Immigration and the use of public maternity services in England[*]

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Abstract

Immigration has a number of potentially significant effects on the economies of host countries. The current literature largely focuses on the impact on labour market outcomes, while relatively little attention is paid to understanding the pressures on demand for public services. This paper investigates the impact of immigration on the use and quality of publicly funded maternity services in England. It shows that areas with a greater concentration of immigrants have higher demands for maternity care, with significantly higher birth rates and greater use of resource-intensive procedures even after controlling for population and supply side characteristics. However, these increases in demand do not result in a deterioration in the observable quality of maternity services, with no increases in 30 day emergency readmissions for mothers or children. These results cannot be explained by reductions in average patient length of stay. I discuss three alternative explanations for these findings: first, that there is slack within the existing system; second, that hospitals substitute resources towards maternity services from other types of care; and finally, hospitals make other efficiency gains.

Keywords: health care; migration; public services
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1 Introduction

Immigration has a number of potential impacts on the economies of host countries. The existing literature places a large emphasis on understanding the effects on labour market outcomes, such as wages and unemployment. A second, important and relatively unexplored impact is that of immigration on the public finances. Concern over the net fiscal contribution of immigrants is a common public objection to immigration (Card, Dustmann and Preston, 2012) and understanding these impacts is of great importance. This paper contributes to this debate by investigating the impact of immigration on the use of maternity services, one particular example of a publicly funded healthcare service.

Existing work on the net fiscal contribution of immigrants typically develops an accounting approach to estimate these impacts. The impact of immigration on public finances will depend on a number of factors, including the tax revenue generated from immigrants, the costs imposed by their reciept of welfare and means-tested benefits, and their demands on public funded services (Preston, 2013). Understanding how immigration changes the demand for public services therefore feeds directly into this debate.

Existing estimates differ in the extent to which these exercises include receipt of government expenditures, such as those on public healthcare.[1] For example, Borjas (1994) compares the amount of tax paid by immigrants with their welfare receipts in the US, and estimates that immigrants make a net fiscal contribution. However, he suggests that these results would reverse once use of public services is included. Dustmann and Frattini (2013) develop a more comprehensive approach for the UK, and include estimates for immigrant use of a range of public services. Impacts vary across different cohorts and regional groups of immigrants, with a negative overall effect of immigration between 1995 and 2012 contrasted by a positive impact of EEA and recent immigrants.

Immigration may also affect the quality of healthcare services enjoyed by those already resident in the host country. Immigrants potentially place differential pressures on health services, leading to overuse or overcrowding of particular services. The literature on the use of healthcare services by immigrants is extremely sparse. Wadsworth (2012) uses individual-level panel data to examine whether immigrants are more or less likely to visit a GP and to use hospital services in the UK and Germany. He finds relatively little differences in service use in the UK. In Germany, immigrants have much lower usage of these services. Laroche (2000) conducts a similar exercise in Canada, and finds no significant differences in the service use of immigrants and natives. Waller, Berrington and Raymer (2012) estimate that migrants have higher fertility rates than comparable natives. However, these difference diminish with years spent in the host country, and is less evident in recent cohorts due to a higher proportion of single, economically motivated migrants.

This paper makes two contributions to the existing literature. First, it provides quantitative estimates of the impact on demand for public funded maternity services as a result of immigration. This builds on the existing literature by using administrative data to examine national changes in the use of this particular service. Second, it presents the first evidence on the impact of immigration on the quality of these services. This provides an important insight into the ability of the health system to adapt to changes in demand, and health implications for users of the system.

This paper makes use of administrative hospital records data from the Hospital Episodes Statistics. I construct measures of demand for maternity services in line with clinical recommendations from the Royal College of Obstretricians and Gynaecologists (RCOG, 2013). This includes the local authority birth rate and the percentage of births that are medically induced or result in an emergency caesarean section. I also use these data to construct the rate of 30 day readmission rate for newborn children and mothers as a measure of the quality of maternity services. These outcomes are combined with population data from the UK Labour Force Survey, namely the percentage of

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[1]Healthcare provides a major component of public expenditure in the UK and in other countries. In 2012, the UK spent 9.4% of GDP on healthcare. Public spending accounted for 82.4% of this figure (Keynes and Tetlow, 2014). Understanding the impact of immigration on the demand for these services if therefore important for accurately conducting such accounting exercises.

local authority populations that are born outside of the UK, to examine the impact of changes in the immigrant concentration on use of the service.

I exploit variation in the changes in the use of health services, and the percentage of the local population who are immigrants, across 331 local authorities in England between 2003/04 and 2009/10. I use measures of local economic conditions and socio-demographic composition to control for observable differences. Endogoneity concerns, arising from the non-random settlement of immigrants and the potential for reverse causality, are addressed through the use of instrumental variables. I instrument current immigrant concentration with lagged values of immigrant concentration from the previous financial year in the same local authority.

I present two main results. First, an increase in the immigrant concentration is associated with increased demand for more, and more resource intensive, maternity care. The estimates indicate that a ten percentage point increase in the immigrant concentration is associated with an increase of 1.8 live births per 1,000 individuals. This compares to a baseline birth rate of 10.9 per 1,000 individuals in 2003/4. Areas with a greater concentration of immigrants also typically experience more expensive delivery episodes, with a higher rate of induced births and emergency caesareans.

Second, the estimates indicate that there is no significant effect of a change in the concentration of immigrants on the local authority volume of 30 day readmissions for either mothers or children. This suggests that despite the increase in demand for maternity services, increases in immigrant concentration are not associated with an observable decrease in the quality of maternity services. However, it is unclear in which way the hospital responds to the increased demand for maternity services. First, there may be existing spare capacity within the system. Second, hospitals may switch resources, such as beds, from the provision of other types of services to maternity care. As a result, overall hospital services may still decrease in quality. Finally, hospitals may adjust on a different margin, such as improvements in efficiency or a reduction in the length of stay. I test this final margin, and find that an increased immigrant concentration is not significantly related to length of stay.

The remainder of the paper is structured as follows. Section 2 describes the data and the main outcomes of interest. It then sets out the empirical strategy and discusses identification issues. Section 3 presents descriptive statistics, and describes how the volume and characteristics of immigrants have changed over the period. Section 4 presents the results and discusses the potential mechanisms through which these impacts operate. Section 5 concludes.

2   Data and empirical method

This paper uses data from two main sources: the British Quarterly Labour Force Survey (LFS) and the admitted care inpatient Hospital Episodes Statistics (HES). The LFS is a quarterly dataset, available at the local authority level between 2003 and 2013. It provides a large representative sample of all UK households. It contains information on the labour market status and educational achievements of all respondents, in addition to a range of socio-demographic variables. This includes country of birth and, in the case of respondents who are born outside of the UK, the year of arrival in the UK. The data are pooled within financial year, combining quarters two, three and four from one year (i.e. 2003) with the first quarter of the next year (i.e. 2004).

I define an immigrant as an individual who is born outside of the UK. I use this to count the number of natives and immigrants who are resident in each local authority for each year, applying the national probability weights to scale up population size to the correct national total. I also calculate the proportion of the local authority population who are defined as immigrants in any given period. These variables can also be split into a number of sub-categories: gender; age; years since arrival; and region of origin (EEA or non-EEA).

The population data are augmented with a range of economic and socio-demographic controls dervied from the LFS. This includes: the demographic composition of the local authority, measuring the proportion of natives and

immigrants who fall into each of nine age-sex specific bands; the proportion of the local authority who completed A levels, or completed higher education, and; employment and unemployment rates. Local authority deprivation measures are also included, using the 2010 level of the ONS Index of Multiple Deprivation (IMD).

HES contain the record of all NHS-funded care in England. Data are available between 1997/98 and 2010/11. Inpatient data contains information on patients, including their age, sex, local authority of residence, the dates of admission and discharge, admission type (elective, emergency or maternity), and up to 20 ICD-10 diagnoses codes.

I use this information to calculate a number of measures relating to maternity care, in line with clinical recommendations from the Royal College of Obstetricians and Gynaecologists (RCOG, 2013). These indicators serve three distinct purposes. First, I create four indicators that capture overall demand for maternity services. The live birth rate in each local authority indicates total demand pressure on maternity services within the local area. I calculate birth rates in each local authority by calculating the total number of women resident in each area who are admitted to an NHS hospital for a delivery episode in any year, and divide by total population.[2] In addition, I calculate the percentage of labours that follow particular processes. This includes: the percentage of labours that are medically or surgically induced; the percentage of labours that result in an emergency caesarean section; and, the percentage of induced labours that result in an amergency caesarean. These measures indicate demand for births that are more-resource intensive than natural births, and therefore represent a higher cost to the NHS.

Second, I calculate two measures of the quality of maternity care in each local authority. This includes the percentage of newborn children who are readmitted to hospital via emergency readmission within 30 days of initial discharge. An analogous measure is also created for maternal readmission. A higher rate of child readmission is indicative of poorer maternity care (Young et al., 2013), while increased maternal readmissions indicate variation from the usual post-natal recovery process.

Finally, I calculate the local authority mean length of stay for both children and mothers in each financial year. In the face of increased demand pressures, the NHS may potentially attempt to reduce the length of stay for patients following a delivery episode. This would allow hospitals to treat a greater number of patients with the same level of resources. I use this measure to examine the extent to which this mechanism explains the results relating to demand and quality of services.

To estimate the impact of changes in the local area immigrant concentration on the use of health services, I divide England into 331 local authorities. In the baseline specification, the birth rate of residents in local authority i, within PCT p, in year t (as measured by the number of residents admitted to hospitals for delivery episodes) is given by the following:

$$Y_{ipt} = \alpha_{ipt} + \beta_1 M_{ipt} + \beta_2 X_{ipt} + \lambda_p + \tau_t + \varepsilon_{ipt} \tag{1}$$

where M_{ipt} is the percentage of non-UK born residents in local authority i, in year t. The PCT and time effects, λ_p and τ_t respectively, control for permanent differences across PCTs in the number of admissions, and for the national time trend in admissions, for delivery episodes.[3] The coefficient of interest is β, the effect of changing the percentage of immigrants living in the local authority, on the local authority level birth rate. The same specification is used to explore the impact on the likelihood of the use of different processes (percentage of induced labours and emergency caesareans) and the quality of maternity services (percentage of children and mothers readmitted within 30 days of discharge).

The model has three endogoneity concerns. First, areas with a greater growth in admittances for the use of healthcare services, for reasons other than changes in the immigrant concentration, may nevertheless be correlated

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[2]96% of all births in England took place in NHS hospital in 2011/12 (RCOG, 2013). As a result, the vast majority of births are contained in the data. Rates are presented as per 1,000 residents.

[3]There is substantial variation in maternity care practices across different PCTs over time. When examining the impact of immigration on the use of different birth processes, readmissions and length of stay, the introduction of PCT fixed effects controls for permanent differences in 'best maternity practices' as viewed by different health authorities .

with a larger growth in immigrant concentrations. In an attempt to control for these factors, X_{ipt} includes a number of time-varying measures of local area characteristics which may be correlated with both hospital admissions and the immigrant concentration. This includes the demographic composition of the local authority, which measures the proportion of the population who fall into 18 distinct age-sex categories, the proportion of the population who attained A levels (or equivalent), and those who gained higher education, and the local authority unemployment and employment rates.

I also include time invariant measures of the deprivation level of the local authority, using the ONS Index of Multiple Deprivation (IMD), and a range of local area healthcare quality measures. This contains a weighted average of time-invariant hospital quality measures, including Foundation and Teaching hospital status, of all NHS trusts used by patients resident in the area. This will provide a measure for differences across regions in the quality of healthcare provided, but will not be influenced by population changes over the period themselves.

The identifying assumption is that conditional on X_{it}, the other unobserved and time varying determinants of hospital admissions, ε_{itkp}, are uncorrelated with the changes in the immigrant population. A second potential source of endogoneity is that areas with higher levels of immigrant concentration and higher rates of admissions are different to areas with lower concentrations and admittances in an unobservable way. A third concern is that the settlement choice of immigrants is non-random. If they choose to settle in areas where the use of health services is currently low (perhaps so that they enjoy shorter waiting times or better access to this care) then there will be simultaneous impacts between the outcome and the immigrant concentrations.

I address both of these concerns through the use of instrumental variables using lagged values of the immigrant concentration for current concentration values. One determinant of immigrant location is the existance of immigrant communities within an area (Bartel, 1989; Altonji and Card, 1991; Dustmann et al., 2003). As a result, immigration tends to follow historical settlement patterns. In an approach common to the migration and labour market outcomes literature, I instrument immigrant concentration in local authority i, in year t, with the immigrant concentration in the same local authority, in year $t-1$. This assumes both that current immigrant concentrations are correlated to past immigrant concentrations, and that the lagged value of the immigration concentration is unrelated to the health service outcomes other than through its effect on the current immigrant concentration.

3   Descriptive statistics

Before examining the impacts of immigration on the demand for public healthcare services, it is important to understand the changes in the size and the composition of the immigrant population in recent years. Figure 1 shows the number of immigrants resident in England in each financial year between 2003/04 and 2009/10. There are two points of note. First, the size of the immigrant population has increased substantially. In 2003/04, there were 4.6 million immigrants living in England. In 2010/11, this population had grown to 6.6 million immigrants. This represents a substantial increase of 43% in just seven years.

Second, immigrants accounted for an increasingly larger share of the national population over time. In comparison to the population growth in the immigrant population displayed in Figure 1, the native population grew by 0.3 million individuals, or 0.7% of the native population. As a result, immigrants accounted for 13.0% of the national population in 2009/10, as compared to a share of 9.5% in 2003/04.

It is important to note that there has been substantial geographical heterogeneity in these changes in population size and composition. Table 1 presents descriptive statistics for local authority populations in 2003/04 and 2009/10, which highlight the variation across regions. The table makes three main points.

First, it shows that the mean local authority population grew by 6.3% over the period, from 144,000 in 2003/04 to 153,000 in 2009/10. The size of these populations vary substantially in both years. These differences also grew over time. In 2003/04, the largest local authority had a population 29 times the size of the smallest local authority.

This increased slightly to 30 times in 2009/10. This indicates that it is important to control for population size (through the use of per capita admission rates) when conducting the analysis in the next Section.

Second, mean local authority immigrant concentration grew over this period, increasing from 8.19% in 2003/04 to 10.55% in 2009/10. Again, there are large differences in the concentration between regions in any given year. In 2009/10, one region had an immigrant concentration of only 0.22%. This compares to the most concentrated local authority of 56.92%.

Finally, the third row reveals that there was substantial geographical variation in the change in immigrant concentrations over the period. The average change in immigrant concentration was 2.36 percentage points. However, these changes were far greater in magnitude in other areas. One area experienced a fall in the immigrant concentration of 9.04 percentage points, while the concentration increased by 15.22 percentage points in another local authority.

These trends clearly show that the size of the immigrant population in England has grown in recent years. This raises a number of further questions: what are the characteristics of these immigrants, how do these characteristics compare to natives, and how has this changed over time? If immigrants are very different to natives (in both observable and unobservable ways), it is likely that they will place different demands on health services when living in England. In order to understand the impacts that immigration may have on the demand for, and the quality of, services it is important to examine these differences.

Table 2 presents characteristics for natives and immigrants in 2003/04 and 2009/10. It also separately distinguishes the characteristics of recent immigrants who have moved to England in the previous five years. This allows a comparison of characteristics both between immigrants and natives over time, and also to examine if and how the types of recent immigrants have changed.

The table presents four main points. First, the mean age of natives increased over the period, from 38.52 in 2003/04 to 38.69 in 2009/10. In contrast, immigrant age has fallen significantly, from 41.75 in 2003/04 to 39.60 in 2009/10. Note that recent immigrants are substantially younger than both the typical native and pre-resident immigrant. The demands placed on healthcare services are typically higher at older age groups. As a result, increases in a younger population may have disproportionately small impacts on the demand for many types of healthcare service.

Second, the proportion of white immigrants fell over the period. In 2003/04, 56% of immigrants were white. In 2009/10, 45% of immigrants were white. The proportion of the native population who are white also fell over the period, but by a smaller magnitude.

Third, immigrant education levels have increased substantially over the period. The proportion of immigrants with a degree or other higher education attainment increased from 0.22 in 2003/04 to 0.37 in 2009/10. This is significantly greater than the equivalent proportion of the native population (0.30), and is driven through a sharp increase in the proportion of recent immigrants with degrees. The proportion of immigrants with a highest educational attainment below A-levels has fallen over the period, from 0.64 to 0.52. Existing literature suggests that there is a strong socio-demographic gradient in health (Smith, 2005). Educational levels can therefore be viewed as a good indicator for the levels of services required by different populations.

Finally, the average number of years since arrival has fallen from 23.16 years in 2003/04 to 18.83 in 2009/10. This is driven by the increased number of recent immigrants arriving after the expansions of the EU in 2004 and 2007.

Taken together, these trends suggest that the immigrant population in England has grown over the past decade, and that this population is increasingly younger and better educated. This is likely to result in a change in the composition of services provided, with demand for some services decreasing while others increase. In particular, the demand for maternity services is likely to increase as the size of the population of child-bearing age increases.

Table 3 shows indicators of local authority demand for maternity services in 2003/4 and 2009/10. This has X

points of note. First, the average birth rate has increased over this period, rising from 10.94 per 1,000 individuals in 2003/04 to 11.57 in 2009/10. Second, the percentage of induced labours and caesareans have both increased. Increase in induced births in line with international experiences, but is worrying given clinical evidence of worse outcomes for mothers and children (cite both). The incidence of caesarean section has also increased significantly over this period. In some aspects, this may represent increased patient choice (Cite). However, the percentage of emergency caesareans has also increased, particular following an induced labour episode. Regardless of the health implications, the increased incidence of these procedures represents the more common use of resource-intensive maternity procedures in maternity care. This is likely to have consequences in providing healthcare.

Table 4 presents summary statistics for post-delivery outcomes for both mothers and children in 2003/04 and 2009/10. The rate of readmissions for mothers and children has increased over time. In 2003/04, the mean local authority readmission rate for mothers was 0.84. This increased to 1.02 in 2009/10. Similarly, the readmission rate rose for children, increasing from an average of 4.06% in 2003/04 to 6.05% in 2009/10. There is also significant variation across different local authroities in these readmission rates, and this has increased over time. When examining length of stay, significant declines for both mothers and children are observed. Average mother length of stay decreased from 2.72 days in 2003/04 to 2.30 days in 2009/10. Similarly, child length of stay decreased from 2.30 at the start of the period to 1.93 in 2009/10.

Taken together, Tables 3 and 4 suggest that there is an increasing use of hospital by mothers, both for delivery episodes and subsequent readmissions. I now examine whether this increase in demand is related to immigration over this period, and what impact this has on the quality of maternity care experienced by mothers and children.

4   Results

Table 5 presents estimates of the relationship between immigrant concentration and the live birth rate (births per 1,000 individuals) between 2004/5 and 2009/10. In all cases the dependent variable is the number of live births recorded in NHS hospitals per 1,000 local authority residents.

Column one controls only for the national time trend in live births over the period and for permenant differences in the live birth rate across PCTs. The estimated coefficient on immigrant concentration is positive and significant at the 1% level, and suggests that an increase of ten percentage points in the immigrant concentration is associated with an additional 2.3 live births per 1,000 individuals in each local authority in each year. This compares to a baseline mean birth rate of 10.9 per 1,000 individuals.

Column two introduces variables which capture the characteristics of the nearest NHS trust in order to control for the quality of care received within the local area. This includes indicators of whether the nearest NHS trust had Foundation Trust status in 2004, and Teaching Hospital status in 2010.[4] This marginally reduces the magnitude of the estimated coefficient on immigration concentration from 0.226 to 0.205. It remains significant at the 1% level. When examining the relationship between the live birth rate and the nearest trust characteristics, one sees a mixed picture. In areas where the nearest trust achieved Foundation Trust status by 2004 the live birth rate is higher, while areas where the nearest trust is a Teaching Hospital have lower average live birth rates. Areas with a greater number of maternity beds and more (full-time equivalent) midwives typically have higher live birth rates. Interestingly, these areas are associated with a lower maternity bed occupancy rate, with the increased number of beds appearing to more than compensate for the effect of higher birth rates on the availability of beds.

Column three includes additional controls for the demographic composition and the economic conditions of the local authority. This reduces the magnitude of the effect of the immigrant concentration, although the estimated coefficient remains positive and significant at the 1% level. As one would anticiapte, areas with a larger proportion

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[4]Trusts which achieved Foundation trust status in 2004 are considered to provide quality healthcare. Similarly, Teaching Hospitals are typically associated with better standards of care.

of females aged between 18-44 have higher birth rates on average. In addition, areas with a greater share of the population with higher education or A-levels are associated with lower births rates. For example, a ten percentage point increase in the percentage of individuals with higher education (instead of GCSEs or O-levels) is associated with one fewer birth per 1,000 individuals. More deprived areas also have significantly higher birth rates, as indicated by the positive coefficient on the 2010 IMD score.

In columns four and five, I instrument current immigrant concentration with a lagged value of immigrant concentration from the previous financial year. When controlling only for the characteristics of the nearest trust in column four, the estimated coefficient on immigrant concentration is 0.285 and is statistically significant at the 1% level. In column five, I introduce additional controls for the local economic conditions and the demographic composition of the local authority. The magnitude of the estimated coefficient is substantially reduced at 0.179, and remains significant at the 1% level. This suggests that an increase in the immigrant concentration by ten percentage points is associated with an additional 1.8 live births per 1,000 individuals.

It should be noted that given the reduction in the magnitude of the estimated coefficient on immigrant concentration when demographic and economic controls are included, these results suggest that immigrants tend to settle in areas with lower average levels of education and a younger population. If immigrants tend to live in areas where the population have lower levels of education, and where the population is typically younger (or in other words, in areas with characteristics that are typical of a high birth rate) then omitting these factors will falsely attribute the impact of these characteristics to the immigrant concentration.

This draws attention to the important distinction that can be drawn between the set of results provided in columns two and four, and columns three and five. The specifications in columns two and four control only for permenant differences across regions, and variation in local standards of care. They do no account for the changes to the characteristics of the population that occur as a result of immigration. As a result, such results can be considered 'unconditional' estimates of the impact of immigration on the use of these health services. In contrast, columns three and five control for the changes in the characteristics of the local population. For example, this would account for changes in demographic composition over the period. In this way, the estimates presented in columns three and five abstract from the changes to the characteristics of the population. They therefore estimate the effect of changes in the immigrant concentration holding all other relevant characteristics constant.

Policymakers may be interested in both sets of results. The first set of results provide an important answer to the policy question of what is happening to the demand for maternity services when the immigrant concentration changes. This includes both the direct impact on demand for healthcare services as a result of an increased share of the population being immigrants, and the indirect changes to the demand for healthcare services as the characteristics of the population change (for example, as a greater share of the population are aged between 18 and 44). The second set of results focuses solely upon the first of these channels, abstracting from the secondary impacts of the related demographic changes. This provides evidence on how a particular set of the population (i.e. immigrants) use maternity services, and how the overall demand for the service changes as this share of the population grows.

Table 6 presents estimates of the relationship between immigrant concentration and a range of other demand indicators, including the percentage of labours that are medically or surgically induced (columns one and two), the percentage of births which required an emergency caesarean (three and four), and the percentage of induced labours that resulted in an emergency caesarean (five and six). The estimates in columns one, three and five present the full fixed effects specification (column three above), while even columns present results from the full IV specification (column five above).

Looking first at the percentage of induced births, there is some evidence of a positive relationship with immigrant concentration. When instrumenting current concentrations, the estimate is positive and significant at the 10% level. Similarly, the estimates suggest a positive relationship between the immigrant concentration and the percentage

of births which result in emergency caesareans. Positive and significant coefficients (at the 10% level at least) are found in both specifications. In particular, the IV specification suggests that a ten percentage point increase in the immigrant concentration is associated with a 1.24 percentage point increase in emergency caesareans. This effect is significant at the 5% level, and compares to a baseline level of 9.02% in 2003/04. In contrast, there appears to be no significant effect on the percentage of induced births that result in an emergency caesarean. This suggests that despite the associated increase in induced births and emergency caeasareans, increased immigration does not appear to have resulted in an increase in induced births which have immediate negative consequences for patients.

Taken together, the results in Tables 5 and 6 indicate that there is a positive relation between immigrant concentration and the demand for NHS maternity services. In particular, there is a strong positive relationship between immigrant concentration and the birth rate. This represents a large increase in the demand for maternity services in areas where immigration has been strong in recent years. In addition, there is greater demand for maternity services that are more resource-intensive (in the form of a greater percentage of induced births or emergency caeasreans). These procedures, at the very least, represent a larger cost to the NHS than a natural birth. More worryingly, mothers and children may also experience worse outcomes as a result of the (unneccesary) use of these procedures (Maslow and Sweeney, 2000). A natural extension is then to examine the impact this increased demand has had on the quality of services provided, and the mechanisms through which these impacts occur.

Table 7 displays the relationship between the immigrant concentration and the percentage of newborn children who are readmitted to hospital within 30 days of initial discharge. This aims to capture the impact of increased immigrant concentration on the quality of maternity services provided in the local area through the immediate impact on child health. In column one, where I only control for the national time trend and PCT fixed effects, the estimates indicates no significant correlation between immigrant concentration and the percentage of children re-admitted within 30 days of initial discharge. The remaining specifications introduce additional controls in the same style as above. Columns four and five again set out the results from the preferred IV specifications.

When controlling only for the characteristics of the local health economy (and PCT and year fixed effects) the results in column two and four indicate a small positive relationship between the immigrant concentration and the percentage of children readmitted as emergency cases within 30 days of discharge. However, the effect is small and marginal only at the 10% level. When introducing additional controls there impacts are no longer significant. In the full IV specification, the coefficient is very small in magnitude and is not significantly different from zero. Taken together, these estimates provide little evidence to suggest that the care received by children during birth has deteriorated in any substantial way as a result of the increased demand pressures observed above.

Table 8 repeats this analysis for readmissions rates for mothers. In all cases, the dependent variable is the percentage of mothers within the local authority who are readmitted to hospital as an emergency case within 30 days of initial discharge. The estimates suggest that the relationship between maternal readmission and immigrant concentration are negative. In all cases, the coefficients are significantly different from zero at the 10% level (and significant at the 5% level in the second column). Although the coefficients are small in magnitude, these findings are perhaps surprising given that one might expect to observe declines in quality(and therefore more admissions) in areas where demand for maternal care was greater.

Taken together, the estimates in Table 7 and 8 indicate that despite the increased demand for maternity services in areas where immigrant concentrations have increased, there are no observable negative impacts on the quality of care received by children or mothers. In fact, the rate of readmission for mothers has, if anything, declined.[5] There are important questions relating to the mechanisms which might explain these results. It is interesting that a large increase in the demands on NHS-provided maternity services does not result in an observable deterioration in the quality of those services. This may be explained by three potential mechanisms.

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[5]It is important to note that some complications associated with worse maternity care may be captured by the primary care system rather than through readmission to NHS hospitals. Unfortunately, the available data do not capture such episodes, and therefore visits to GPs, practice nurses or outpatient midwif appointments will not be included in the analysis.

First, there may simply be spare capacity in the existing provision of NHS maternity services. An increase in demand could therefore be met through the use of existing resources without a reduction in the quality of the service. Second, hospitals may divert resources from other areas of care to provide additional maternity services instead. For example, beds previously used to provide other types of care may be used in maternity wards instead.

Finally, it may be that hospitals have become more efficient at providing maternity services in response to increased demand. Such efficiency gains could be met through a reduction in the average length of stay for mothers and children. As a result, the same level of resources (such as beds) could be used to provide care for more individuals. In Table 9, I test whether there are observable changes in the length of stay for children and mothers in areas with different immigrant concentrations. Columns one and two examine the impact on average length of stay for children. OLS estimates in column one suggest that there is a negative relationship between child length of stay and the immigrant concentration, significant at the 10% level. The magnitude of the coefficient is however small, with a 10 percentage point in the immigrant concentration related to a reduction of 0.07 days in hospital. This is relative to a baseline of 2.30 in 2003/04. Column two instruments current immigrant concentration with the value from the previous year. The magnitude changes little, but becomes insignificant at the 10% level. Columns three and four repeat this analysis for mean length of stay for mothers. The coefficients are positive, but are again small in magnitude and are not significantly different from zero.

Taken together, these estimates suggest that hospitals have not met increased maternity demand through a reduction in the length of stay of patients. Better understanding the mechanisms through which this increased demand has been met is important in understanding how publicly funded services adapt to changes in the size and composition of the population which they serve. In particular, the secomd potential channel would most likely lead to reductions in the quality of other types of care provided by the NHS, but that are not covered in this analysis. Further research should therefore focus on developing a better understanding of these mechanisms.

5   Discussion

This paper exploits spatial variation in the change in hospital outcomes and in the local concentration of immigrants to examine the relationship between immigration and the use of publicly funded maternity services in England. I combine administrative hospital data from the Hospital Episodes Statistics with population information from the British Labour Force Survey to estimate how the demand for, and quality of, public-funded maternity care varies with the percentage of the local population born outside of the UK. Endogoneity concerns arising from the non-random settle of immigrants are addressed through the use of lagged immigrant concentrations as an instrument for contemporary concentrations.

The main results of the paper can be summarised as follows. First, there is a significant and positive relationship between immigrant concentration and the local authority birth rate. When using a full set of controls for the quality of local care, and the socio-demographic and economic characteristics of the local authority, the instrumental variable estimates indicate that an increase in the immigrant concentration of ten percent is associated with an additional 1.8 births per 1,000 residents. This compares to a baseline of 10.9 births in 2003/04. Second, the rate of more resource-intensive procedures such as induced labour and emergency caesareans is greater in areas with greater immigrant concentrations. Taken together, these results suggest that areas with greater shares of immigrant population demand more, and more resource intensive, maternity services. Third, despite these increases in demand pressures, I find no significant relationship between immigrant concentration and health outcomes for mothers and children, with no observed increase in 30 day readmittances for newborn children or mothers. Finally, these contrasting results cannot be explained by a reduction in the average length of hospital stay for mothers or children.

These findings add to a sparse literature on the wider non-labour market impacts of immigration. They suggest that increased immigration introduces additional demand for certain types of publicly funded services. However,

the finding that the quality of maternity services does not deteriorate, despite the additional demand pressures on these services, is significant. Future work should examine the mechanisms through which the system adapts to this additional demand pressure: either through switching resources from other sectors, efficiency gains (other than length of stay reductions), or through pre-existing spare capacity in providing these services. In addition, understanding the impact of immigration on other aspects of the health service, such as the use of accident and emergency departments, would be an useful avenue for extending this work.

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Table 1: Local authority populations, 2003/4 - 2009/10

		Mean	S.D.	Min	Max
Total population (000s)	2003/04	144	95	33	963
	2009/10	153	102	34	1,019
Immigrant concentration (%)	2003/04	8.19	9.06	0.46	53.52
	2009/10	10.55	10.14	0.22	56.92
Change in concentration (Percentage points 2003/04 - 2009/10)		2.36	3.55	-9.04	15.22

Notes: Author's calculations using LFS data with national probability weights. Immigrants are defined as non-UK born individuals.

Table 2: The characteristics of immigrants, 2003/4 - 2009/10

	Natives		Immigrants		Recent Immigrants	
	2003/04	2009/10	2003/04	2009/10	2003/04	2009/10
Mean age	38.52	38.69	41.75	39.60	24.84	26.39
Ethnicity (% white)	0.97	0.94	0.56	0.45	0.56	0.48
% higher education	0.21	0.30	0.22	0.37	0.13	0.33
% below A-level	0.55	0.45	0.64	0.52	0.78	0.60
Mean years since arrival	-	-	23.16	18.83	2.43	2.89

Notes: Author's calculations using LFS data. Recent immigrants are defined as arrivals within the last five years.

Table 3: Local authority maternity indicators, 2003/4 and 2009/10

		Mean	S.D.	Min	Max
Live births per 1,000 individuals	2003/04	10.94	2.58	4.87	21.56
	2009/10	11.57	3.19	5.26	23.78
% induced births	2003/04	16.15	7.11	0.00	34.65
	2009/10	18.73	5.90	0.11	32.46
% caesareans	2003/04	15.97	8.23	0.06	30.85
	2009/10	21.00	6.77	0.14	34.21
% emergency caesareans	2003/04	9.02	4.82	0.00	19.93
	2009/10	11.90	4.24	0.14	20.81
% emergency caesareans	2003/04	16.41	9.21	0.00	100.00
(induced cases only)	2009/10	19.06	7.60	0.00	50.00

Notes: Authors' calculations using HES data.

Table 4: Local authority post-delivery outcomes, 2003/4 and 2009/10

		Mean	S.D.	Min	Max
Mothers					
% readmitted within 30 days	2003/04	0.84	0.40	0.00	2.91
	2009/10	1.02	0.49	0.00	3.41
Length of stay (days)	2003/04	2.72	0.61	1.05	3.56
	2009/10	2.30	0.30	1.67	4.74
Children					
% readmitted within 30 days	2003/04	4.06	1.89	0.34	19.38
	2009/10	6.05	2.37	0.99	18.10
Length of stay (days)	2003/04	2.30	0.44	1.37	5.19
	2009/10	1.93	0.54	1.04	7.65

Notes: Authors' calculations using HES data.

Table 5: Immigrant concentration and local authority live birth rate per 1,000 individuals, 2004/5 - 2009/10

	LA live birth rate (per 1,000 individuals)				
	(1)	(2)	(3)	(4)	(5)
Population					
Immigrant concentration	0.226***	0.205***	0.112***	0.285***	0.179***
	(0.012)	(0.011)	(0.011)	(0.016)	(0.018)
Nearest Trust Characteristics					
Number of maternity beds		0.133***	0.055***	0.118***	0.053***
		(0.014	(0.012)	(0.015)	(0.013)
Bed occupancy rate (%)		-13.73***	-11.75***	-14.30***	-12.36***
		(2.101)	(1.807)	(2.134)	(1.831)
FTE number of midwives		0.006***	0.005***	0.006***	0.005***
		(0.001)	(0.001)	(0.001)	(0.001)
Local Authority Economic Controls					
IMD score (2010)			0.164***		0.156***
			(0.010)		(0.011)
Percentage with higher education			-0.018**		-0.022***
			(0.008)		(0.008)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
PCT Fixed Effects	Yes	Yes	Yes	Yes	Yes
Nearest Trust Controls	No	Yes	Yes	Yes	Yes
Demographic Controls	No	No	Yes	No	Yes
Instrument	No	No	No	Yes	Yes
Observations	2,177	2,177	2,177	2,177	2,177
Pseudo R-squared	0.208	0.348	0.541	0.329	0.531

Notes: *** denotes significance at 1%, ** at 5%, and * at 10% level. The dependent variable is the number of live births recorded in NHS hospitals for 1,000 individuals in the local authority. Immigrant concentration measures the percentage of the local authority population born outside of the UK. Columns 4 and 5 uses the percentage of the local authority population who are born outside of the UK from in year t-1 as an instrument for immigrant concentration in year t. Demographic controls account for the size and composition of the local authority population (age-sex adjusted). Early FT status denotes Foundation Trust status in 2004. Teaching status applies to 2010. Bed occupancy rate denotes the annual mean percentage of total Trust maternity beds which are occupied. FTE denotes the full time equivalent number of midwives at Trust level.

Table 6: Immigrant concentration and maternity care indicators, 2004/5 - 2009/10

	% induced births		% emergency c-sec		% emergency c-sec (induced births)	
	(1)	(2)	(3)	(4)	(5)	(6)
Immigrant concentration	0.057	0.158*	0.055*	0.124**	0.014	0.073
	(0.052)	(0.083)	(0.032)	(0.052)	(0.061)	(0.098)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
PCT Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Instrument	No	Yes	No	Yes	No	Yes
Nearest Trust Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,866	1,866	1,866	1,866	1,860	1,860
Number of PCTs	137	137	137	137	137	137
Pseudo R-squared	0.072	0.070	0.100	0.098	0.054	0.053

Notes: *** denotes significance at 1%, ** at 5%, and * at 10% level. Immigrant concentration measures the percentage of the local authority population born outside of the UK. Columns 2, 4 and 6 use the percentage of the local authority population who are born outside of the UK from in year t-1 as an instrument for immigrant concentration in year t. Demographic controls account for the size and composition of the local authority population (age-sex adjusted). Economic controls include the percentage of the working age population with A-levels and some higher education, the median gross weekly wage, and the 2010 IMD score. Nearest trust characteristics include an indicator of Foundation Trust status in 2004, Teaching Hospital status in 2010, the number of maternal beds and the occpancy rate in each financial year, and the full time equivalent number of midwives employed by the Trust.

Table 7: Immigrant concentration and the percentage of newborn children readmitted to hospital within 30 days of discharge, 2004/5 - 2009/10

	Percentage of children readmitted within 30 days				
	(1)	(2)	(3)	(4)	(5)
Immigrant concentration	-0.009	0.021*	-0.001	0.031*	0.006
	(0.012)	(0.012)	(0.014)	(0.017)	(0.02)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
PCT Fixed Effects	Yes	Yes	Yes	Yes	Yes
Instrument	No	No	No	Yes	Yes
Nearest Trust Characteristics	No	Yes	Yes	Yes	Yes
Demographic Controls	No	No	Yes	No	Yes
Economic Controls	No	No	Yes	No	Yes
Observations	1,866	1,866	1,866	1,866	1,866
Number of PCTs	137	137	137	137	137
Pseudo R-squared	0.109	0.154	0.187	0.154	0.187

Notes: *** denotes significance at 1%, ** at 5%, and * at 10% level. The dependent variable is the percentage of newborn children resident in the local authority who are re-admitted to hospital within 30 days of initial discharge. Immigrant concentration measures the percentage of the local authority population born outside of the UK. Columns 4 and 5 uses the percentage of the local authority population who are born outside of the UK from in year t-1 as an instrument for immigrant concentration in year t. Demographic controls account for the size and composition of the local authority population (age-sex adjusted). Economic controls include the percentage of the working age population with A-levels and some higher education, the median gross weekly wage, and the 2010 IMD score. Nearest trust characteristics include an indicator of Foundation Trust status in 2004, Teaching Hospital status in 2010, the number of maternal beds and the occpancy rate in each financial year, and the full time equivalent number of midwives employed by the Trust.

Table 8: Immigrant concentration and the percentage of mothers readmitted to hospital within 30 days of discharge, 2004/5 - 2009/10

	Percentage of mothers readmitted within 30 days				
	(1)	(2)	(3)	(4)	(5)
Immigrant concentration	-0.006*	-0.005**	-0.007*	-0.007*	-0.011*
	(0.003)	(0.003)	(0.004)	(0.004)	(0.006)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
PCT Fixed Effects	Yes	Yes	Yes	Yes	Yes
Instrument	No	No	No	Yes	Yes
Nearest Trust Characteristics	No	Yes	Yes	Yes	Yes
Demographic Controls	No	No	Yes	No	Yes
Economic Controls	No	No	Yes	No	Yes
Observations	1,866	1,866	1,866	1,866	1,866
Number of PCTs	137	137	137	137	137
Pseudo R-squared	0.014	0.057	0.068	0.056	0.067

Notes: *** denotes significance at 1%, ** at 5%, and * at 10% level. The dependent variable is the percentage of mothers resident in the local authority who are re-admitted to hospital within 30 days of initial discharge. Immigrant concentration measures the percentage of the local authority population born outside of the UK. Columns 4 and 5 uses the percentage of the local authority population who are born outside of the UK from in year t-1 as an instrument for immigrant concentration in year t. Demographic controls account for the size and composition of the local authority population (age-sex adjusted). Economic controls include the percentage of the working age population with A-levels and some higher education, the median gross weekly wage, and the 2010 IMD score. Nearest trust characteristics include an indicator of Foundation Trust status in 2004, Teaching Hospital status in 2010, the number of maternal beds and the occpancy rate in each financial year, and the full time equivalent number of midwives employed by the Trust.

Table 9: Immigrant concentration and length of hospital stay, 2004/5 - 2009/10

	Child length of stay		Mother length of stay	
	(1)	(2)	(3)	(4)
Immigrant concentration	-0.007*	-0.006	0.002	0.005
	(0.004)	(0.006)	(0.002)	(0.003)
Year Fixed Effects	Yes	Yes	Yes	Yes
PCT Fixed Effects	Yes	Yes	Yes	Yes
Instrument	No	Yes	No	Yes
Nearest Trust Characteristics	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes
Observations	1,866	1,866	1,866	1,866
Number of PCTs	137	137	137	137
Pseudo R-squared	0.143	0.142	0.282	0.280

Notes: *** denotes significance at 1%, ** at 5%, and * at 10% level. The dependent variable is the number of days between admission (birth) and discharge date for mothers (children) resident in the local authority who are re-admitted to hospital within 30 days of initial discharge. Immigrant concentration measures the percentage of the local authority population born outside of the UK. Columns 2 and 4 uses the percentage of the local authority population who are born outside of the UK from in year t-1 as an instrument for immigrant concentration in year t. Demographic controls account for the size and composition of the local authority population (age-sex adjusted). Economic controls include the percentage of the working age population with A-levels and some higher education, the median gross weekly wage, and the 2010 IMD score. Nearest trust characteristics include an indicator of Foundation Trust status in 2004, Teaching Hospital status in 2010, the number of maternal beds and the occpancy rate in each financial year, and the full time equivalent number of midwives employed by the Trust.

Figure 1: Non-UK born population in England, 2003/04 - 2009/10