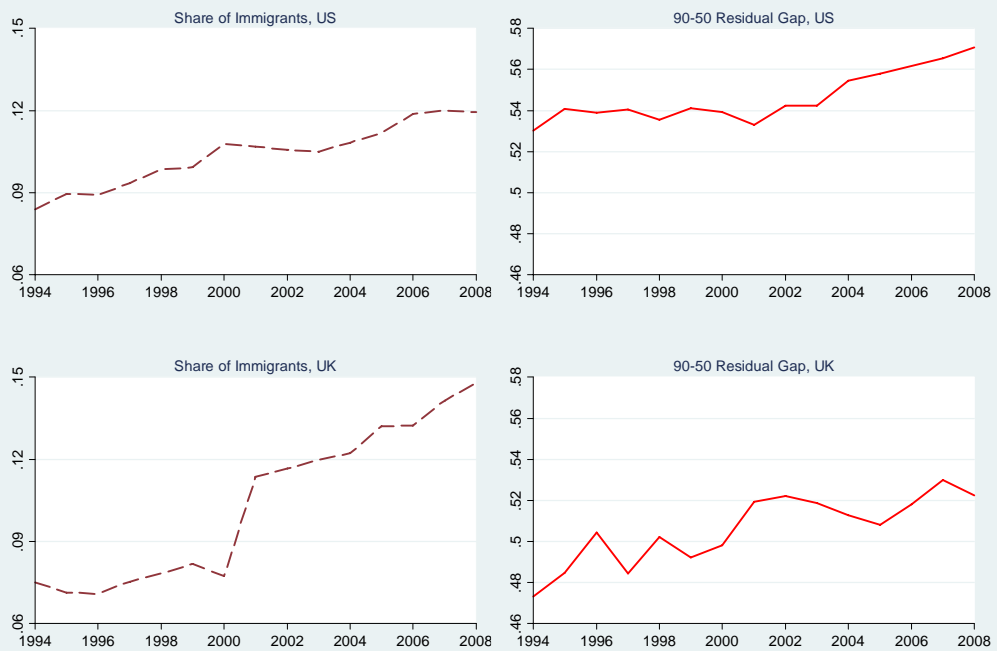


Figure 4a. Actual Residual Variance for All Workers, Natives and Immigrants, Men 1994-2008

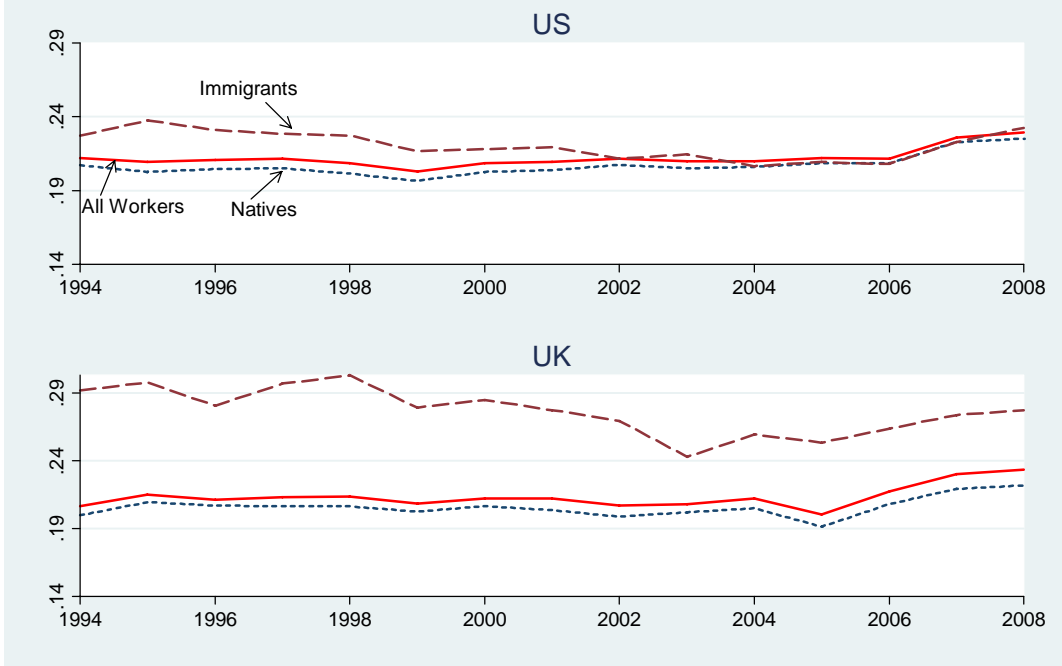


Figure 4b. Actual Residual Variance for All Workers, Natives and Immigrants Women, 1994-2008

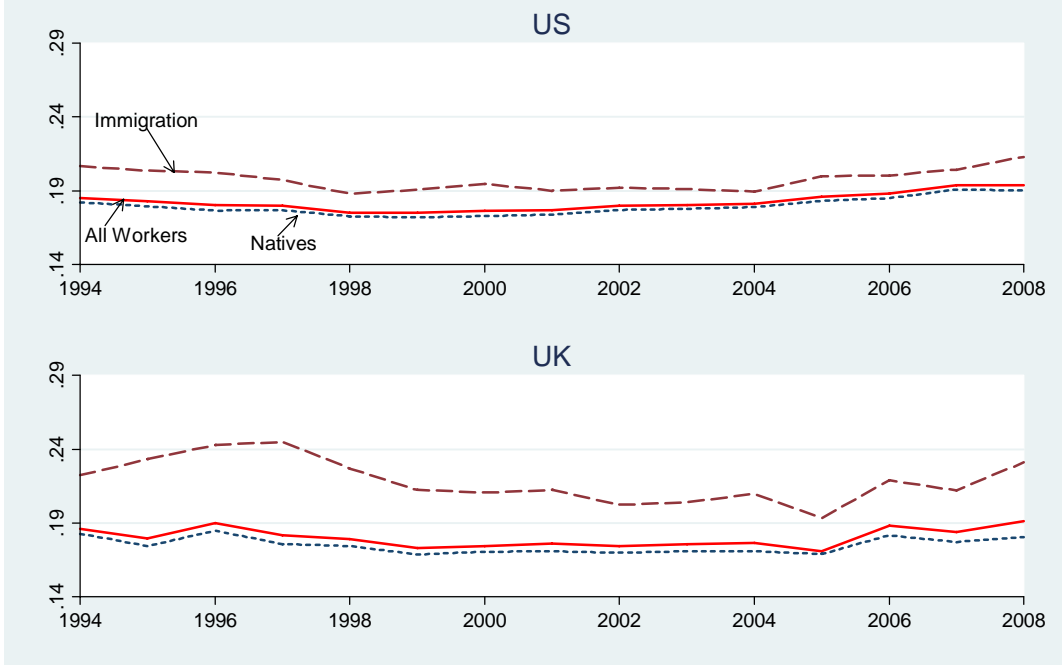


Figure 5a. Residual Variance, Composition Effects and Share of Immigrants at 1994  
All Workers Men, 1994-2008

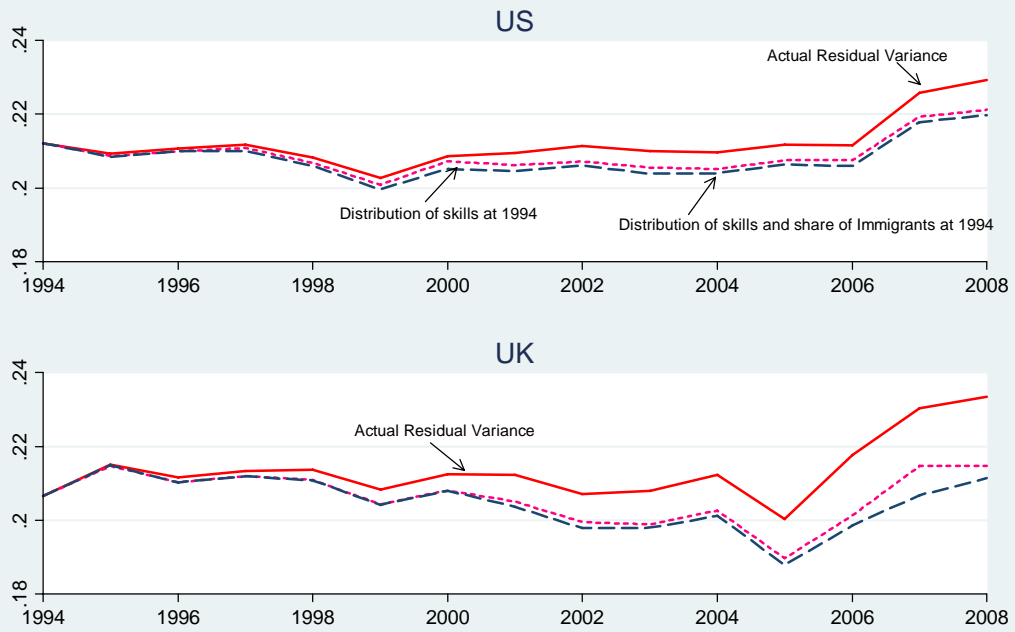


Figure 5b. Actual Variance, Composition Effects and Share of Immigrants at 1994  
All Workers, Women 1994-2008

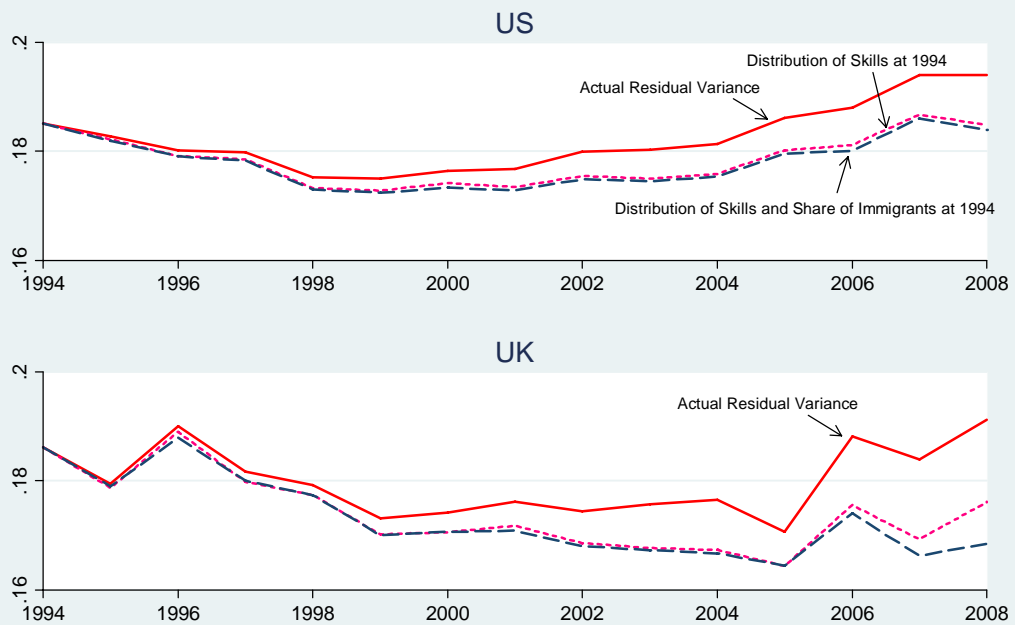




Figure 6a. Actual Residual Variance, Composition Effects and Share of Immigrants at 2008  
All Workers, Men

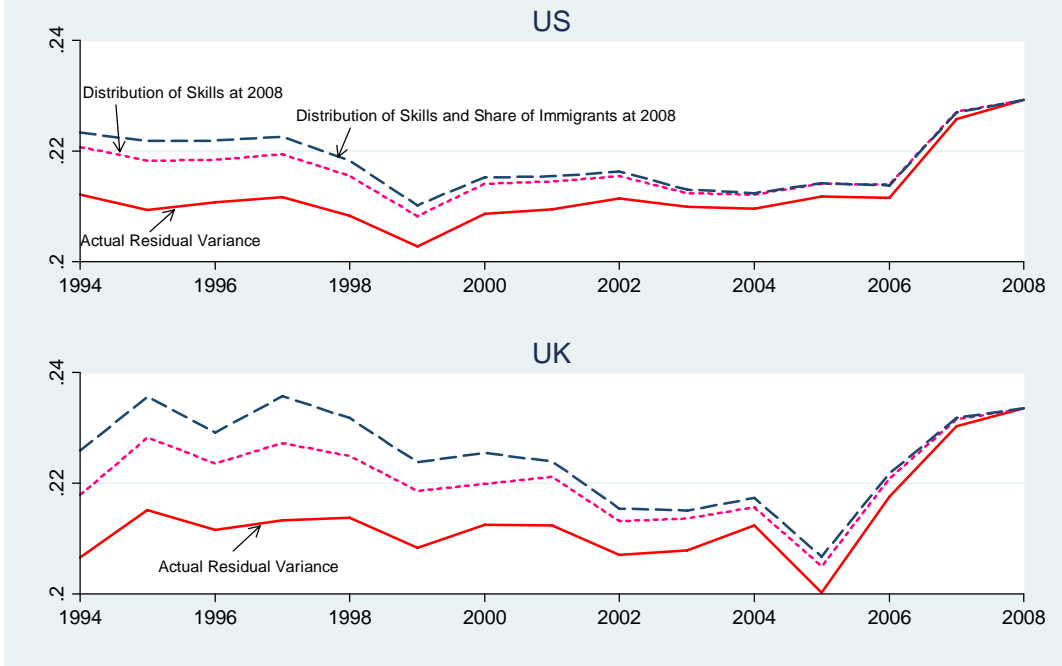


Figure 6b. Actual Residual Variance, Composition Effects and Share of Immigrant at 2008  
Women 1994-2008

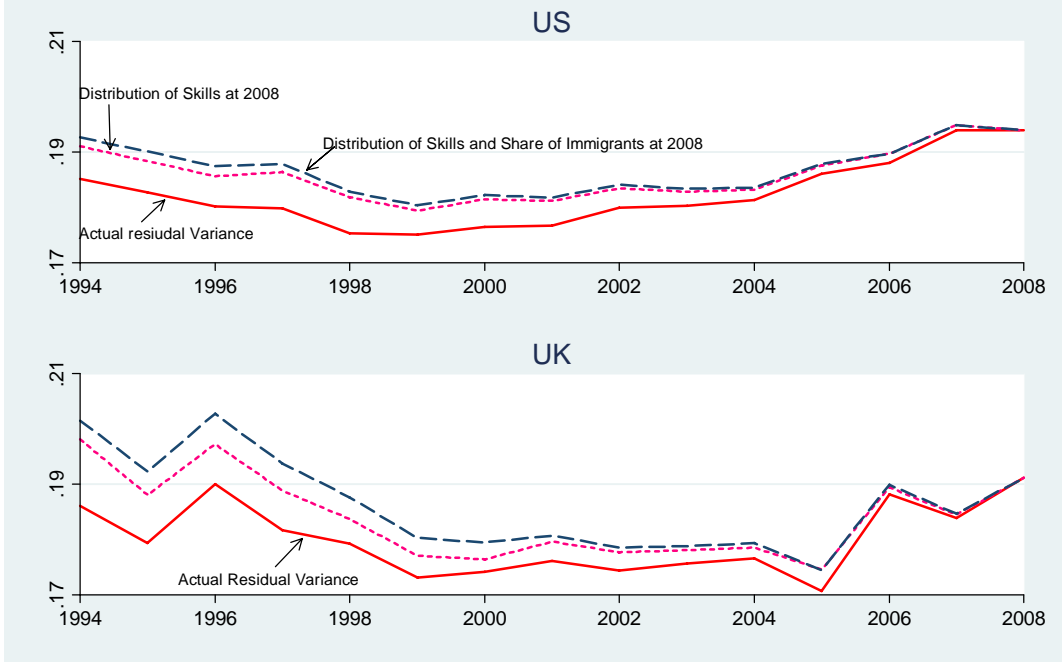


Figure 7a. Actual Residual Variance, Composition Effects and Share of Immigrant at 1994  
Natives Men 1994-2008

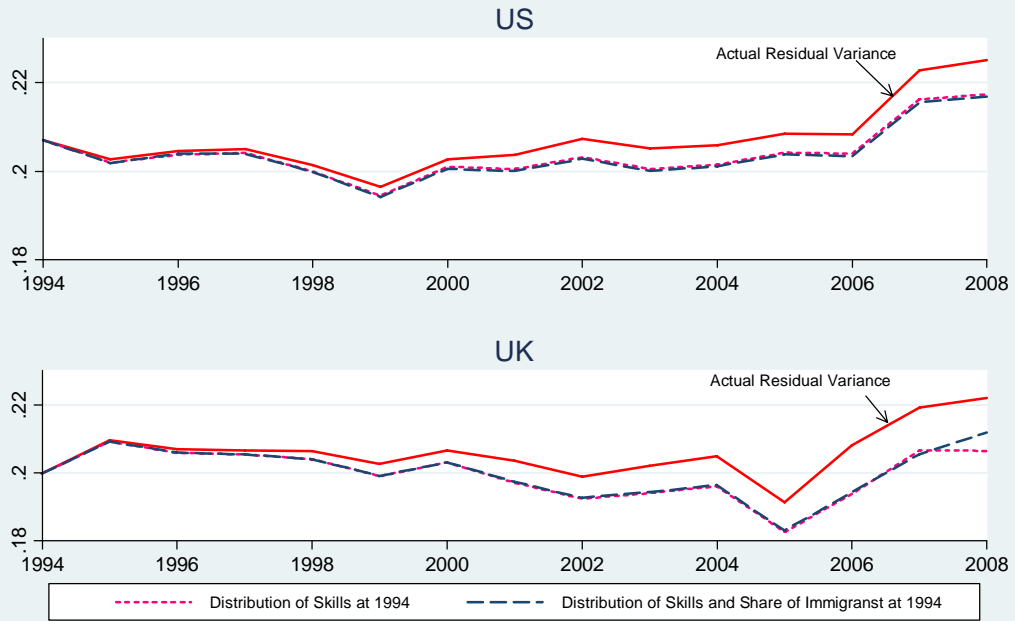


Figure 7b. Actual Residual Variance, Composition Effects and Share of Immigrants at 2008  
Natives Men, 1994-2008

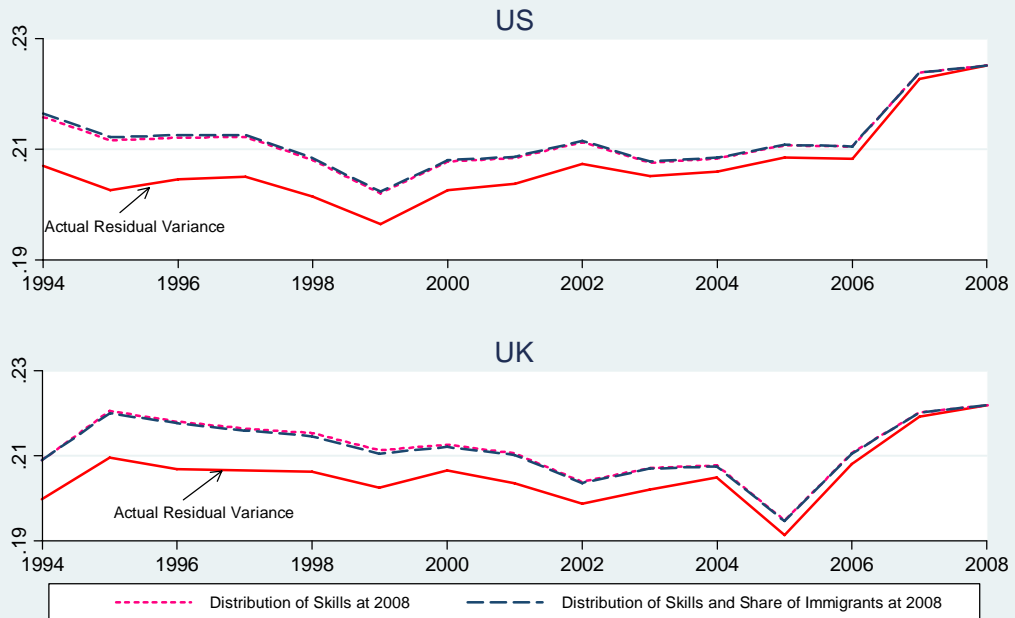


Figure 8a. Actual Residual Variance, Composition Effects and Share of Immigrants at 1994  
Natives, Female 1994-2008

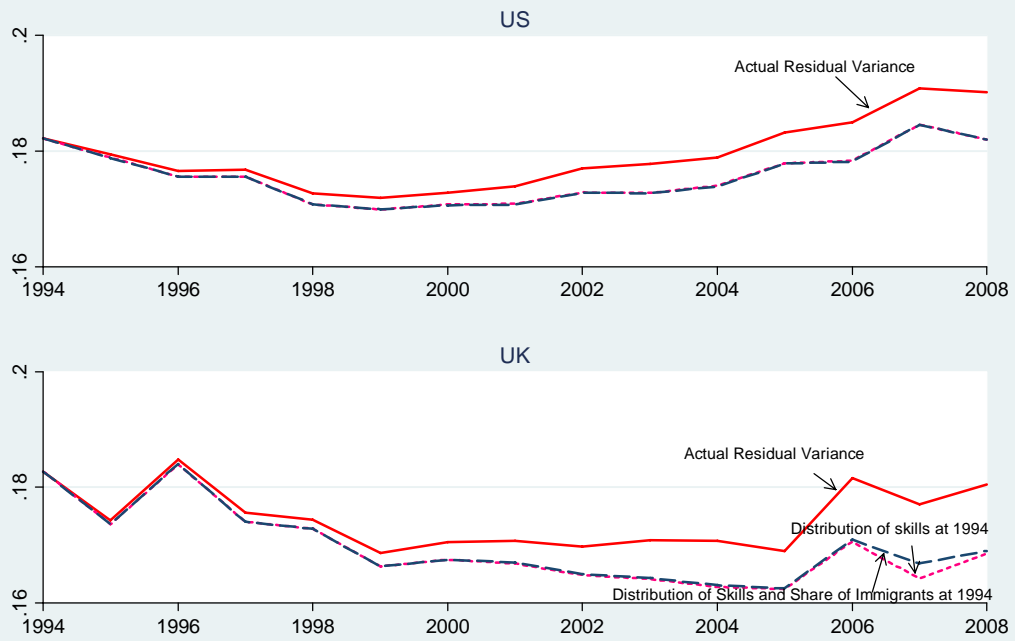


Figure 8b. Actual Residual Variance, Composition Effects and Share of Immigrants at 2008  
Natives, Women, 1994-2008

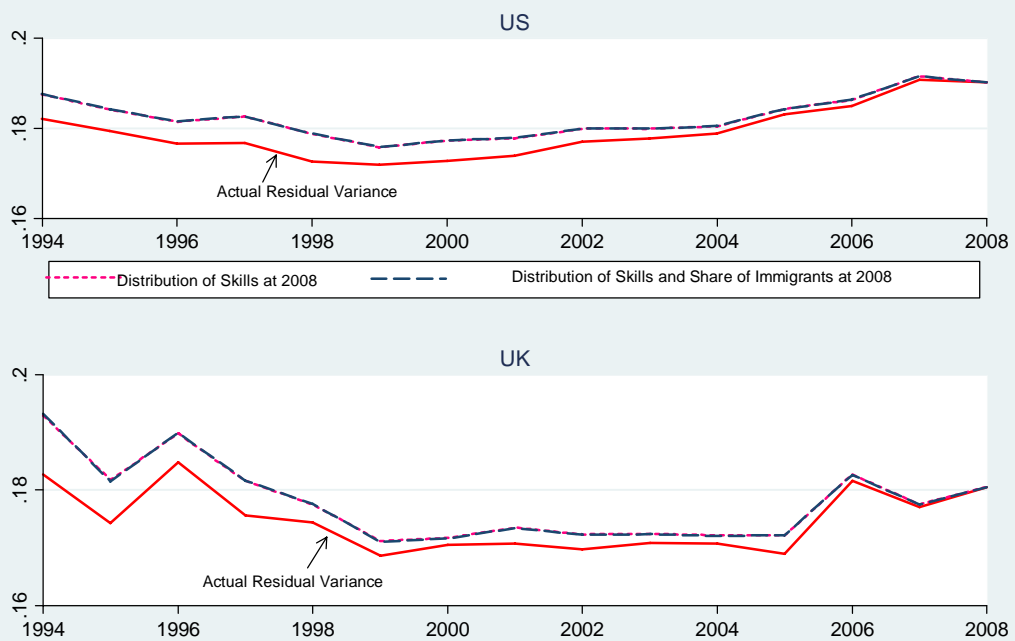


Figure 9a. 90-50 Residual Gap, Men US 1994-2008  
 Holding skills of Workers and Share of Immigrants at 1994

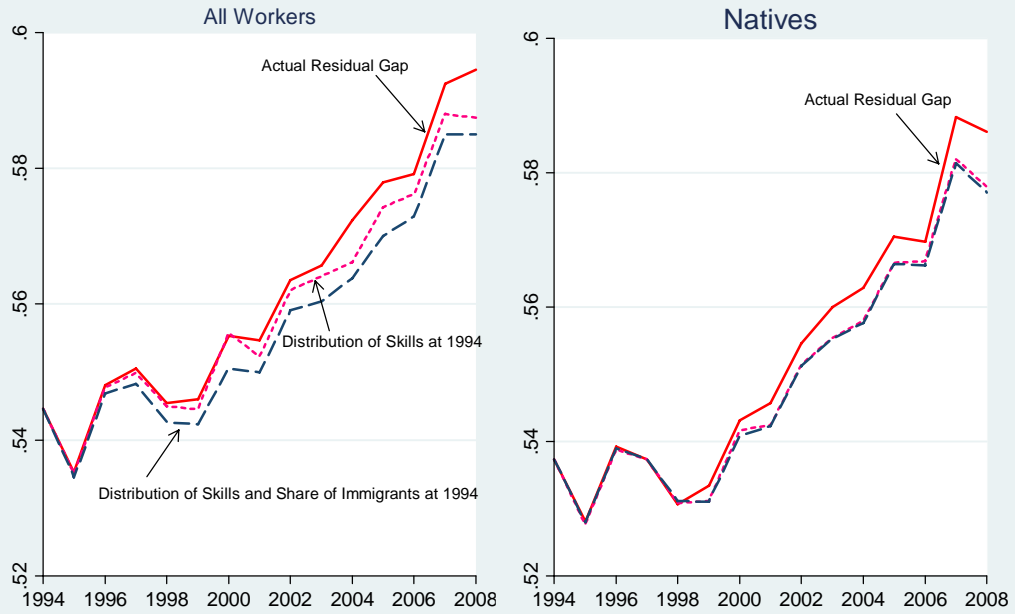


Figure 9b. 90-50 residual Gap, Men 1994-2008 UK  
 Holding skills of workers and share of immigrants at 1994

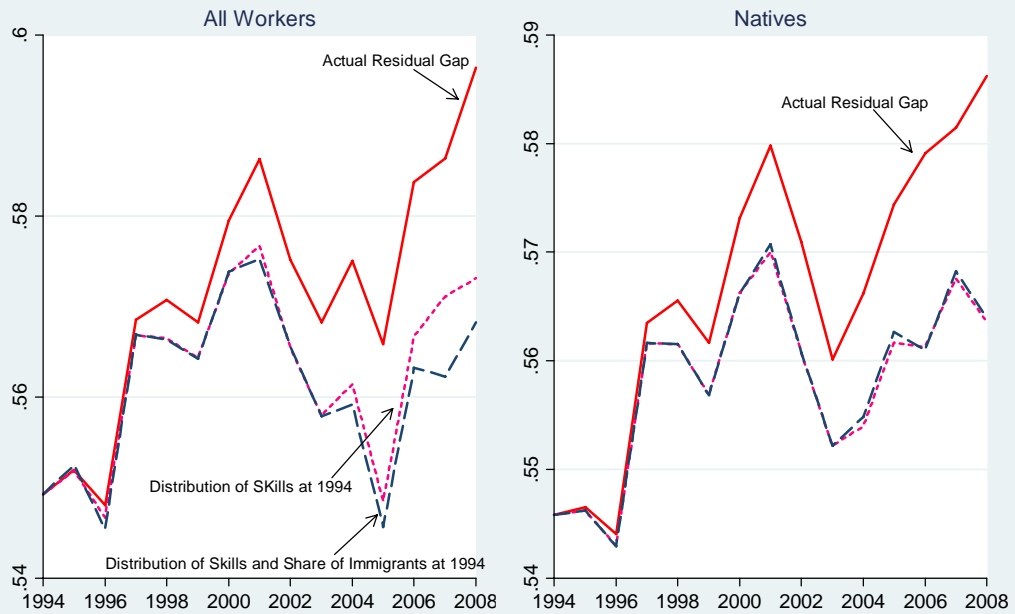


Figure 9c. 90-50 Residual Gap Women 1994-2008, US  
Holding Distribution of Skills and Share of Immigrants at 1995

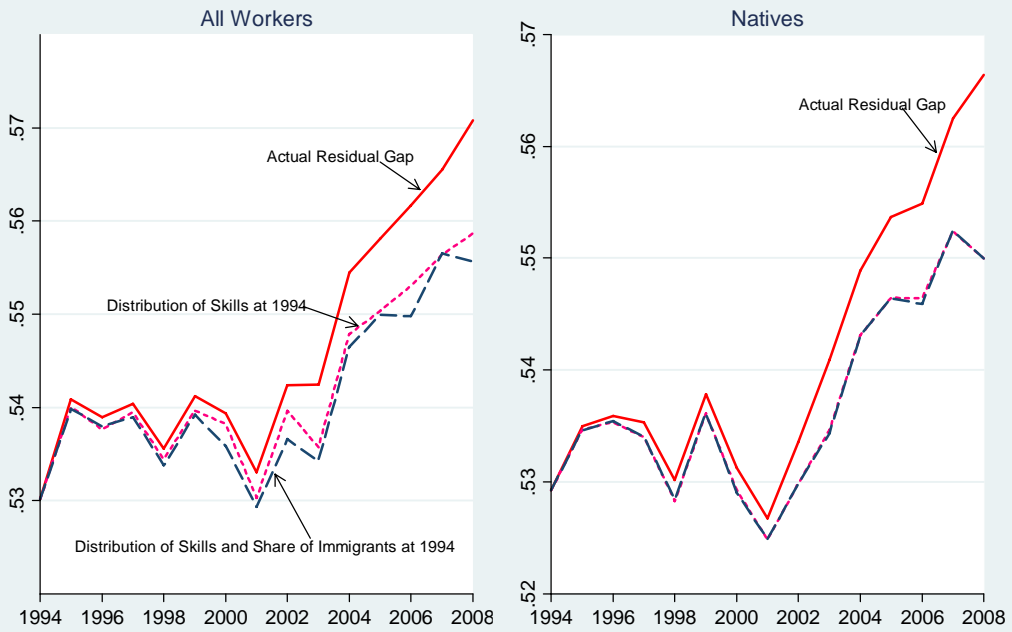


Figure 9d. 90-50 Residual Gap, Women 1994-2008 Uk  
Holding Distribution of Skills and Share of Immigrants at 1994

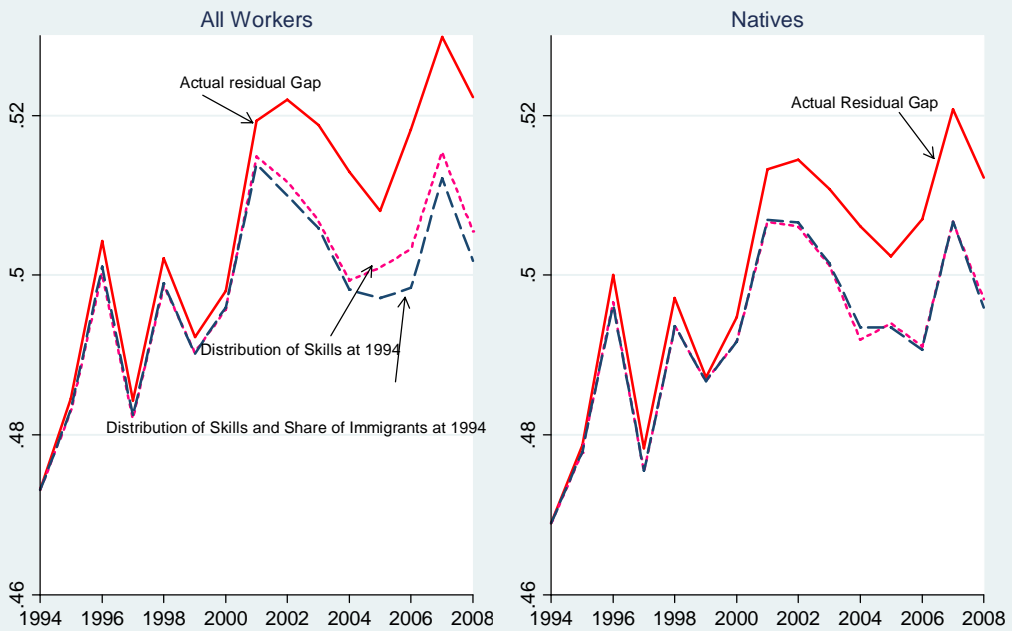


Figure 10a. 50-10 Residual Gap, Men 1994-2008 US  
Holding skills and share of immigrants at 1994

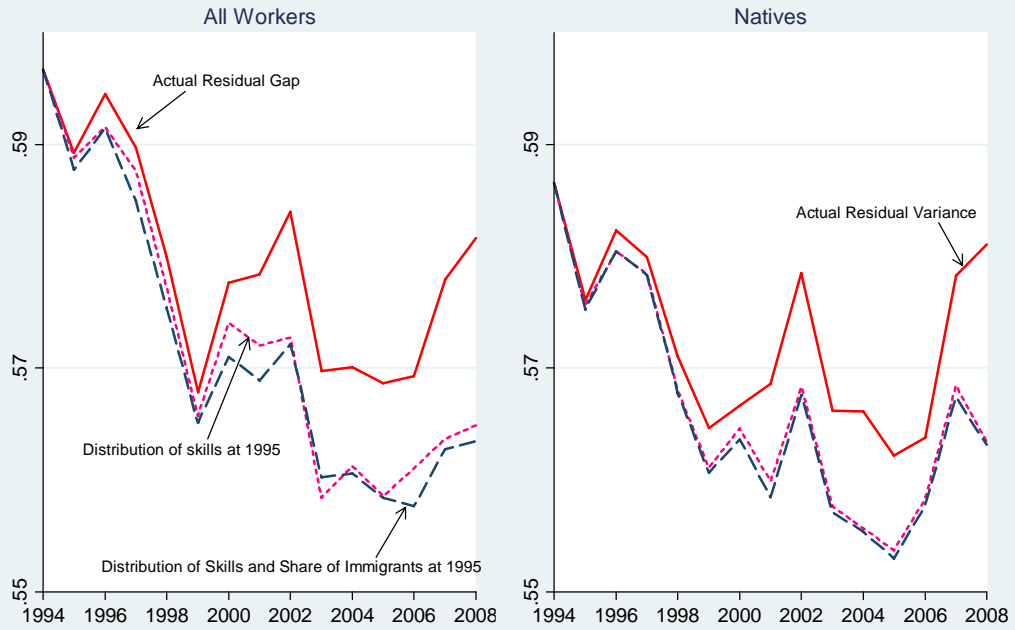


Figure 10b. 50-10 Residual Gap, Women 1994-2008 UK  
Holding Skills and Share of Immigrants at 1994

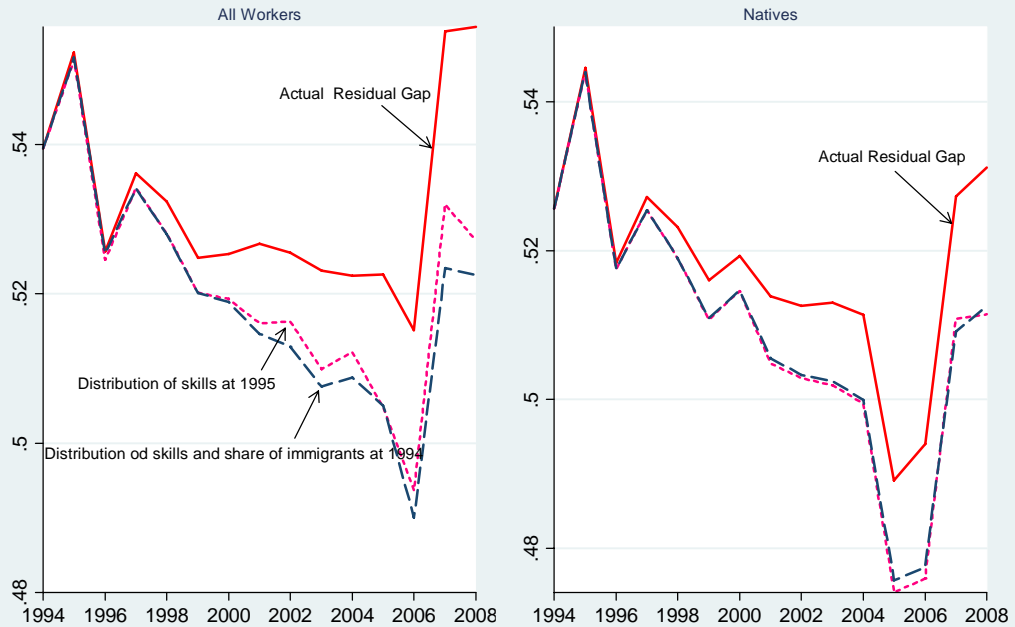


Figure 10c. 50-10 Residual Gap, Women 1994-2008 UK  
Holding distribution of skills and share of immigrants at 1994

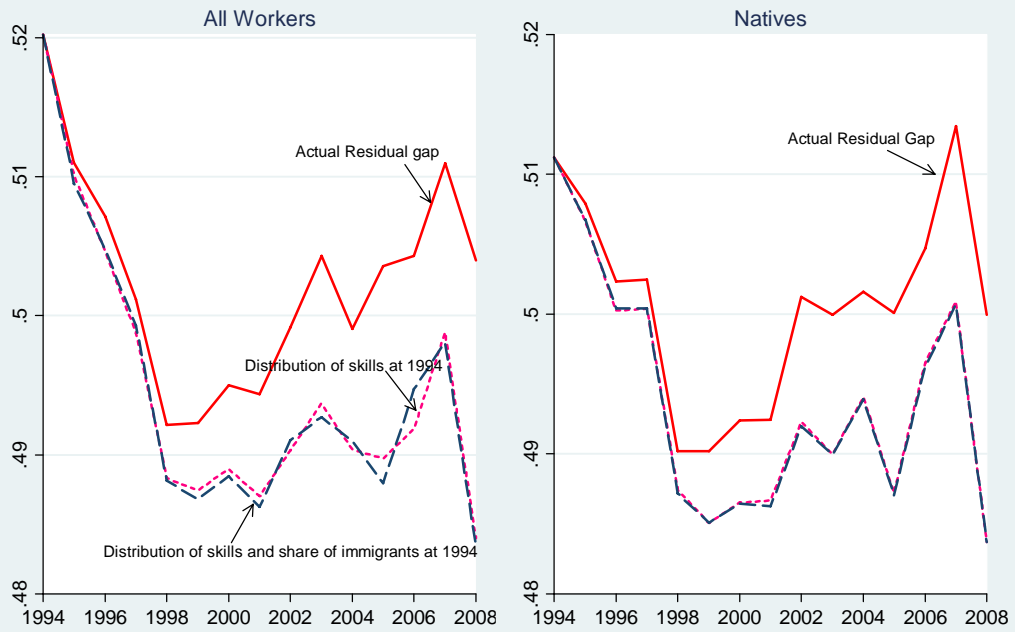
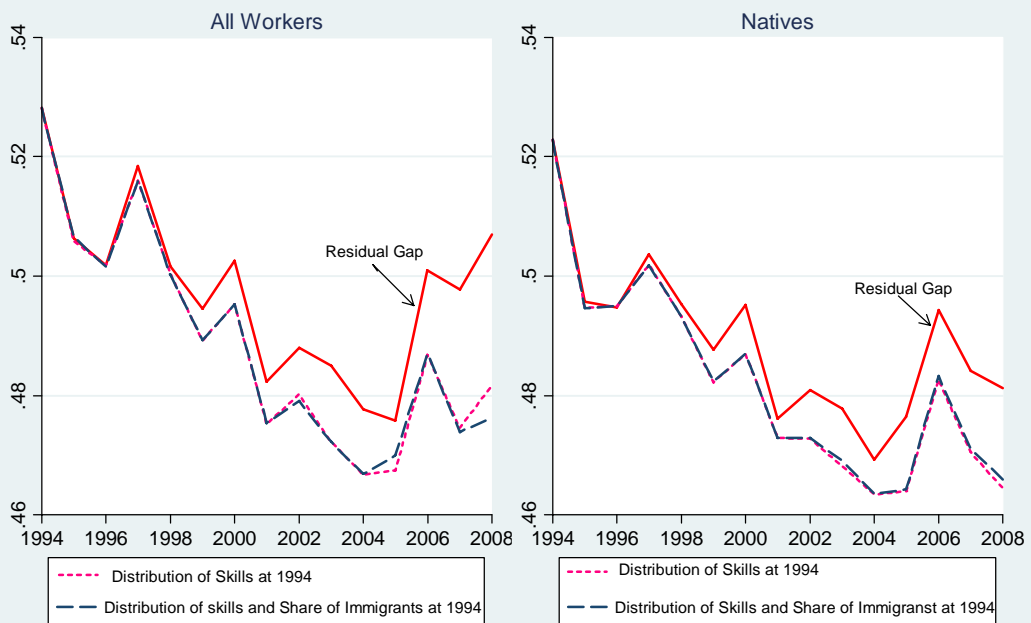


Figure 10d. 50-10 Residual Gap Female, UK  
Holding Skills and Share of Immigrants at 1994



Part Two: analysis by New and Old Immigrants

Figure 11a. Standard Deviation of Log Hourly Wage, male

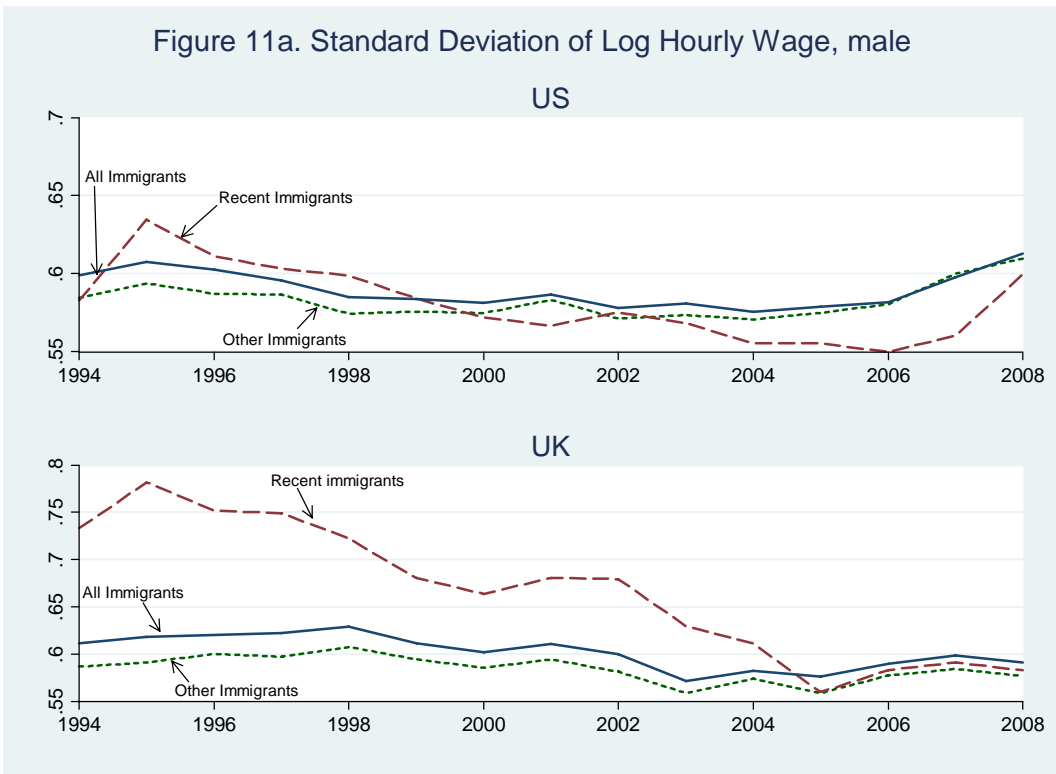


Figure 11b. Standard Deviation of Log Hourly Wage Female

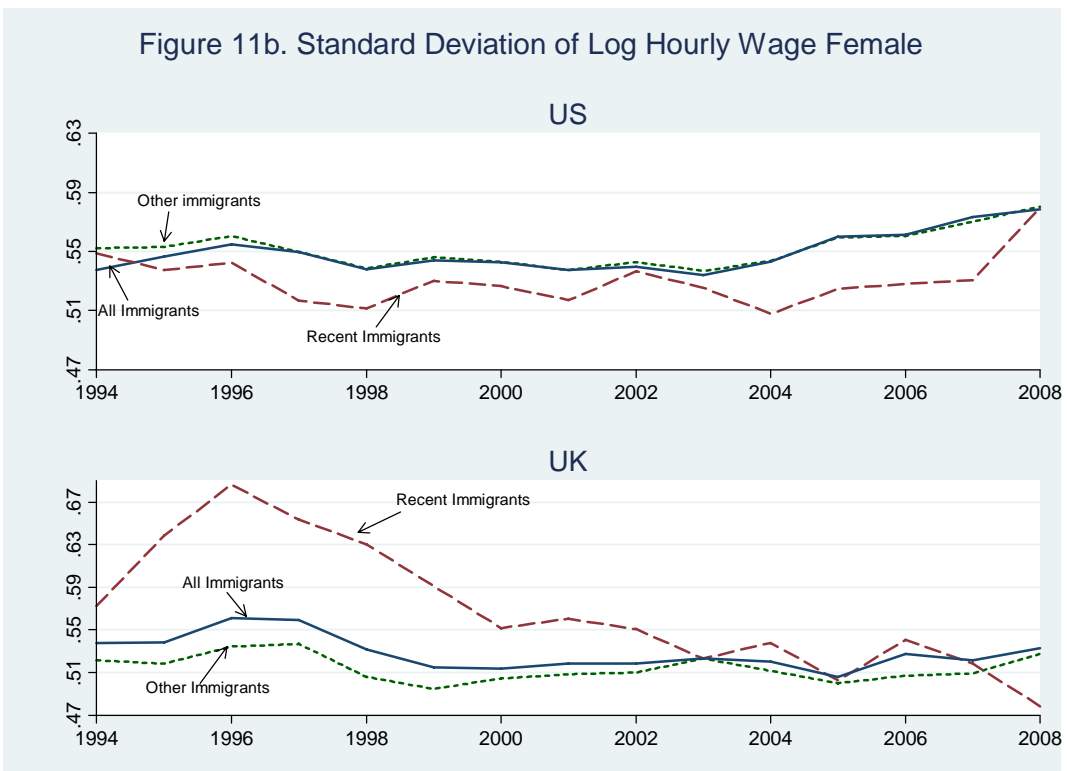




Figure 12a. 90-50 Log Hourly Wage Gap, Men



Figure 12b. 90-50 Log Hourly Wage Gap, Female

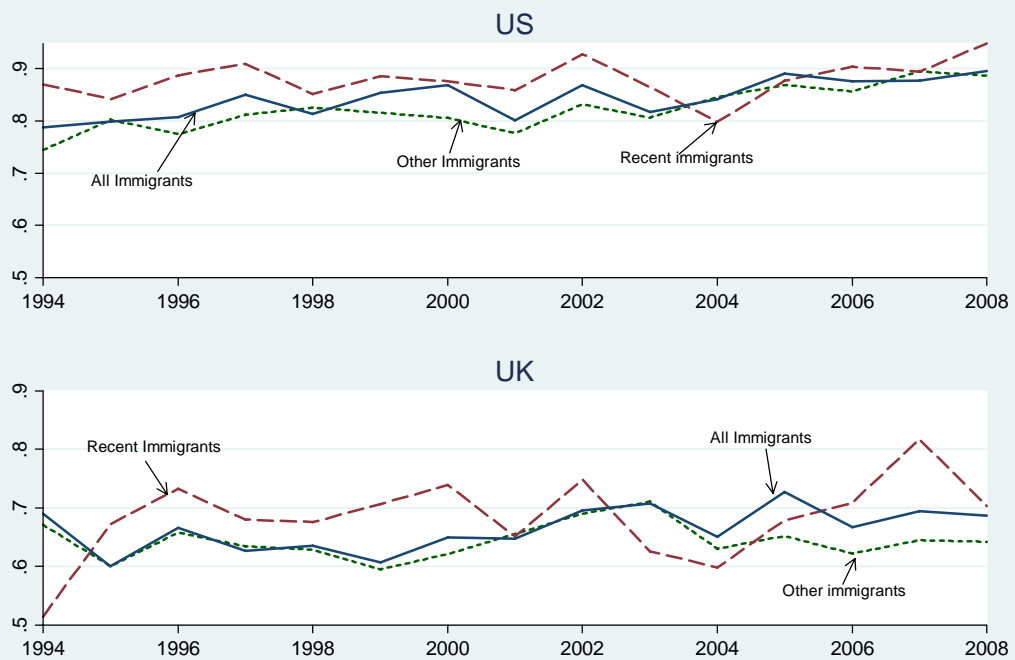


Figure 13a. 50-10 Log Hourly Wage Gap, Men

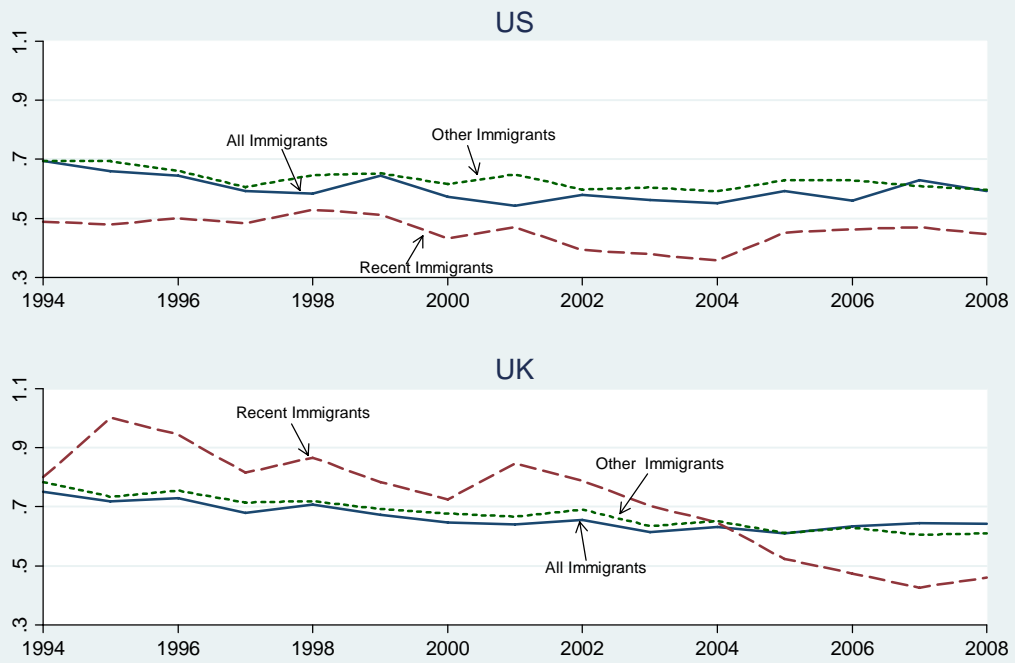


Figure 13b. 50-10 Log Hourly Wage Gap, Female

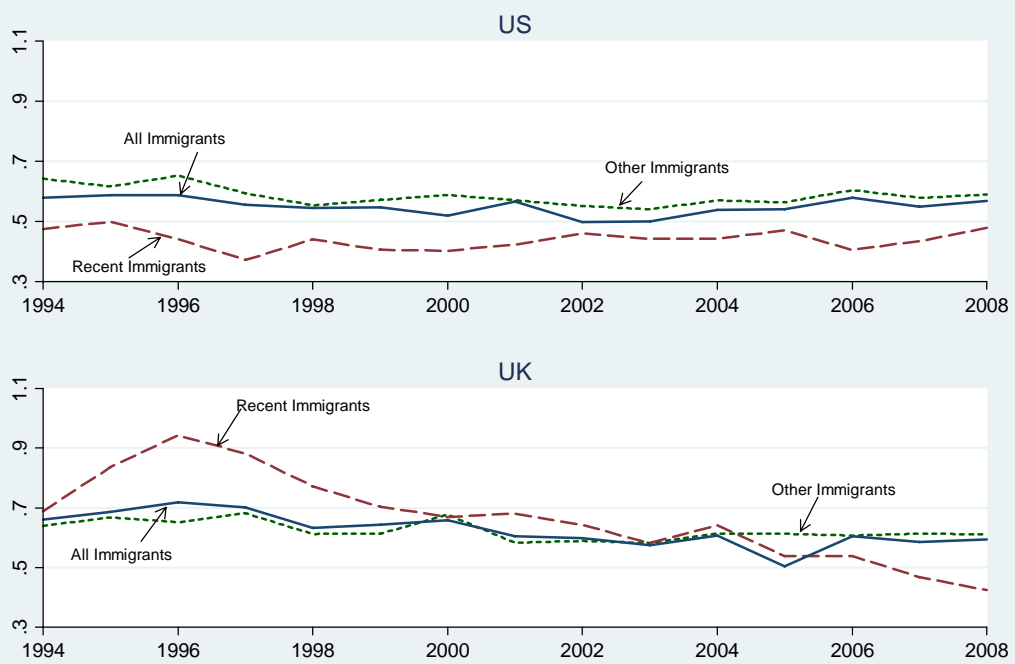


Figure 14a. Actual Residual Variance, Men

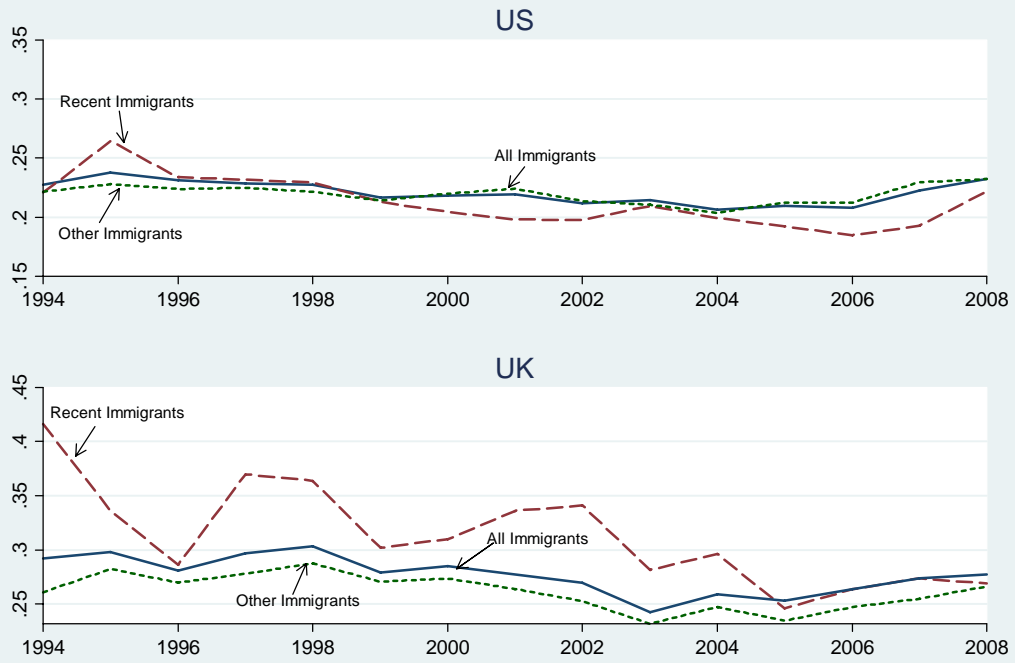


Figure 14b. Actual Residual Variance, Female

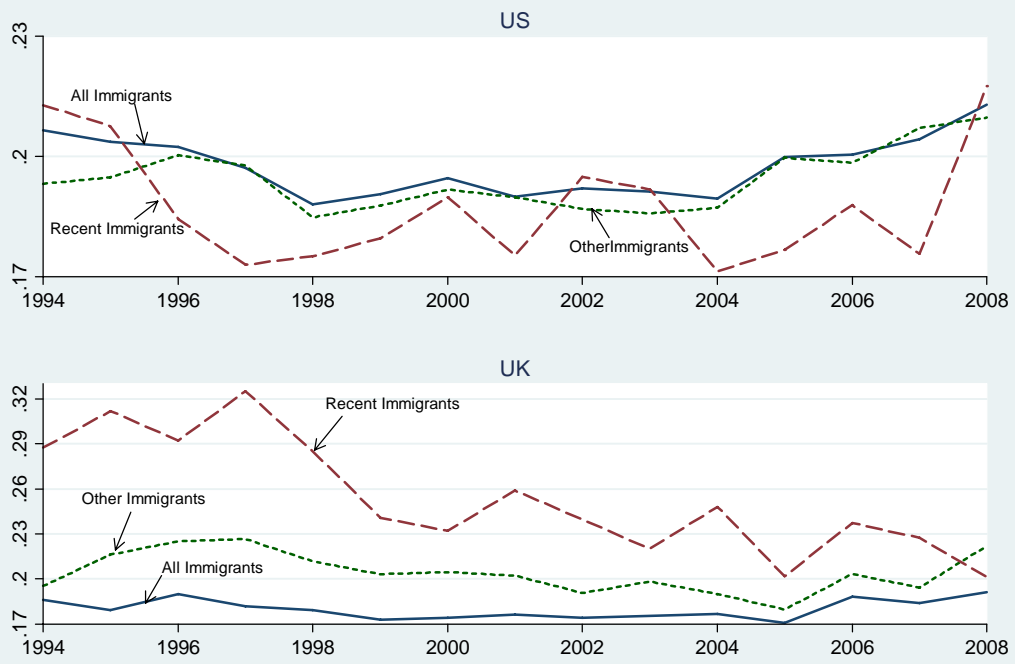


Table 6a. Wage Inequality by Cohorts of arrivals. Male immigrants in the U.S.

<i>Cohorts of arrivals</i>	<i>1994</i>	<i>2000</i>	<i>2008</i>
<b>Before 1967</b>			
Standard dev.	0.555	0.592	0.635
Residual variance	0.224	0.268	0.299
<b>1968-1977</b>			
Standard dev.	0.565	0.573	0.611
Residual variance	0.205	0.225	0.227
<b>1978-1989</b>			
Standard dev.	0.556	0.550	0.579
Residual variance	0.208	0.209	0.229
<b>1990-1998</b>			
Standard dev.	0.613	0.562	0.599
Residual variance	0.243	0.197	0.215
<b>1999-2008</b>			
Standard dev.		0.571	0.607
Residual variance		0.195	0.223
Stand dev. all Immigrants	<b>0.599</b>	<b>0.581</b>	<b>0.613</b>
Residual Variance Immigrants	<b>0.227</b>	<b>0.218</b>	<b>0.232</b>

Table 6b. Analysis by cohorts of Arrival, Male Immigrants UK

<i>Cohorts of arrivals</i>	1994	2000	2008
<b>Before 1967</b>			
Standard dev.	0.527	0.557	0.544
Residual variance	0.213	0.244	0.217
<b>1968-1977</b>			
Standard dev.	0.625	0.561	0.595
Residual variance	0.270	0.241	0.300
<b>1978-1989</b>			
Standard dev.	0.631	0.615	0.570
Residual variance	0.302	0.281	0.281
<b>1990-1998</b>			
Standard dev.	0.793	0.675	0.611
Residual variance	0.473	0.353	0.275
<b>1999-2008</b>			
Standard dev.		0.631	0.594
Residual variance		0.291	0.281
Sand dev. Immigrants	<b>0.611</b>	<b>0.602</b>	<b>0.591</b>
Residual Variance Immigrants	<b>0.292</b>	<b>0.285</b>	<b>0.277</b>

Figure 17. Residual Variance by Education Group  
Men, U.S.

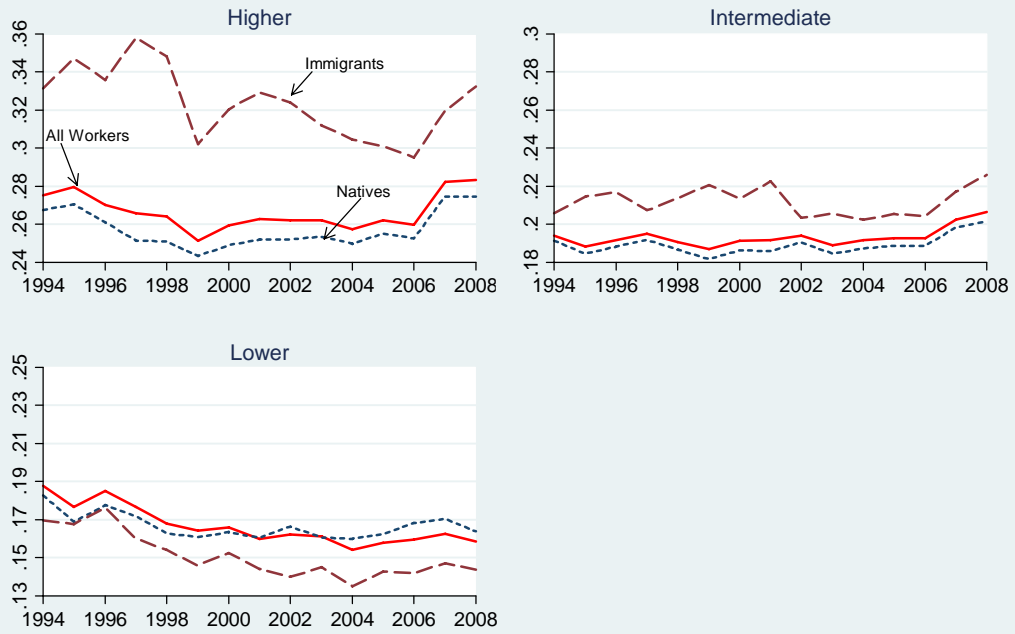


Figure 18. Residual Variance by Education  
Women, U.S.

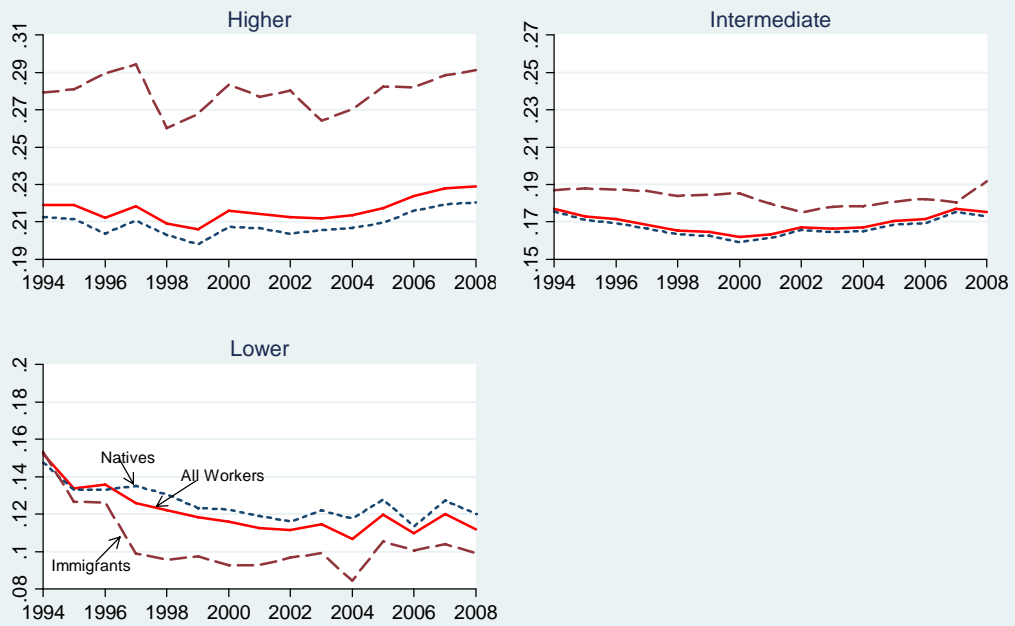


Figure 19. Residual Variance by Education  
Men, UK

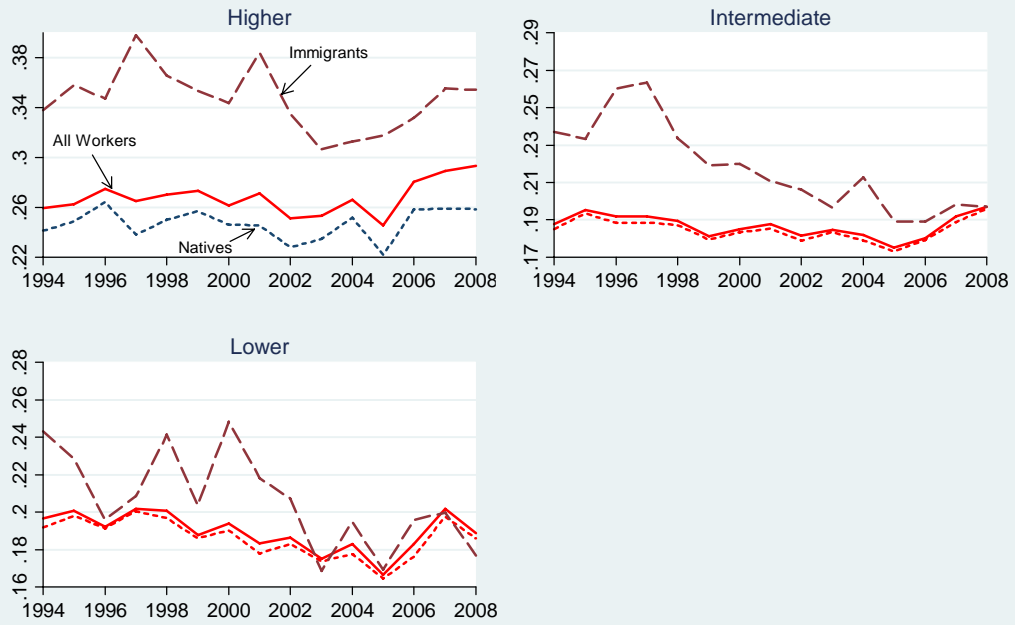


Figure 20. Residual Variance by Education  
Women, UK

