An Empirical Analysis of Inter-Regional Migration as an Adjustment Mechanism to Immigration in Modern Britain

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Abstract

Many studies find immigration has no significant effect on the wages or employment of the destination country's residents. This seemingly contradicts economic theory, which suggests immigration should have a negative effect. One potential explanation for these unexpected results is some residents respond to immigration into their region by moving to other regions within the destination country. This possibly dilutes the effects of immigration by spreading them across the country. Therefore, this inter-regional migration may act as an adjustment mechanism to immigration, mitigating the effect of immigration on wages and employment. This paper's research aim is to understand if inter-regional migration is an adjustment mechanism to immigration in modern Britain. This is achieved by replicating Hatton and Tani's (2005) study 'Immigration and Inter-Regional Mobility in the UK, 1982-2000' and updating the period to 2003 to 2019. Using three fixed effects regression models, this paper examines if immigration is a determinant of inter-regional migration. The results of the replication suggest inter-regional migration may no longer be an adjustment mechanism to immigration in modern Britain, as while immigration to a region is found to reduce the region's net in-migration rate, the effects are small and mainly insignificant. However, due to endogeneity concerns this paper recommends the models be re-examined using a Two Stage Least Squares estimator to ensure these results are valid.

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Introduction

In the last 40 years net immigration to the UK has reached levels higher than ever before, as shown in Figure One, with net immigration into the UK exceeding 100,000 people each year between 1998 and 2020 (Sturge, 2024).

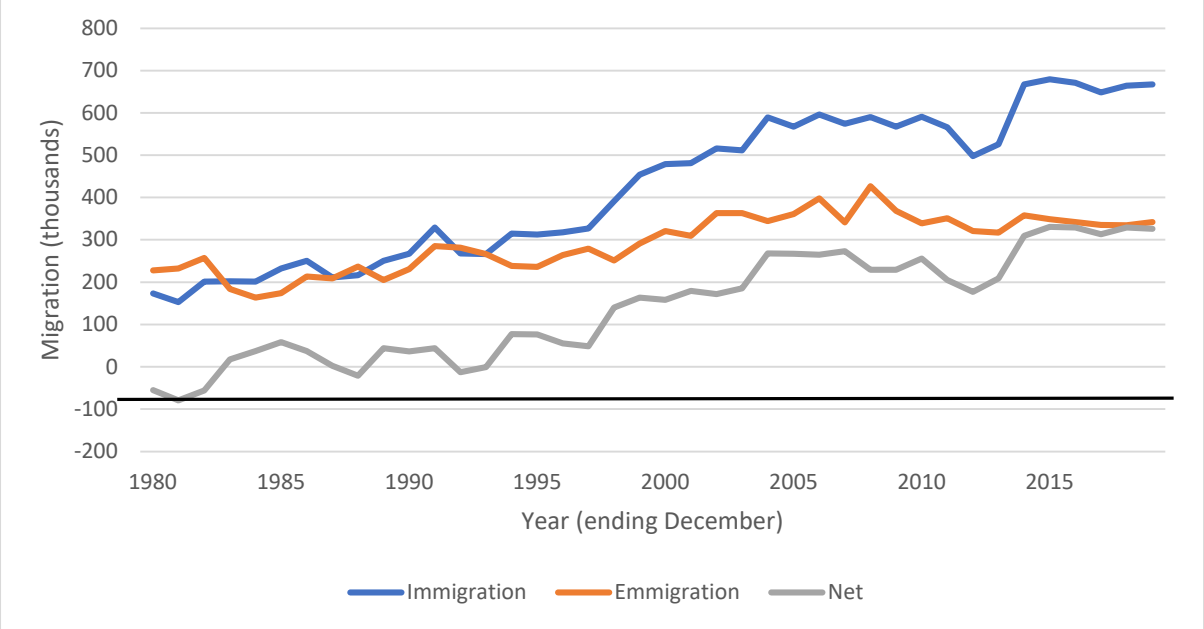

Figure 1. Long Term International Migration, UK, 1980-2019, ONS (2015; 2020a)

Increased immigration has led to concerns regarding the effects of immigration on employment and earnings. Basic supply and demand theory can be used to predict the impact of immigration on the destination country's labour market outcomes, specifically wages and employment, using four key assumptions: wages are set by the interaction of supply and demand, labour supply is inelastic, all immigrants are active members of the labour force and immigrants are perfect substitutes for native workers. Under these assumptions, immigration acts as a supply shock, increasing the number of workers available in the destination country's labour market and competition for jobs as a result. Labour demand is assumed to be a downward sloping curve, therefore an increase in labour supply is expected to decrease the wages and employment of native workers.

However, most research only finds small or insignificant effects of immigration on native wages and employment (Grossman, 1982; Card, 1990; LaLonde and Topel, 1991; Pischke and Velling, 1997; Dustmann, Fabbri and Preston, 2005). It is important to know what the

true effects of immigration are. Therefore, literature is increasingly exploring why these findings contradict economic theory.

One possible explanation is the pieces of research finding these small effects commonly use the 'spatial correlations approach' (Borjas, 2003; Hatton and Tani, 2005). The 'spatial correlations approach' compares labour market outcomes across regions of a country with different rates of immigration. Economic theory predicts lower earnings and/or employment rates will be found in regions with higher rates of immigration (Hatton and Tani, 2005). Borjas (2003) argues studies fail to find effects of immigration using this approach as it allows for adjustment mechanisms which may conceal the true effects of immigration.

Consequentially, academics are seeking to identify potential adjustment mechanisms to immigration induced supply shocks in a destination country's labour market. Proposed adjustment mechanisms include: changes in an economy's output mix (Dustmann, Fabbri and Preston, 2005), changes in technology used by firms (Lewis, 2005), and inter-regional migration of native populations (Filer, 1992; Hatton and Tani, 2005; Borjas, 2006; Beine and Coulombe, 2018).

Hatton and Tani (2005) empirically examine inter-regional migration as an adjustment mechanism to immigration in Britain using a fixed effects model on panel data for the 11 regions of Britain between 1982 and 2000. Hatton and Tani (2005, p.F353) argue their findings of consistently negative relationships between immigration and inter-regional migration suggest inter-regional migration acts as an adjustment mechanism to immigration in the British labour market. However, it has been over twenty years since Hatton and Tani's (2005) study, therefore the results may no longer be up to date.

The research aim of this paper is to update Hatton and Tani's (2005) study 'Immigration and Inter-Regional Mobility in the UK, 1982-2000' to understand if inter-regional migration is an adjustment mechanism to immigration in modern Britain. This will be done through replicating the methodology set out by Hatton and Tani (2005) with updated data.

The rationale behind this research aim is the significant increase in immigration to the UK since 1982 to 2000. Hatton and Tani (2005) found immigration's effect on inter-regional migration was only significant for the southern regions of Britain, as well as being larger. Hatton and Tani (2005, p.F353) suggest this could be due to larger inflows of international migrants in the southern regions, making the effects of immigration easier to detect.

If Hatton and Tani's (2005) suggestion is correct, higher levels of immigration in modern Britain may alter the size and/or significance of the effect of immigration. Therefore, replicating Hatton and Tani's (2005) study using data from 2003 to 2019 enables an investigation into whether a change in the relationship between immigration and inter-regional migration has occurred.

An up-to-date estimation of the effect of immigration on inter-regional migration in modern Britain is important as it has implications on whether inter-regional migration acts as an adjustment mechanism to immigration in modern Britain. Furthermore, knowing whether inter-regional migration is a potential adjustment mechanism to immigration could influence the most valid approach to measuring the effects of immigration on labour market outcomes.

From this rationale three key research questions were developed. This paper's objective is to answer these questions through estimating the effects of net international immigration on net inter-regional migration using panel data for the 11 British regions between 2003 and 2019.

The first research question is whether inter-regional migration is a mechanism used by the modern British labour market to adjust to supply-side immigration shocks. Based on Hatton and Tani's (2005) findings, it is hypothesised that the net immigration rate will have a negative relationship with net inter-regional in-migration rates, suggesting the answer to this research question will be yes.

The second research question asks whether the effects of immigration on inter-regional migration, often referred to as displacement effects, are still larger in the southern regions of Britain than for all eleven British regions. Hatton and Tani (2005) found the displacement effects were larger and more significant for the southern regions. The hypothesised answer is larger displacement effects will still be found for the southern regions.

The final research question is whether the relationships between immigration and inter-regional migration found for 2003 to 2019 are different to the ones found by Hatton and Tani (2005) for 1982 to 2000. The hypothesis is the relationships found in this paper between immigration and inter-regional migration will show larger displacement effects and increased significance relative to Hatton and Tani's (2005) findings, due to larger immigration inflows in 2003 to 2019.

Literature Review

Various pieces of literature have sought to estimate the effects of immigration on labour market outcomes, but most tend to find little to no effects (Hatton and Tani, 2005). This literature review begins with a brief overview of an influential study in this area by Card (1990). Then the review focuses on literature measuring the effect of immigration on UK labour markets. The first study to examine this issue in the UK uses spatial correlations, and finds immigration has little effect on labour market outcomes of natives. This leads to a discussion on why spatial correlations often find little effects of immigration on natives' wages and employment, contradicting economic theory's predictions. One explanation is when using spatial correlations, labour market adjustment mechanisms conceal the true effect of immigration. The main potential adjustment mechanisms are summarised and evaluated as to their relevancy for the UK. Finally, the literature review focuses on studies which investigate inter-regional mobility as an adjustment mechanism. The results of this literature review highlight a gap in literature for an assessment of inter-regional migration as an adjustment mechanism in modern Britain. This paper will seek to further address this gap by updating Hatton and Tani's (2005) study 'Immigration and Inter-Regional Mobility in the UK, 1982-2000' to 2003 to 2019.

Card's (1990) natural experiment compares changes in Miami natives' wages and employment to similar cities in the United States for 5 years after the Mariel Boatlift, an event which led to a large influx of immigrants into Miami. Card's (1990) findings suggest there is almost no effect of immigration on natives' wages and employment.

Card's (1990) study is well respected within immigration literature due the exogenous rise in immigration, which better allows for causal inference. However, Card (1990) explains Miami may be better placed to adjust to immigration influxes than other cities, due to a history of experiencing large immigration waves.

Furthermore, Dustmann, Hatton and Preston (2005) argue the effects of immigration found in one country cannot be assumed to apply to another due to differences between countries in terms of labour markets and demographics of immigrants received. Most studies examining the effects of immigration on labour market use data from the United States (Grossman, 1982; Card, 1990; Lalonde and Topel, 1991; Borjas and Katz, 2007). Therefore, as this paper focuses on the British labour market, it is necessary to consider literature measuring the effects of immigration in the UK.

However, literature measuring the effect of immigration on UK labour market outcomes is sparse. The first and most relevant study on this topic for the UK was conducted by Dustmann, Fabbri and Preston (2005) for 1983 to 2000. Dustmann, Fabbri and Preston (2005) measure the labour market effects of immigration to the UK using spatial correlations between regional immigration flows and labour market outcomes. The study considers the effects of immigration on aggregate employment, unemployment, participation and wages. Dustmann, Fabbri and Preston (2005) find little evidence of immigration impacting labour market outcomes, upholding the findings of Card (1990) for the UK.

Although, interpreting the weak spatial correlations found by Dustmann, Fabbri and Preston (2005) as evidence against immigration affecting labour market outcomes may lack validity due to adjustment mechanisms masking the true effect of immigration (Borjas, Freeman and Katz, 1996; Borjas, 2003). Borjas, Freeman and Katz (1996) highlight issues with comparing the effects of immigration within areas, they find examining a larger geographic area for the impact of immigration on labour market outcomes results in larger estimates of negative effects. This suggests immigration has a larger effect at a national level than at a local level, potentially explaining why weak spatial correlations are found when using spatial correlations to compare regions. Borjas, Freeman and Katz (1996, pp. 248-250) suggest the understated effects could be due to inter-regional migration.

Borjas (2003) expands on this suggestion by Borjas, Freeman and Katz's (1996). Borjas (2003) explains immigration to a region should increase the supply of labour in the local labour market, causing wages to decrease, and natives to respond by moving their labour to other regions within the country. As natives move away from the region which received the immigrant influx, supply of labour in the region should fall, reducing the downward pressure on wages caused by immigration. Meanwhile, native workers are expected to cause downward pressure on wages in the local labour markets of the regions they move to. Therefore, if native workers adjust to immigration through inter-regional migration the effect of immigration may be spread across the country. Overall, this could result in all local labour markets within the country re-equilibrating at a lower wage than before the immigration shock. As spatial correlations rely on differences in labour market outcomes between regions with differing immigration rates, this spreading of the effect could be causing the misleading low correlations (Borjas, 2003).

Both Borjas, Freeman and Katz (1996) and Borjas (2003) provide evidence suggesting there are negative effects of immigration when using an approach that prevents such adjustment. They measure the effect of immigration through comparing immigration induced changes to labour supply within skill groups, rather than areas. Borjas (2003) explains there should be less mobility between skill groups than areas, potentially preventing adjustment mechanisms which may dilute the effect on labour market outcomes. Using this method Borjas (2003, p.1370) found evidence suggesting two-thirds of immigration's national impact on wages is concealed in spatial correlations. Therefore, supporting the theory spatial correlations may fail to find the true effects of immigration on labour market outcomes due inter-regional mobility acting as an adjustment mechanism (Borjas, Freeman and Katz; 1996; Borjas, 2003).

However, this evidence is again based on data for the United States. Additionally, there are other potential adjustment mechanisms than inter-regional migration. Therefore, alternative adjustment mechanisms should be considered when exploring why studies find little effects of immigration on UK labour market outcomes.

There are two main alternative adjustment mechanisms. Both describe how a labour market can adjust to immigration induced changes in the supply of different skills, without decreasing the wages or employment of natives. Basic economic theory predicts an increase in the supply of workers in a particular group through immigration should lead to a decline in the wages of native workers in that skill group, as workers with the same skill level are assumed to be substitutes.

The first alternative adjustment mechanism suggests as economies typically have more than one industry, instead of adjusting to immigration through labour market outcomes, an economy could change its output mix instead (Rybcyznski, 1955, cited in Dustmann, Frattini and Glitz, 2008). For example, an increase in the supply of unskilled labour can be adjusted to through increased manufacturing of goods which production are low-skilled intensive (Dustmann, Frattini and Glitz, 2008).

A second possible adjustment mechanism to immigration induced changes in the skill mix is changing production technology. Industries could shift production methods to use technology which more intensively uses the skill group that immigration has increased in supply. Through this adjustment an economy could absorb the labour influx without changing wages, employment or output mix (Dustmann, Frattini and Glitz, 2008). Furthermore, evidence supports changing production technology as an adjustment mechanism, finding around two-

thirds of the absorption of additional workers from immigration is done through adjusting production technology (Hanson and Slaughter, 2002; Lewis, 2004; Dustmann and Glitz, 2008; González and Ortega, 2007, cited in Dustmann, Frattini and Glitz, 2008, pp. 6).

While this evidence may suggest inter-regional migration is not the main adjustment mechanism, Dustmann, Fabbri and Preston (2005) describe the skill distribution of immigrants as similar to the UK born native workforce. Therefore, immigration to the UK is unlikely to change the skill mix of labour, which these adjustment mechanisms rely on. Additionally, the studies in support of changing production technology as an adjustment mechanism are not based on UK data. Therefore, changes in output mix and production technology may not be as important adjustment mechanisms in the UK.

This leads back to inter-regional migration as a potentially important adjustment mechanism in the UK. Despite Card (2005, p.17) describing inter-regional mobility as a "relatively unimportant" adjustment mechanism, various studies have concluded immigration appears to be a determinant of inter-regional migration, including a study focusing on the UK by Hatton and Tani (2005). Thus, suggesting that inter-regional migration could play a role in UK labour markets adjusting to supply-side shocks from immigration.

Although, there are few up to date studies on immigration as a determinant of inter-regional mobility. Filer's (1992) study of inter-regional migration in the US between 1975 and 1980 is one of the more recent key pieces of literature in the area. Filer (1992) found immigration inflows have a statistically significant effect on inter-regional migration. It is estimated the displacement effect of a 1% increase in an area's labour force from immigration leads to a decrease in net native migration into the area equivalent to nearly 1.25% of the area's workforce (Filer, 1992, p.261). This suggests inter-regional migration in response to immigration more than offsets the inflow of immigrants. However, the regression used by Filer (1992) did not control for labour market variables, such as average wage in the area or employment rate. Through omitting these variables which could influence net inter-regional migration, it is possible that Filer's (1992) results suffer from omitted variable bias. This could be leading to biased coefficients on immigration, meaning the large displacement effects found may not be valid.

A similar study for the US was undertaken by Card (2001) for immigration between 1985 and 1990. However, Card (2001) considers the effects of immigration on inter-regional migration within the same skill group and finds immigration did not lead to inter-regional migration.

This finding is drastically different to the large displacement effects found by Filer (1992). A later study by Borjas (2006) finds results which appear to be a middle ground between these conflicting findings. Borjas (2006) finds immigration does correlate with lower in-migration rates and higher out-migration, as expected from inter-regional migration as an adjustment mechanism. Although rather than finding immigration more than offsets the inflow of immigrants as Filer (1992) did, Borjas (2006, p.255) finds "for every 10 immigrants that enter a state two fewer natives choose to live in that state", with the effect being larger in metropolitan areas. However, the issue persists that these studies focus on labour markets in the United States, therefore the application of the findings to UK labour markets is limited due to differences in the structure of the markets.

There is only one study thus far that examines inter-regional migration as an adjustment mechanism in the UK. Hatton and Tani (2005) use a panel of 11 British regions between 1982 and 2000 to estimate the displacement effects of immigration. While Hatton and Tani (2005) find the expected negative correlations, with results suggesting an increase in the net immigration rate to a region of 100 leads to a decrease in the net-in migration rate from other British regions of 35, the findings are not significant. However, when the panel is reduced to the southern regions of Britain the results are significant. Hatton and Tani (2005) suggests this is due to the southern regions having the highest immigration rate of the 11 regions. Therefore, this implies inter-regional migration may be an important adjustment mechanism for UK labour markets, but in the period considered the rates of immigration in Britain were too low for inter-regional migration in response to immigration to be significant.

This presents a gap in the literature for examining the relationship between immigration and inter-regional migration in modern Britain. In the 20 years since Hatton and Tani (2005) estimated the displacement effects of immigration in the UK, immigration to the UK has increased significantly. Hatton and Tani (2005) only find significant displacement effects of immigration on natives in southern regions where immigration was higher. Therefore, as immigration has increased, it is possible the relationship between immigration and inter-regional migration has changed.

Perhaps if Hatton and Tani's (2005) methodology was applied to the last 20 years, the displacement effects of immigration could be found to be significant in all British regions due to higher immigration. However, it is also possible there has been changes in the UK labour

market or demographics of immigrants coming into the UK since Hatton and Tani's (2005) study, which may have decreased the displacement effects.

This paper seeks to fill the gap in the literature for an up-to-date study on inter-regional migration as an adjustment mechanism in Britain by replicating and updating Hatton and Tani's (2005) study to the period 2003 to 2019.

Methodology

This chapter sets out the approach taken to address the research gap highlighted by the literature review and achieve this paper's research aim of understanding if inter-regional migration was an adjustment mechanism to immigration in modern Britain. This is done by using regression analysis to examine immigration as a determinant of inter-regional migration.

Empirical Framework

To answer this paper's research questions, regarding how inter-regional migration as an adjustment mechanism in Britain has changed over time, the results of this paper must be compared to Hatton and Tani's (2005). Therefore, to enable such comparison this paper seeks to replicate Hatton and Tani's (2005) methodology.

Hatton and Tani (2005) run three different regression models, each of which this paper will replicate with updated data. The models use the same variables and regions as Hatton and Tani (2005). However, the models in this paper exclude vacancy inflow rates as a control variable due to there being no data available on vacancy rates for 2003 to 2019.

The variables are measured annually between 2003 and 2019 for the 11 regions of Britain[1] to create a panel dataset. The first year with a full set of data after Hatton and Tani's (2005) panel ends is 2002. This paper's period begins in 2003 to allow for variables lagged by one year. The period ends in 2019 to use as up-to-date data as possible, while avoiding potential reductions in the inter-regional mobility of labour due to COVID-19 lockdowns from 2020. This period achieves the aim of updating Hatton and Tani's (2005) study to modern Britian.

[1] East, East Midlands, London, North East, North West, Scotland, South East, South West, Wales, West Midlands and Yorkshire and the Humber.

Regression Specifications

Model One

Model One uses regional pairs to examine the effect of immigration on bilateral net inter-regional in-migration rates. The 11 regions of Britain create 55 unique regional pairs, for example region *a* and region *b* would make one regional pair.

Model One is estimated using the following equation:

$$\begin{aligned} NIRMR_{ba,t} = {} & \beta_0 + \beta_1(NFIR_{b,t-1} - NFIR_{a,t-1}) + \beta_2(\log(UR_{b,t}) - log(UR_{a,t})) \\ & + \beta_3(\log(AE_{b,t-1}) - \log(AE_{a,t-1})) + \beta_4(\log(HPI_{b,t}) - \log(HPI_{a,t})) \\ & + \beta_5(PCLHPI_{b,t} - PCLHPI_{a,t}) + \gamma_t + \varepsilon_{ba,t} \end{aligned}$$

Where the dependent variable NIRMR is net inter-regional migration rate from region *a* to region *b* in year *t*. The independent variable of interest, NFIR, is the difference in net foreign immigration rate between regions *a* and *b,* lagged by one period (*t* – 1). Four controls are included which also may determine inter-regional migration: the logged values of the unemployment rate (UR) in year *t*, average earnings (AE) in (*t* – 1), house price index (HPI) in year *t* and the percentage change in the logged value of HPI in year *t* from (*t* – 1). These are measured as the difference between regions *a* and *b.*

β_0 represents the intercept of the model, while β_{1-6} represent the coefficients estimated by the model. Dummy variables for each year are also included, shown as γ_t. The error term is included as $\varepsilon_{ba,t}$.

Model Two

Model Two uses the same explanatory variables as Model One, but the dependent variable of Model Two is gross inter-regional in-migration rate (GIRMR) instead. Model Two uses 110 regional pairs because for every net flow between regional pairs in Model One there are two gross flows.

To replicate Hatton and Tani (2005) the gross flows between regional pairs are both treated as inflows to maintain the same coefficient directions as Model One.

This equation is used to model gross inflows from region *a* to *b*:

$$GIRMR_{ba,t} = \beta_0 + \beta_1(NFIR_{b,t-1} - NFIR_{a,t-1}) + \beta_2(\log(UR_{b,t}) - \log(UR_{a,t})) + \beta_3(\log(AE_{b,t-1}) - \log(AE_{a,t-1})) + \beta_4(\log(HPI_{b,t}) - \log(HPI_{a,t})) + \beta_5(PCLHPI_{b,t} - PCLHPI_{a,t}) + \gamma_t + \varepsilon_{ba,t}$$

While this equation models gross flows from region *b* to *a*:

$$GIRMR_{ab,t} = \beta_0 + \beta_1(NFIR_{a,t-1} - NFIR_{b,t-1}) + \beta_2(\log(UR_{a,t}) - \log(UR_{b,t})) + \beta_3(\log(AE_{a,t-1}) - \log(AE_{b,t-1})) + \beta_4(\log(HPI_{a,t}) - \log(HPI_{b,t})) + \beta_5(PCLHPI_{a,t} - PCLHPI_{b,t}) + \gamma_t + \varepsilon_{ab,t}$$

Model Two combines the two equations into one model which includes both directions of flows between regional pairs for each variable.

Model Three

Model Three estimates the overall displacement effect of immigration to a region through using the 11 regions as entities, rather than bilateral pairs. The dependent variable of Model Three is the net in-migration rate (NIMR) to a region from all other regions. The same explanatory variables are used as Models One and Two, but the value for each region is used instead of differences between regions.

The equation for Model Three is as follows:

$$NIMR_{a,t} = \beta_0 + \beta_1 NFIR_{a,t-1} + \beta_2\log(UR_{a,t}) + \beta_3\log(AE_{a,t-1}) + \beta_4\log(HPI_{a,t}) + \beta_5 PCLHPI_{a,t} + \gamma_t + \varepsilon_{a,t}$$

Data and Variable Construction

Inter-regional migration was estimated using mid-year National Health Service registration data (ONS, 2009; 2010; 2011; 2012; 2021), as Hatton and Tani (2005) used. Net inter-regional migration from *a* to *b* was calculated for Model One by subtracting the inflow of migrants from region *b* to *a* from the inflow from *a* to *b*. Model Two uses inflow data between regional pairs to measure gross inter-regional in-migration. The rate is then

calculated for both these models by dividing the respective flows by half the aggregated populations of the regional pair in the previous year (ONS, 2020c; 2024a). The net inter-regional migration rate for Model Three was calculated for each region by subtracting total outflows to all other regions from total inflows to the region, then dividing by the region's population in the previous year.

Net foreign immigration inflows for each region were calculated using inflow data based on the International Passenger Survey, as Hatton and Tani (2005) used, defining a foreign immigrant as a person with 'non-British' citizenship (ONS, 2020b). To calculate the rate this figure was divided by half the aggregated populations of the regional pair in the previous year for Models One and Two, and the region's population in the previous year for Model Three (ONS, 2020c; 2024a).

The unemployment rate for each region was calculated by dividing the region's annual average claimant count (ONS, 2024c-m) by its labour force base (ONS, 2024b). It is unclear what definition Hatton and Tani (2005) used for the labour force. Therefore, this paper defines the labour force as the number of economically active individuals aged 16 and over.

Average earnings were estimated using data from the ONS (2023) on average weekly earnings of full-time jobs, excluding overtime, for each region. This data is based on responses to the Annual Survey of Hours and Earnings (ASHE), which replaced the New Earnings Survey used by Hatton and Tani (2005). Hatton and Tani (2005) used the wages of full-time manual employees. However, data on regional average weekly earnings from the ASHE for 2002 to 2019 does not provide a job sector breakdown. Therefore, the average weekly wage of all full-time jobs is used in this paper.

The variables for house prices are based on the annual average of the UK House Price Index (HPI) from the ONS (2024n), as Hatton and Tani (2005) used. Both the logged level of each region's HPI and the percentage change in the log of the HPI from the previous year are used.

Both variables are used as controls for house prices due to each having opposite effects on inter-regional migration (Muellbauer and Cameron, 1998, cited by Hatton and Tani, 2005, p F350). The level of HPI is expected to have a negative effect on net in-migration as a region with relatively more expensive housing disincentivises in-migration. However, change in HPI is predicted to have a positive effect on net in-migration, because larger increases in a region's house prices signals potential capital gains, leading to increases in in-migration to the region.

All rates were multiplied by 100 to convert them into percentages.

Empirical Strategy

To replicate Hatton and Tani (2005), each model is first run for all regions without controls, only including net immigration rate and the time dummies as explanatory variables, and then with controls. Following this, the sample is restricted to the six southern regions of Britain[2] and the models are again run with and without control variables.

The regression models are run using a fixed effects model (FEM) with the generalised least squares estimator in Gretl. The FEM controls for time-invariant differences between regions (entity fixed effects). Time dummies for each year are also included to control for unobserved factors affecting all regions over time. Additionally, robust standard errors (RSE) which are heteroskedasticity and autocorrelation consistent (HAC) are used to address heterogeneity and autocorrelation in the data.

These choices replicate those made by Hatton and Tani (2005), however they are supported by robustness tests for each model in this paper. A Wald joint test and an F-test both indicate at the 5% level of significance time effects should be included. At the 5% level of significance a Wald test indicates there is heteroskedasticity present. While the Woolridge test for autocorrelation shows there is autocorrelation also present at the 5% significance level. Therefore, to address the heteroskedasticity and autocorrelation RSE should be used.

The test for differing group intercepts indicates at the 5% significance level the use of regional dummies through the fixed effects model is statistically sensible. However, when the Hausman test is performed on Model One and Two, the null hypothesis is unable to be rejected at the 5% level of significance, suggesting it is more efficient to use a random effects model. Although, as all regions of Britain are included, the sample is not random, and therefore the REM is not applicable. Additionally, the use of a FEM in this paper is justified through the objective of replicating Hatton and Tani's (2005) study.

Limitations

[2] East, East Midlands, London, South East, South West and West Midlands

It is important to acknowledge the potential limitations of this methodology which may affect the interpretation of the results.

Hatton and Tani (2005, p.F252) describe vacancy inflow rates as "an important determinant of regional in-migration", finding it significant at the 5% level for all models. The omission of vacancy inflow rates as an explanatory variable may lead to omitted variable bias. Therefore, its exclusion may result in endogeneity and biased/inconsistent results. This may lead to incorrect interpretations of the size and/or significance of the displacement effects of immigration and hinder causal inference.

Hatton and Tani (2005) highlight potential issues with endogeneity within the model and lag the wage variable to address this. However, other variables in the model may lead to endogeneity due to the presence of simultaneity bias. For example, inter-regional migration into a region could increase the unemployment rate if there are insufficient job vacancies to meet the supply of labour. Alternatively, house prices are likely to increase in response to inter-regional in-migration to a region as demand for housing increases. High inter-regional in-migration to a region may signal to immigrants the region is economically desirable, leading to higher rates of immigration to these regions. Endogeneity could cause the coefficient on immigration to be biased and inconsistent, again limiting causal inference due as the true effect of immigration on inter-regional migration may not be estimated.

A final possible limitation is multicollinearity occurring due to the controls used in the models likely being confounding variables, which could result in correlation between these variables and the immigration rate variable. The Belsley-Kuh-Welsh test suggests there is moderately strong multicollinearity within the models. Multicollinearity is problematic as it may lead to wide confidence intervals and variables incorrectly appearing insignificant, potentially causing inference errors. Therefore, care must be taken when determining the significance of net immigration rate as determinant of inter-regional migration.

Results

The results of each FEM model are presented in the tables below. The objective of the models is to determine the relationship between immigration and inter-regional migration. Column 1 of each table shows the results of the model without controls when run using all eleven regions, then with controls in Column 2. The sample is then restricted to the six southern regions of Britain, as Hatton and Tani (2005) did. Columns 3 and 4 present the results of the model for the restricted sample without and with controls respectively. The time dummies are not reported.

The tables report the estimated coefficient and p-value for each variable, the R-squared of the model, the p-value of the F-test for the joint significance of the variables and the number of observations. The asterisks reflect p-value results, showing the likelihood the relationship is due to chance (*=10%, **=5%, ***= 1%). The asterisks for the variables' coefficients are based on t-tests. In this paper a result is considered significant if there is a 5% or less probability it is due to chance.

If inter-regional migration is an adjustment mechanism to immigration, it is expected the models will estimate negative coefficients for net immigration rate, as increased immigration to a region should lead to increased outflows and decreased inflows of inter-regional migrants due to the labour market effects of immigration in the region. Negative coefficients are also expected for unemployment rate and house prices, as higher levels of these in a region should disincentivise people from living or moving there, causing a reduction in net in-migration to the region. Conversely, positive coefficients are expected for average earnings and change in house prices, as higher levels of these incentivise people to move to a region.

Model One

Table 1. Model One's regression results for the dependent variable bilateral net inter-regional migration to b from a.

	11 Regions		6 Southern Regions	
	(1)	(2)	(3)	(4)
	Coefficient			
Constant	−0.0097 ***	−0.0181 ***	-0.0337 ***	−0.0556 ***
Net immigration rate (*b* - *a* at *t*-1)	−0.0171 ***	−0.0080 **	−0.0303 *	−0.0147
Log unemployment rate (*b* – *a* at *t*)		−0.0985 ***		−0.2453 ***
Log average earnings (*b* - *a* at *t*-1)		0.0562		−0.1704
Log house price (*b* – *a* at *t*)		−0.1046 ***		−0.2188 ***
Δ Log house price (*b* – *a* at *t*)		0.0063 ***		0.0154 ***
LSDV R-squared	0.9439	0.9567	0.9545	0.9756
F-test on named regressors p-value	0.0036 ***	5.44135e-09 ***	0.0757 *	0.0012 ***
Number of observations	935		255	

Table 1 presents the results for Model One. The signs of all variables are as expected, except for average earnings in Column 4.

The coefficient of net immigration rate is negative and significant for the 11 regions of Britain, both with and without controls. Net immigration rate's coefficient in Column 2 estimates a 100 percentage point (PP) increase in the net immigration rate to region *b*, holding net immigration to region *a* constant, leads to a 0.8 PP decrease in the net migration rate to *b* from *a.* Therefore, despite the coefficient's direction and significance supporting inter-regional migration as an adjustment mechanism to immigration, the estimated displacement effects are small.

The coefficients of net immigration rate are both larger for the southern regions in Columns 3 and 4, similar to Hatton and Tani's (2005, p.F352) findings. However, the coefficients are insignificant, indicating immigration does not have a significant effect on the net inter-regional migration rate in southern regions.

Columns 2 and 4 show the addition of controls decreases the size of the coefficients on net immigration rate. This indicates the importance of including control variables, as without controls the coefficient is biased upwards, which could lead to an overestimation of the displacement effect of immigration. The coefficients of the control variables are significant, apart from average earnings which is insignificant. This significance supports the inclusion of the control variables. Hatton and Tani (2005, p.F352) found unemployment rate to be insignificant and average earnings to be significant, suggesting a potential change in drivers of inter-regional migration.

The R-squared score is extremely high in all columns, suggesting the models explain most of the variation in the dependent variable. The F-test for the joint significance of the named regressors is significant for Columns 1, 2 and 4. The high R-squared but insignificant F-test in Column 3 suggests most of the variation in the dependent variable is explained by the time dummies and entity fixed effects.

Table 2. Using Model One's findings to address the research hypothesises.

Hypothesised answer to research questions.	Do the results of Model One support the hypothesis?
Net international immigration will have a negative relationship with net inter-regional in-migration rates	Yes, but the results are not significant for the southern regions.
Larger displacement effects will be found for the southern regions	
The relationships between immigration and inter-regional migration found in this paper will show larger displacement effects and increased significance relative to Hatton and Tani's (2005) findings	No, the effects found in this paper are smaller. The coefficients of immigration for all regions are more significant than found by Hatton and Tani (2005, p.F352), but less significant in the southern regions.

Model Two

Table 3 presents the results from Model Two, where the dependent variable is gross inter-regional migration inflows to *b* from *a*. The direction of the coefficients are in the expected direction, apart from average earnings in Column 4. Coefficients of the explanatory variables for Model Two are smaller than Model One, which Hatton and Tani (2005, p.F354) also found.

The size of the coefficient on net immigration rate decreases when controls are added in both Columns 2 and 4, like in Model One. The coefficient of net immigration rate in Column 2 suggests a 100 PP increase in net immigration to region *b* will lead to a 0.4 PP reduction in inter-regional migration inflows from *a*. This is a larger effect than found by Hatton and Tani (2005, p.F354), suggesting the effect of immigration on gross inter-regional inflows has increased since 1982 to 2000. However, the coefficient is insignificant in all columns, suggesting net immigration rate does not have a statistically significant relationship with gross inter-regional in-migration rates.

The R-squared results in Table 3 are again extremely high, however the joint F-test results in columns 1 and 3 are insignificant. Thus, implying most variation is explained by the fixed effects and time dummies, rather than the net immigration rate. The F-test is significant in columns 2 and 4, suggesting the variables are jointly significant, most likely due to the addition of the controls which are all significant, except for average earnings.

Table 3. Model Two's regression results for the dependent variable gross inter-regional migration to b from a.

	11 Regions		**6 Southern Regions**	
	(1)	(2)	(3)	(4)
	Coefficient		Coefficient	
Constant	0.2284 ***	0.2284 ***	0.4331 ***	0.4331 ***
Net immigration rate (*b* - *a* at *t*-1)	−0.0076 *	−0.0040	−0.0098	−0.0029
Log unemployment rate (*b* – *a* at *t*)		−0.0498 ***		−0.1138 ***
Log average earnings (*b* - *a* at *t*-1)		0.0332		−0.0126
Log house price (*b* – *a* at *t*)		−0.0542 ***		−0.1135 ***
Δ Log house price (*b* – *a* at *t*)		0.0032 ***		0.0086 ***
LSDV R-squared	0.9826	0.9838	0.9850	0.9880
F-test on named regressors p-value	0.0516 *	1.8178e-08 ***	0.2678	0.0007 ***
Number of observations	1870		510	

Table 4. A summary of the findings of Model Two in relation to the research hypothesises.

Hypothesised answer to research questions.	Do the results of Model Two support the hypothesis?
Net international immigration will have a negative relationship with net inter-regional in-migration rates	Yes, but the results are not significant.
Larger displacement effects will be found for the southern regions	Only found without controls and the results are not significant.
The relationships between immigration and inter-regional migration found in this paper will show larger	Yes, when the sample is on all 11 regions, but the effects smaller for the southern regions.

displacement effects and increased significance relative to Hatton and Tani's (2005) findings	However, both papers' coefficients are insignificant at 5%.

Model Three

Table 5 presents the results of Model Three. The coefficients of all variables are in the expected direction, except for net immigration rate in Column 4. The only significant variables in Model Three are house prices and change in house prices, and unemployment rate only in the southern regions. The addition of controls in Columns 2 and 4 reduce the coefficient on the immigration variable drastically, suggesting upward bias without controls.

Model Three estimates the total displacement effect of immigration, which Models One and Two cannot, due to the use of bilateral flows. Hatton and Tani (2005, p.354) suggest the displacement effect calculated by Model Three should be 10 times the effect calculated by Model One. This is found for all columns except for Column 4. The results of Column 2 suggest a 100 PP increase in the net immigration rate to a region should lead to a 4.44 PP decrease in the net in-migration rate from all other regions. Although slightly larger effects are found in the southern regions when controls are used, this is much lower than Hatton and Tani's (2005) finding of a 35 PP decrease.

The coefficients on net immigration rate are insignificant in all columns. Overall, the results of Table 5 suggest net immigration rate does not have a statistically significant effect on the net in-migration rate, unlike Hatton and Tani's (2005, p.F355) findings of a significant effect in southern regions.

The high R-squared result but insignificant F-test for Columns 1 and 3 suggest most of the variation in the dependent variable is explained by the fixed effects and time dummies. The significant F-test and increased R-squared in Columns 2 and 4 indicate the explanatory power of the control variables.

Table 5. Model Three's regression results for the dependent variable net in-migration rate.

	11 Regions		**6 Southern Regions**	
	(1)	(2)	(3)	(4)
	Coefficient		Coefficient	
Constant	0.0379	−7.4748	−0.1360	−10.5203
Net immigration rate (*t*-1)	−0.2005	−0.0444	−0.1105	0.0742
Log unemployment rate (*t*)		−1.5034		−2.3124 **
Log average earnings (*t*-1)		2.6474		3.3796 *
Log house price (*t*)		−1.6359 **		−1.9315 ***
Δ Log house price (*t*)		0.1153 ***		0.2098 ***
LSDV R-squared	0.8858	0.9366	0.9090	0.9695
F-test on named regressors p-value	0.3982	0.0346 **	0.7105	0.0034 ***
Number of observations	187		102	

Table 6. A summary of the findings of Model Three in relation to the research hypothesises.

Hypothesised answer to research questions.	Do the results of Model Three support the hypothesis?
Net international immigration will have a negative relationship with net inter-regional in-migration rates	Yes, except for when the regression is run on southern regions with controls. But the relationship is not significant for any of the ways Model Three was ran.
Larger displacement effects will be found for the southern regions	Only with controls, but the results are not significant.
The relationships between immigration and inter-regional migration found in this paper will show larger displacement effects and	No, the effects of immigration found are smaller and less significant. Hatton and Tani (2005, p.F355) found the effects of immigration to be significant for the

increased significance relative to Hatton and Tani's (2005) findings	southern regions only, but this paper found no significant effects of immigration.

Discussion and Conclusion

The aim of this research was to examine if inter-regional migration acts as an adjustment mechanism in modern Britain by replicating Hatton and Tani's (2005) study in an updated period. If immigration is found to have a significantly negative effect on inter-regional migration, this suggests inter-regional migration acts as an adjustment mechanism, potentially explaining why literature often finds little effects of immigration on labour market outcomes.

While the results suggest there is a negative relationship between the net immigration rate and inter-regional in-migration rate, it is mostly insignificant at the 5% level. Net immigration rate was found to only have a significant negative effect on net inter-regional migration when using bilateral flows with all 11 regions of Britain. However, despite finding the relationship is significantly different to zero, the estimates suggest an extremely large increase in immigration is needed for a relatively small displacement effect.

These small and mainly insignificant displacement effects of immigration suggest the answer to the research question asking whether inter-regional migration is an adjustment mechanism to immigration shocks used by the modern British labour market is that it is unlikely. Furthermore, the results suggest the initial hypothesis that it is used, based on Hatton and Tani's (2005) results, was incorrect.

When the sample was restricted to assess the effects of immigration on the southern regions of Britain, the models found a mixture of larger and smaller negative effects. Although, a positive total displacement effect of immigration was found for the southern regions with controls. However, no model found immigration had a statistically significant effect on inter-regional migration in the southern regions. Therefore, this implies immigration may have no significant effect on inter-regional migration in the southern regions of Britain. This is different to Hatton and Tani's (2005) findings of larger and more significant displacement effects in the southern regions compared to when using all regions.

Consequently, the results suggest the answer to the second research question of whether the displacement effects for the southern regions of Britain are still larger than the effects for all

British regions is no. The hypothesised answer of yes was incorrect, immigration does no longer appear to have consistently larger displacement effects in the southern regions of Britain.

Compared to Hatton and Tani's (2005) findings, this paper found smaller displacement effects of immigration on the rates of bilateral net inter-regional in-migration and total net in-migration. While smaller displacement effects were also found on bilateral gross inter-regional in-migration rates for the southern regions, larger effects were found on the sample including all regions. Overall, this suggests the effect of immigration on inter-regional migration between 2003 and 2019 was generally smaller than the effect found by Hatton and Tani (2005) for 1982 to 2000.

Therefore, the answer is yes to the final research question which asks if the relationships between international immigration and inter-regional migration found for 2003 to 2019 are different to the ones found by Hatton and Tani (2005) for 1982 to 2000. The effect of immigration on inter-regional migration appears to have decreased since 1982 to 2000. Hence, while the hypothesis was correct that the effects would be different, it incorrectly predicted the effects of immigration would be larger.

Overall, the results suggest the effect of immigration on inter-regional migration is negative as expected. However, the effect of immigration is small and mostly insignificant, which indicates inter-regional migration may not be an important adjustment mechanism in modern British labour markets, as Card (2005) suggests.

The effects for 2003 to 2019 are smaller and less significant than the effects found by Hatton and Tani (2005) for 1982 to 2000, indicating a potential decrease in inter-regional migration in response to immigration over time. This could be due the continued high levels of immigration in modern Britain resulting in inter-regional migration becoming an unsustainable adjustment mechanism. Therefore, perhaps a different adjustment mechanism should be explored as an explanation for studies finding immigration has little effect on labour market outcomes in the 21st century. It is important academics identify the correct adjustment mechanism so it can be controlled for to measure the 'true' effects of immigration.

However, before making such conclusions, it is important to acknowledge the potential role of the limitations in the methodology of this paper in the unexpected findings of small and insignificant effects of immigration.

While tests suggest there is multicollinearity in the model, which can lead to coefficients incorrectly appearing insignificant, it is unlikely this is the case for the effect of immigration. This is because when controls are omitted in Models Two and Three, which decreases the likelihood of multicollinearity, the results suggest immigration is still an insignificant determinant of inter-regional migration.

Furthermore, it is unlikely the omission of vacancy inflow rates is leading to downward bias, as it is assumed to be positively correlated with inter-regional in-migration and immigration to a region. Therefore, it is possible the simultaneity in the model is causing endogeneity, resulting in biased coefficients, which may explain the unexpected small effects found.

While Hatton and Tani (2005) finding lagging wage addresses endogeneity in their data, it is possible this lag does not address endogeneity in the updated data this paper uses. Therefore, endogeneity is potentially present in this paper's models due to simultaneity bias, which may cause the results to be biased and an inability to establish the causal effect of immigration on inter-regional migration.

Therefore, before making conclusions regarding the displacement effects of immigration and the importance of inter-regional migration as an adjustment mechanism in modern Britain, the potential endogeneity in the model should be addressed. There are various methods to address endogeneity. Hatton and Tani (2005) trial lags of the different variables to see which influence the coefficient of immigration. A more robust method to identify and address potential sources of simultaneity bias is using the 2 Stage Least Squares (2SLS) estimator. If the Hausman test identifies a variable as a source of endogeneity, then the coefficients estimated using a 2SLS model with entity and time dummies should be used to estimate the displacement effects of immigration.

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