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THE LONG-TERM ECONOMIC IMPACTS OF REDUCING MIGRATION: THE CASE OF THE UK MIGRATION POLICY

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The Long-Term Economic Impacts of Reducing Migration:

the Case of the UK Migration Policy

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Abstract

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1. Introduction

International migration is a growing phenomenon – between 1990 and 2010 the number of international migrants worldwide has increased from 155 to 214 million (United Nations, 2012). Migration has a significant economic impact on both sending and receiving countries. From the point of view of developed economies, which usually play the role of host countries, there are two distinctive views on the possible effects of immigration.

First, immigration can be regarded as one potential solution to the challenges presented by the population ageing process that is currently ongoing in most advanced economies. As an example, over the past 50 years, the proportion of the UK population aged 65 and above has increased from 12% to 17%, and by 2060 it is estimated to reach 26%[1]. Changes in population structure are determined by three demographic processes: fertility, mortality and migration. While fertility and mortality generally tend to adjust slowly and have a long-term impact on demographic structure, migration can change rapidly, thereby playing a more important role in the short run. In addition, migration flows are more responsive to changes in policy. That is why many developed countries use migration policies as a tool to address demographic challenges. The rationale behind this remedy is that migrants tend to be younger than the native population on average, and therefore will be able to replace falling native working age population during the transition period.

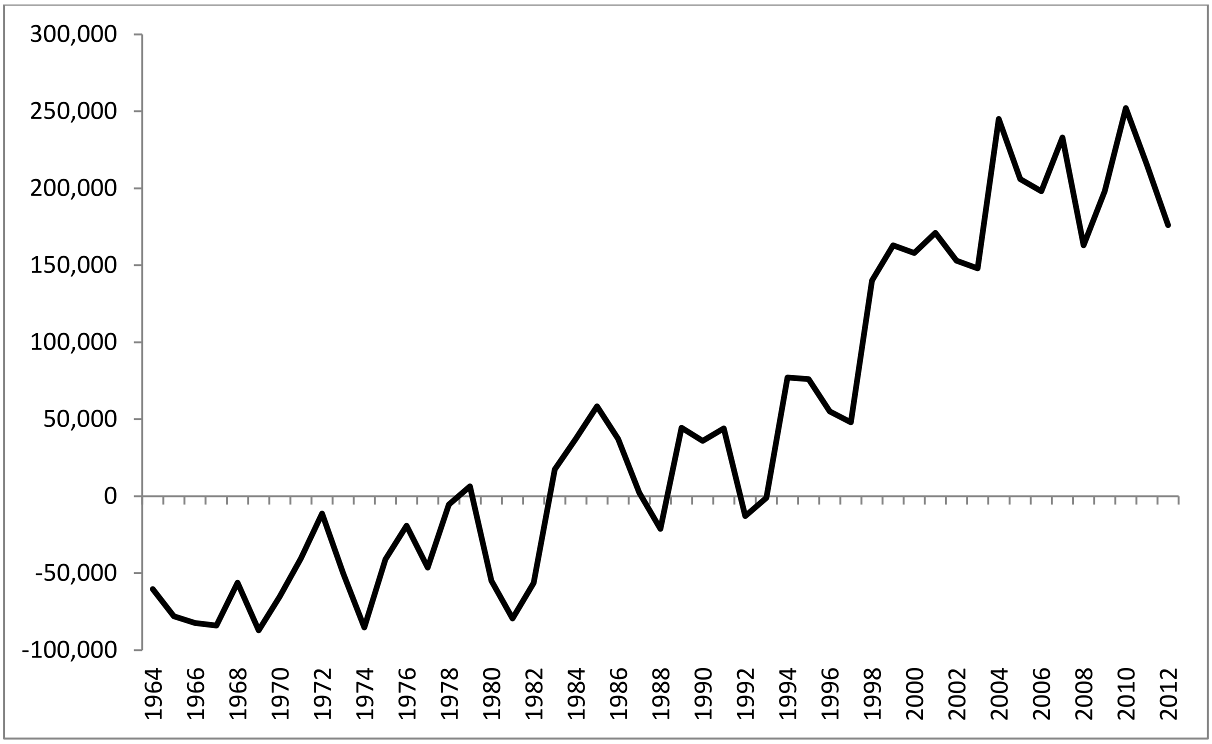
Second, the overall impact of immigration on the host economy can be analysed from the viewpoint of competition. The main argument is that immigrant workers compete with natives for jobs, resulting in higher unemployment and lower pay for native workers. Immigrants also apply for welfare benefits and use free (or subsidised) public services. Hence, proponents of this view claim that the negative impact of immigration also extends to the public purse. Although most of the researchers do not find evidence that the expansion of immigration leads to negative labour market outcomes for native-born workers (Dustmann et al, 2008; Lemos and Portes, 2008), this view is often popular among the press and the general public.

In this paper, we attempt to provide a quantitative assessment of the long-term impact of migration on the economy that may cast new light on this debate. As an experiment, we

[1] According to the 2010-based principal ONS projections

chose the migration target set by the senior partner of the current UK coalition government (the Conservative Party) to reduce the level of net migration from "hundreds of thousands to tens of thousands". As Figure 1 below shows, positive net migration in the order of "hundreds of thousands" is a relatively recent phenomenon in the UK, since it traditionally experienced negative net migration. The recent large influx of immigrants after the accession of the Eastern European countries to the EU in 2004 (so-called A8 countries[2]) raised tensions within society and brought migration policy to the forefront of the political debate. Tightening of the migration rules, introduced by the current government, has started to produce the expected results; according to the most recent estimates for net migration, during 2012 net migration was 177,000 – the lowest level since 2008.

Figure 1. Net migration, UK, 1964-2012



Source: ONS

The principal net migration assumption in the 2010-based ONS population projections is that it will remain at 200,000 per year over the next 50 years[3]. Thus, if the current

[2] The A8 countries are the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.
[3] 2010-based population projections were selected because they are the last vintage of projections available before the change in migration policy. In the latest 2012-based projections ONS took into account change in policy and adjusted principal long-term migration assumption from 200,000 to 160,000 per year.

government succeeds in achieving its migration target, then net migration will be reduced by more than half relative to the ONS assumption. The goal of this paper is to model and analyse the overall economic impact of this policy.

At the empirical level, there exist a number of contributions that shed light onto the several channels in which immigration can have a bearing on the UK's economy. While many of them focus on the labour market aspects, there is also a growing literature on the net fiscal impact of migration.

Among the first group of papers, Lemos and Portes (2008) study the labour market impact of A8 immigration to the UK and do not detect any significant effects on native's wages or unemployment. Manacorda et al (2012) attempt at resolving that observed insensitivity of natives' wages to immigration by arguing that UK native and foreign born workers may be imperfect substitutes. After estimating the elasticity of substitution between workers of different origin, they conclude that immigration mainly reduces the wages of immigrants, with little impact on those of natives. An empirical analysis of the effects of immigration on average wages in the UK is conducted in Nickel and Saleheen (2008). These authors find that, even though small, the immigrant-native ratio has a significant negative impact on the average occupational wage rates of that region, for both native and foreign workers. They also find that the biggest effect is in the semi/unskilled services sector.

On the fiscal implications of immigration in the UK, Sriskandarajah et al (2005) provide evidence showing that the net contribution of immigrants into the welfare state is positive. Moreover, their analysis also suggests that the relative net fiscal contribution of foreigners is greater than that of UK-born. Similarly, Gott and Johnson (2002) also find that the fiscal impact of the immigrant population is positive overall, although they also warn it is likely that this result masks the different performance of subsections of this population. In a recent study, Dustmann et al. (2010) estimated the fiscal impact of A8 immigrants in the UK. They found that these immigrants have a positive net contribution to public finances. Contrary to these positive results on the effects of immigration, Coleman and Rowthorn (2004) find that the purely economic consequences of large-scale immigration are not equally distributed, giving rise to winners and losers. However, they also argue that the purely economic dimension of immigration is negligible in comparison with the demographic, social and environmental issues that come with it.

The other major strand of literature on the economic impact of immigration to the UK is based on the use of general equilibrium macroeconomic models, which are especially suitable for investigating the future possible consequences of migration. These approaches generally employ agent-based macroeconomic models which are calibrated to the UK. There has been particular interest in analysing the macroeconomic impacts of A8 immigrants to the UK, after the EU enlargement in May 2004. Barrell et al (2007) use the structural macroeconometric model *NiGEM* and estimate that, even though the overall isolated impact is likely to be small from an aggregate perspective, migration from these countries resulted in higher GDP and lower unemployment and inflation. In the same vein, Iakova (2007) employs the IMF's dynamic general equilibrium model with demographic features and finitely-lived individuals, *Multimod,* to explore the effects of Eastern European immigration to the UK. The results from her simulations point to positive effects of this migration on economic growth, capital accumulation, consumption and public finances. Based on an assumed path of migration flows, Bass and Brucker (2011) employ a CGE model with imperfect labour markets and draw the conclusion that the EU enlargement contributed to the increase in GDP per person in the UK at the expense of slower gains in wage and unemployment.

Our paper adds to the latter body of research by considering migration from all origins and by employing a richer model structure. In this sense, our aim is to develop a framework where we can conduct a dynamic assessment of future changes in immigration policy. For this purpose, we employ a dynamic overlapping generations computable general equilibrium model (OLG-CGE), which is widely acknowledged as the best tool for the modelling of issues associated with demographic change. Among the advantages of an OLG-CGE framework is its age-disaggregated nature, which makes it possible to study age-specific behaviour and the impact of changes in the population age structure on the economy.

The model is in the Auerbach and Kotlikoff (1987) tradition and introduces age-specific mortality following Borsch-Supan et al. (2006). This modification allows precise replication of the population structure from any population projection and dramatically improves the accuracy of demographic shocks.

There are several approaches to modelling migration in an OLG-CGE framework. One approach is to assume that immigrants are identical to natives, i.e. they come with the same level of assets, qualification and productivity as natives in the corresponding group. An alternative approach is to assume that immigrants differ from natives at least in some dimensions. Fehr et al. (2004) and Chojnicki et al. (2011) assume that immigrants hold the same level of assets as natives of the same age and qualification, while Storesletten (2000) assumes that immigrants have no assets when they come.

We adopt a different approach. In the presented model there are two types of migrants: foreign-born and native-born. It is assumed that the new foreign-born migrants have the same level of assets as the foreign-born population already living in the UK. Correspondingly, new native-born migrants own the same level of assets as the native-born population that stays within the country. We also attempt to differentiate the native-born and foreign-born population along other dimensions as much as possible. The two groups exhibit different employment rates, productivity levels, qualification distribution as well as different probability of receiving benefits from the government. Such detailed differentiation allows us to capture multidimensional effects of migration on the labour market, aggregate demand and public finances.

The rest of the paper is organised as follows. In section 2, we give a description of the model. In section 3, we outline the calibration procedure. Section 4 describes performed simulations and presents results for two policy alternatives. Finally, section 5 concludes with a brief discussion.

2. The Model

The model presented in this section is designed to analyse the long-term economic implications of demographic change in the UK. Below we describe the demographic structure of the model and outline the main features of the production, household and government sectors. The exogenous demographic process is superimposed on the model and provides the exogenous shock or driving force behind the simulations results.

2.1 Demographic Structure

The population is divided into 21 generations or age groups (i.e., 0-4, 5-9, 10-14, 15-19, …, 100-104). Demographic variables, fertility, mortality and net-migration rates are assumed to be exogenous.[4] This is a simplifying assumption given that such variables are likely endogenous and affected by, for example, changes in economic growth. Every cohort is described by two indices. The first is *t*, which denotes time. The second is *g*, which denotes a specific generation or age group.

The size of the cohort belonging to generation *g+k* in any period *t* is given by the following two laws of motion:

$$(1) \qquad Pop_{t,g+k} = \begin{cases} Pop_{t-1,g+k+5} fr_{t-1} & for \quad k = 0 \\ Pop_{t-1,g+k-1}\left(sr_{t-1,g+k-1} + mr_{t-1,g+k-1}\right) & for \quad k \in [1,20] \end{cases}$$

The first equation simply implies that the number of children born at time *t* (age group *g+k = g*, i.e. age group 0-4) is equal to the size of the first adult age group (*g+k+5=g+5*, i.e. age group 20-24) at time *t-1* multiplied by the "fertility rate", *fr*, in that period. If every couple has two children on average, the fertility rate is approximately equal to 1 and the size of the youngest generation *g* at time *t* is approximately equal to the size of the first adult generation *g+5* one year before. A period in the model corresponds to five years and a unit increment in the index *k* represents both the next period, *t+k,* and, for an individual, and a shift to the next age group, *g+k*.

The second law of motion gives the size at time *t* of any age group, *g+k,* beyond the first generation, as the size of this generation a year ago times the sum of the age specific conditional survival rate, *sr,* and the net migration rate, *mr,* at time *t-1.* In this model the fertility rates vary across time, while the survival and net migration rates vary across time and age. For the final generation (i.e., the age group 100-104 (*k*=20)), the conditional survival rate is zero. This means that everyone belonging to the oldest age group in any period dies with certainty at the end of the period.

[4] In fact we assume that there is a net excess demand for positive net migration in UK from foreigners. Hence the number of foreign immigrants in UK is somewhat under the control of the British government.

To account for the fact that both foreign- and native-born population can migrate, we disaggregate age-specific net migration rates by origin, i.e. there are separate net migration flows for natives (mostly negative) and foreigners (mostly positive). Aggregate net migration rates, *mr*, are a sum of native net migration rates, *nmr*, and foreign net migration rates, *fmr*. This is done to properly track native- and foreign-born population size. As will be discussed below, these two groups have many different characteristics in the model.

Time variable fertility and time/age-variable net migration and conditional survival rates are calibrated based on exogenous population projections. This permits a precise modelling of the demographic scenario of any configuration within the model. This feature of the model makes it ideal for studying the overall impact of demographic change on the economy.

2.2 Production

At any time *t*, a representative firm hires labour and rents physical capital to produce a single good using a Cobb-Douglas technology. The production function thus reads:

(2) $$Y_t = AK_t^{\alpha} L_t^{1-\alpha}$$

where Y denotes output, *K* is physical capital L denotes effective units of labour, *A* is a scaling factor and α represents the share of physical capital in output. The market in which the representative firm operates is assumed to be perfectly competitive. Factor demands thus follow from the solution to the recursive profit maximization problem:

(3) $$re_t = \alpha A \left(\frac{K_t}{L_t} \right)^{\alpha-1}$$

(4) $$w_t = (1-\alpha) A \left(\frac{K_t}{L_t} \right)^{\alpha}$$

where re and w denote, respectively, the rental rate of capital and the wage rate.

We assume that there are three types of labour that can be employed by the firm, which are indexed as *qual = 1, 2 and 3*. These types are defined in terms of skill-level/qualification:

"high-skilled workers" (*qual=1),* "medium-skilled workers" (*qual=2)* and "low-skilled workers" (*qual=3)*. Native and foreign-born workers of the same skill-level are perfect substitutes. A firm transforms its demand for total labour, *L,* into a skill-specific labour demand, L_{qual}, based on the following constant-elasticity-of-substitution (CES) function:

(5)
$$L_{qual,t} = \varsigma_{qual} \left(\frac{w_t}{w_{qual,t}} \right)^{\sigma^L} L_t$$

where w_{qual} denotes the wage rate for a specific qualification, ς_{qual} is the share of each qualification in total labour input and σ^L represents the elasticity of substitution between qualifications. The relationship between the composite wage rate of the firm's aggregate labour input, w, and the skill-specific market wages, w_{qual}, is given by:

(6)
$$w_t^{1-\sigma^L} = \sum_{qual} \varsigma_{qual} w_{qual,t}^{1-\sigma^L}$$

2.3 Household sector

The household sector in the model is disaggregated by age (21 generations), qualification (3 qualifications) and origin (native- or foreign-born). Household behaviour in every qualification/origin group is captured by 21 representative households that interact in an Allais-Samuelson overlapping generations structure representing each of the age groups. Individuals enter the labour market at the age of 20, retire at age 65, and die at the latest by age 104. Younger generations (i.e. 0-4, 5-9, 10-14 and 15-19) are fully dependent on their parents and play no active role in the model. However, they do influence the public expenditure. An exogenous age/time-variable survival rate determines life expectancy.

Adult generations (i.e. age groups 20-24, 25-29, …, 100-104) optimise their consumption-saving patterns over time. The household's optimization problem consists of choosing a profile of consumption over the life cycle that maximizes a CES type inter-temporal utility function, subject to the lifetime budget constraint. In particular, the inter-temporal preferences of an individual born at time *t* are given by:

(7) $$U_{qual,nat} = \frac{1}{1-\theta}\sum_{k=4}^{20}\left\{\left[\frac{1}{1+\rho}\right]^k \Pi_{m=0}^{k} sr_{t+m,g+m}\left((C_{qual,nat,t+k,g+k})^{1-\theta}\right)\right\} \qquad 0 < \theta < 1$$

where C denotes consumption, ρ is the pure rate of time preference and θ represents the inverse of the constant inter-temporal elasticity of substitution. Future consumption is also discounted at the unconditional survival rate, $\Pi_k sr_{t+k,g+k}$, which is the probability of survival up to the age *g+k* and period *t+k.* It is the product of the age/time-variable conditional survival rate, $sr_{t+k,g+k}$, between periods *t+k* and *t+k+1* and ages *g+k* and *g+k+1*.

The household is not altruistic, i.e. it does not leave intentional bequests to children. However, it leaves unintentional bequests due to unknown life duration. The unintentional bequests are distributed through a perfect annuity market, as described theoretically by Yaari (1965) and implemented in an OLG context by Boersch-Supan et al (2006).

Given the assumption of a perfect annuity market, the household's dynamic budget constraint takes the following form:

(8) $$HA_{qual,nat,t+1,g+1} = \frac{1}{sr_{t.g}} \times \left[Y^L_{qual,nat,t,g}\left(1-\tau^L_t - Ctr_t\right) + Pens_{t,g} + TRF_{nat,t,g} + \left(1+Ri_t\right)HA_{qual,nat,t,g} - C_{qual,nat,t,g}\right]$$

where *HA* is the level of household assets, *Ri* is the rate of return on physical assets, τ^K is the effective tax rate on capital, τ^L the effective tax rate on labour, *Ctr* is the contribution rate to the public pension system, Y^L is the labour income, *Pens* is the level of pension benefits and *TRF* is public transfers other than pensions. The intuition behind the term *1/sr* is that the assets of those who die during period *t* are distributed equally between their surviving peers. Therefore, if the survival rate at time *t* in age group *g* is less than one, then at time *t+1* everyone in their group has more assets. That is, they all receive an unintentional bequest through the perfect annuity market.

Labour income is defined as:

(9) $$Y^L_{qual,nat,t,g} = w_{qual,t} EP_{qual,nat,g} LS_{qual,nat,g}$$

where *LS* is the exogenously given supply of labour differentiated by qualification and origin. It is assumed that labour income depends on the individual's age-specific productivity. In turn, it is assumed that these age-specific productivity differences are captured in age-earnings profiles that are also disaggregated by qualification and origin. These productivity profiles are quadratic functions of age:

$$EP_{qual,nat,g} = \gamma_{qual,nat} + (\lambda_{qual,nat})g - (\psi_{qual,nat})g^2,\ \gamma,\ \lambda,\ \psi \geq 0 \tag{10}$$

with parametric values estimated from micro-data (as discussed in the calibration section). Differentiating the household utility function, subject to its lifetime budget constraint, with respect to consumption yields the following first-order condition for consumption, commonly known as Euler equation:

$$C_{qual,nat,t+1,g+1} = \left[\frac{[1 + Ri_{t+1}]}{(1+\rho\ )} \right]^{\frac{1}{\theta}} C_{qual,nat,t,g} \tag{11}$$

It is important to note that, since survival probabilities are present in both the utility function and the budget constraint, they cancel each other out and are not present in the Euler equation.

2.4 Modelling migration

As was described in the previous section, household sector is disaggregated by qualification (three categories) and origin (native-/foreign-born). Different categories of households have different optimisation problems, i.e. the native-born population and foreign-born populations have different optimal level of assets at every age and qualification level (natives have higher assets than foreigners in every age/qualification group).

We assume that new foreign-born migrants have the same level of assets as the representative foreign-born households in the same age/qualification group already living in the UK. Correspondingly, new native-born migrants own the same level of assets as the native-born population that stays within the country. Intuitively, this assumption might seem important. If immigrants enter the country with a positive (negative) asset position, they will add to (diminish) the level of the capital stock in the host country. Alternatively, if they come without assets, the level of labour productivity in the economy would decline due to capital dilution caused by a higher labour supply that is uncompensated by a higher capital stock. In practice, it plays very minor role because majority of migrants belong to young age groups that have low level of assets[5].

We also attempt to differentiate the native-born and foreign-born population along other dimensions. The two groups have different age-specific employment rates, age-productivity profiles and qualification distributions. They also have different probabilities of receiving transfers from the government. All of these parameters are estimated from the LFS which is discussed in more detail in the calibration section. Such detailed differentiation allows us to capture multidimensional influences of migration on the labour market, aggregate demand and public finances.

2.5 Investment and Asset Returns

Taking into account the discussion of migrant's assets in the previous section, the law of motion for the capital stock, *Kstock*, takes into account both depreciation and the net assets of newly arrived (left) migrants:

(12) $$Kstock_{t+1} = Inv_t + (1-\delta)Kstock_t + \sum_{qual}\sum_{g} HA_{qual,nat,t+1,g+1} NM_{qual,nat,t+1,g+1}$$

where *Inv* represents investment, δ is the depreciation rate of capital, and *NM* is the level of net-migration.

Capital markets are assumed to be fully integrated. This implies that financial capital is undifferentiated from physical capital, so that the interest rate parity holds:

(13) $$1 + Ri_t = re_t + (1-\delta)$$

where *Ri* and *re* denote the net and gross rates of return to physical capital, respectively.

[5] Chojnicki et al. (2011) comes to the same conclusion.

2.6 Government Sector

The Government's budget constraint reads:

(14)
$$\sum_{qual,nat,g} Pop_{qual,nat,t,g} \left\{ \left(\tau_t^L + Ctr_t\right)\left(w_{qual,t} EP_{qual,nat,t,g} LS_{qual,nat,t,g}\right) + \tau^C C_{qual,nat,t,g} \right\} + Def_t$$
$$= Gov_t + GovH_{t,g} + GovE_{t,g} + \sum_{qual,nat,g} Pop_{qual,nat,t,g} \left(TRF_{nat,t,g} + Pens_{t,g}\right) + Ri_t Debt_t$$

where τ^C is the effective tax rate on consumption, *Def* is fiscal deficit, *Debt* is level of public debt, Gov is age-independent public consumption, $GovH$ denotes government expenditure on health and $GovE$ denotes government expenditure on education. The left-hand side of the constraint contains the government revenues, grouping together all tax revenues from different sources and government borrowing. The right-hand side of the equation represents different categories of government expenditure including origin-dependent transfers to households, pension benefits and servicing of the public debt. Note that the pension program is a part of the overall government budget.

Public debt accumulates over time according to the following rule:

(15)
$$Debt_{t+1} = Debt_t + Def_t$$

Public expenditures on health and education are age-dependent. They are fixed per person of a specific age. More specifically, $ASHEPC_g$ is age-specific health expenditure per-person and $ASEEPC_g$ is age-specific education expenditure per-person. Therefore, total public expenditure in these categories depends not only on the size of the population but also on its age structure:

(16)
$$GovH_t = \sum_g Pop_{t,g} ASHEPC_{t,g}$$

(17)
$$GovE_t = \sum_g Pop_{t,g} ASEEPC_g$$

Other types of public expenditures per person, *GEPC,* are assumed to be age-invariant. They are fixed per-person and hence total expenditure, *Gov,* depends only on the size of the total population, *TPop*.

(18) $$Gov_t = \sum_g Pop_{t,g} GEPC$$

In the simulations presented in this paper we use the wage tax rate, τ_t^L, as the only endogenous policy variable that adjusts in every period to achieve a balanced government budget. The choice to focus on the wage tax rate as the main fiscal instrument is justified, among other reasons, by the fact that it does not generate efficiency distortions, given the absence of an endogenous labour-leisure decision.

2.7 Market and Aggregation Equilibrium Conditions

Perfect competition is assumed in all markets. The equilibrium condition in the goods market requires that the UK's output be equal to aggregate absorption, which is the sum of aggregate consumption, investment and government spending:

(19) $$Y_t = \sum_g Pop_{t,g} C_{t,g} + Inv_t + Gov_t + GovH_t + GovE_t$$

Labour market clearing requires that the demand for labour of a specific qualification level be equal to the supply of this qualification:

(20) $$L_{qual,t} = \sum_{nat,g} Pop_{qual,nat,t,g} LS_{qual,nat,g} EP_{qual,nat,g}$$

Similarly, the units of capital accumulated up to period *t* must equal the units of capital demanded by the representative firm in that period:

(21) $$Kstock_t = K_t$$

In the same vein, equilibrium in the financial market requires total stock of private wealth accumulated at the end of period *t* to be equal to the value of the total stock of capital and government debt accumulated at the end of period *t*:

(22)
$$\sum_{g} Pop_{qual,nat,t,g} HA_{qual,nat,t,g} = Kstock_t + Debt_t$$

3. Calibration

The model is calibrated using 2010 data for the UK where available. The data for the demographic baseline shock is taken from the 2010-based principal population projections produced by the Office for National Statistics (ONS). Population projections are used for calibration of the fertility, survival and net migration rates used in the model. They are calculated according to the formulae used in the model to replicate the demographic process (section 2.1). As mentioned above, net migration is disaggregated into native net migration and foreign net migration. For that we use the most recent data available from ONS on the long-term migration by origin. We assume that total future native net migration will be -75,000 a year. This is the average level over the last 7 years. The level of the total foreign net migration is calculated as the difference between the ONS total net migration assumption and the native net migration assumption, i.e. in the case of the principal scenario it is 275,000 per year. Age decomposition follows the data on broad age groups structure of net migration by citizenship from the International Passenger Survey (IPC). We also assume that foreign net migration above the age of 64 is equal to zero, which is confirmed by IPC data.

The data on public finances and GDP components are taken from the ONS and HM Treasury. The effective labour income and consumption tax rates are calculated from the corresponding government revenue categories and calibrated tax bases, namely total labour income and aggregate consumption. Data on total amount of pensions are taken from the Government Actuarial Department (GAD); other transfers are from the Department for Work and Pensions. Based on this information, the effective pension contribution rate and the average size of pension benefits can be obtained. The average pension per person is obtained by dividing the total amount of pension benefits by the total number of people of pension age. For simplicity, it is assumed that both males and females start receiving pension benefits at the age of 65.

The source of the labour market data is the Labour Force Survey (LFS). Three labour market characteristics are derived from the data: age-specific employment rates, the qualification distribution of the labour force and age-specific productivity profiles, all of them by qualification. The latter are estimated via the use of age-earning regressions of the Mincerian type (Mincer, 1958). The first two parameters were calculated from the twenty most recent waves of the LFS (Q2 2008- Q1 2013). Because many of the observations in the LFS lack earnings data, we had to increase the number of included waves to forty for the estimation of the productivity profiles (Q2 2003- Q1 2013).

The level of qualification is defined in terms of the age at which an individual had left full time education. This approach is common in the micro-econometric literature on immigration, because in the LFS foreign qualifications are grouped into the “other” category. High-skilled individuals are assumed to be those who left formal education at the age of 21 or later, medium-skilled people are those who left education in between the ages of 17 and 20 (inclusive) and, finally, low-skilled individuals are those who left education younger than 17 years old or who report to have no qualifications.[6].

All the labour market measures are disaggregated by the origin, namely native- or foreign-born. As an illustration of the heterogeneity in the qualification distribution and labour market outcomes across foreigners and natives, Table 1 summarises the percentage share of individuals in each qualification category and their respective employment rates.

[6] For the treatment of those observations who are still in education, we make use of their reported level of qualification. First, those who report being still in education and at the same time have a level of qualification equivalent to NVQ Level 4 and above are grouped into the high qualification category. Second, those who also report currently being in education but have attained a level of education of either NVQ Level 3 or NVQ Level 2, or they have completed a trade apprenticeship, are considered to be medium-qualified. Finally, those individuals still in education who report having no qualifications or a qualification level below NVQ Level 2 are considered to be low qualified. Those who are still in education but report to have "other qualifications" are the ones who are left out from this skill classification, since without further information, any assignment to some of the three qualification groups would be arbitrary.

Table 1. Labour market descriptive statistics

	Native-born	Foreign-born
Employment rate[1]	75%	69%
High qualification	20%	41%
Medium qualification	30%	36%
Low-qualification	50%	23%

Source: LFS, Q2:2008-Q1:2013

1 Here defined as the number of people employed in each origin group divided by the working age population in the same group.

As apparent from these data, the skill composition of the foreign-born work force is in sharp contrast with that of natives; the majority of them belong to the two highest qualification groups, whereas the distribution for natives is skewed towards low-skilled individuals. The employment rate is, however, higher among natives than among foreigners.

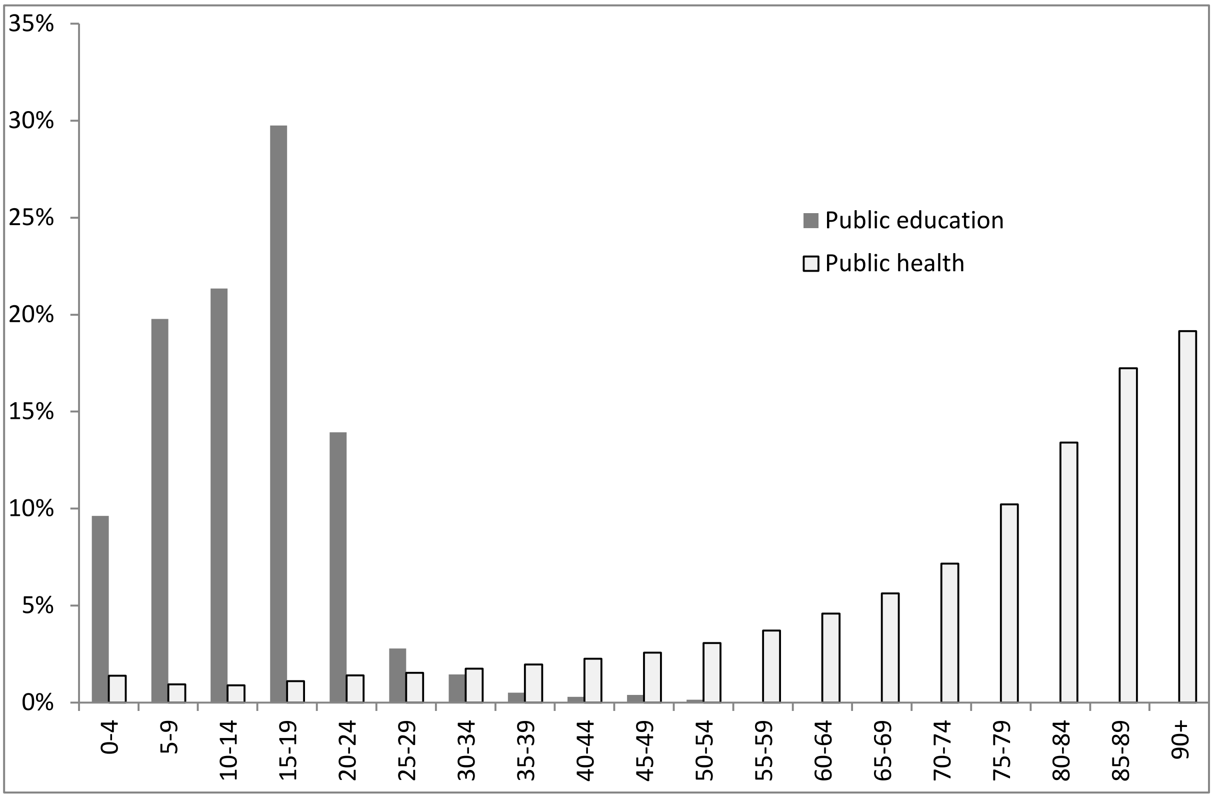
We also observe that immigrants tend to have lower age-earnings profiles for all qualification levels. This confirms the well-known discrepancy in wages between natives and foreigners at the same skill level.

Finally, the data from the LFS are also employed in the estimation of the difference in the likelihood of claiming state benefits between foreigners and natives. For calculation of this parameter, we also used the last twenty waves of the LFS (Q2 2008- Q1 2013). We find that the foreigners in our sample have a 4.5% lower probability of claiming benefits compared to natives[7].

The estimates of the age structure of government spending on health and education are taken from the UK National Transfer Accounts for 2007 constructed by McCarthy and Sefton (2010). Figure 2 shows the age profiles of public spending on health and education in the UK in 2007. For each category numbers add up to 100%. The majority of education spending occurs between the ages 5-9 and 20-24. Health spending grows slowly until the age of 55-59 when it starts increasing much faster and accelerates after age 75-79.

[7] We use the same simple probit regression model with year dummies as in Dustmann et al (2010)

Figure 2. Age Distribution of Health and Education Expenditure per Person, UK, 2007



The capital income share of output (α) is set to 0.3. The (5-year) inter-temporal elasticity of substitution ($1/\theta$) is set to 1.25 and (5-year) interest rate to 10.4% (2% a year).

The calibration procedure is a sequence of four steps. In the *first step*, available labour market data on the distribution of workers' skills is used to calibrate the composition of the population accordingly, such that labour demand equals labour supply for each skill or qualification level.

The *second step* consists of using the information on output, capital and labour demands and the first-order conditions of the firms' optimisation problem to calibrate the scaling parameter in the production function, the wage rate and the capital rental rate.

The *third step* is the most challenging one since it involves equations describing the household's optimisation problem, the equilibrium conditions in the assets and goods markets and the government budget constraint. In particular, the (5-year) rate of time preference is solved endogenously during the calibration procedure in order to generate plausible consumption and capital ownership profiles for each age group, for which no data are easily available. Capital ownership profiles must also satisfy the equilibrium condition on the asset market. Finally, age-independent public expenditure is endogenously determined to close the budget constraint of the government and to ensure the equilibrium on the goods market. Note that the rate of time preference and the inter-temporal elasticity of substitution together determine the slope of the consumption profiles across the age groups in the calibration stage of the model (when the population is assumed to be constant). This slope coincides with the one for the lifetime consumption profile of an individual in the simulation with neither demographic shocks nor economic growth.

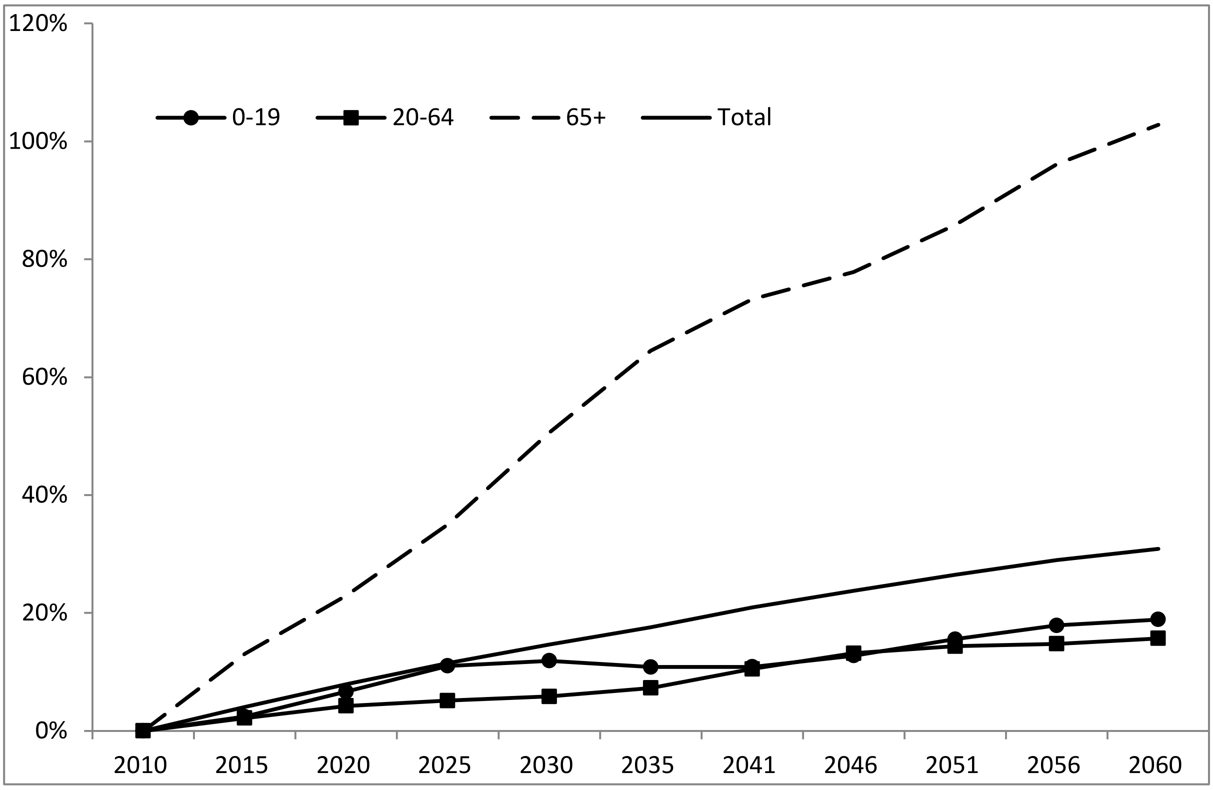
The *fourth and final step* uses the calibration results of the first three steps to verify that the model is able to replicate the observed data corresponding to the initial equilibrium. Only when the initial equilibrium is perfectly replicated by the calibration solution can the model be used to evaluate the consequences exogenous shocks.

4. Simulations and Results

To construct the baseline scenario, we use the 2010-based ONS principal population projections[8]. Figure 3 shows these projections for different age groups over the next five decades. The fastest predicted growth is for the age group 65+ – by the end of the projection horizon, it is expected to increase by over 100% when compared to 2010 figures. The number of children (0-19) and working age adults (20-64) are also expected to rise, but at a much slower pace–there will be 19% and 16% more people in these age groups respectively compared to 2010. Total population is predicted to increase by 31 %.

[8] 2010-based population projections were selected because they are the last vintage of projections available before the change in migration policy. In the latest 2012-based projections ONS took into account and adjusted principal long-term migration assumption from 200,000 to 160,000 per year.

Figure 3. Projected Change in UK Population by Age Groups, 2010-2060



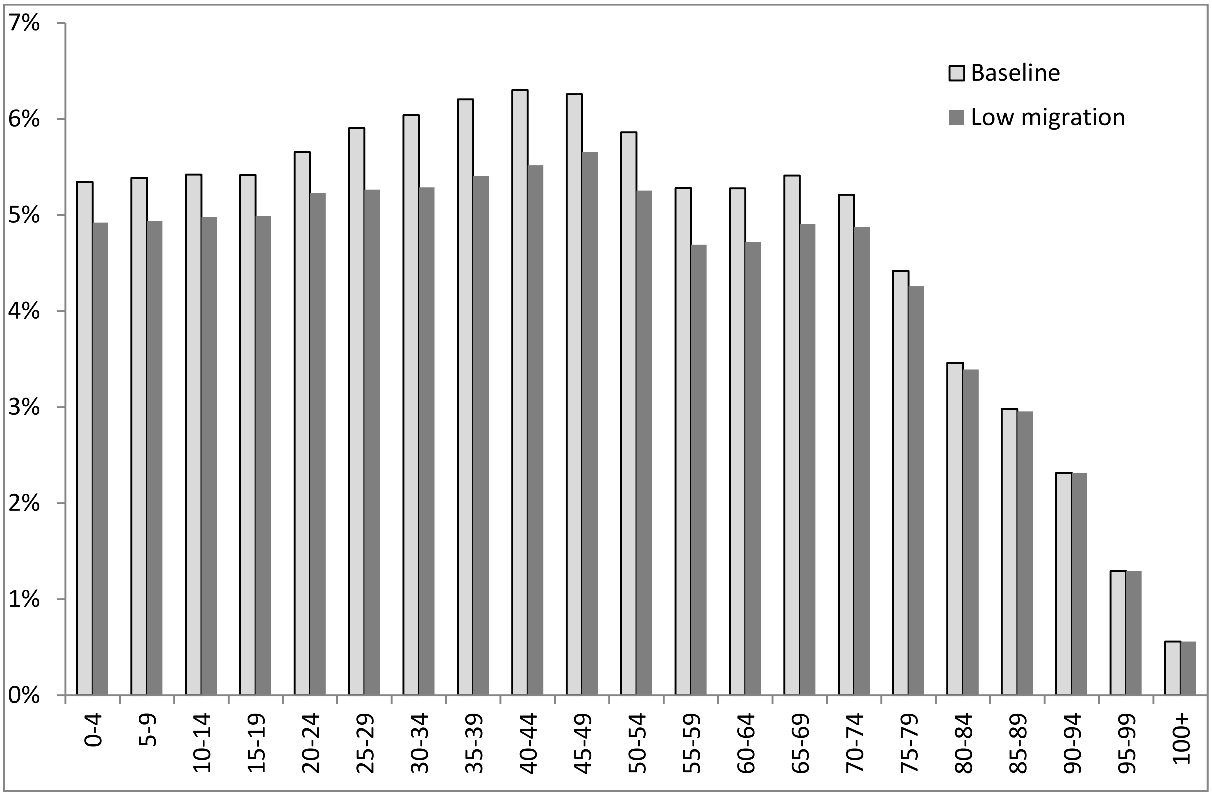
Source: 2010-based principal ONS population projection

To illustrate the effects of immigration on the economy, we make use of a thought experiment that reflects the UK Conservative Party migration policy target: to reduce net migration "from hundreds of thousands to tens of thousands". As noted before, the principal scenario of the ONS population projections assumes a long-term net migration inflow of 200,000 per year on average. This means that net migration has to decrease by at least a factor of 2 to achieve the stated target. We also assume that this policy does not affect the native net migration level and only influences foreign net migration. For simplicity, we model this lower migration scenario by reducing foreign net migration rates in all age groups in the same proportion. This simplifying assumption allows a quick illustration of the overall effects of this migration policy. To achieve the desired lower level of net migration foreign net migration rates have to be reduced by a factor of 1.53[9].

[9] It is not equal to 2 because native net migration is not affected and reducing rates is not equivalent to reducing numbers. This reduction in foreign net migration rates allows achieving desired reduction in net migration numbers.

Figure 4 shows age structure of the UK population in 2060 according to the two scenarios. All bars add up to 100% for the baseline scenario. This means that for the low migration scenario we can see the change in both population size and structure. In the low migration scenario total population is 8.5% smaller than in the baseline scenario. Most of the reduction is concentrated in the working age groups, while effect on retired population is minimal. This is because migrants tend to be younger than native population.

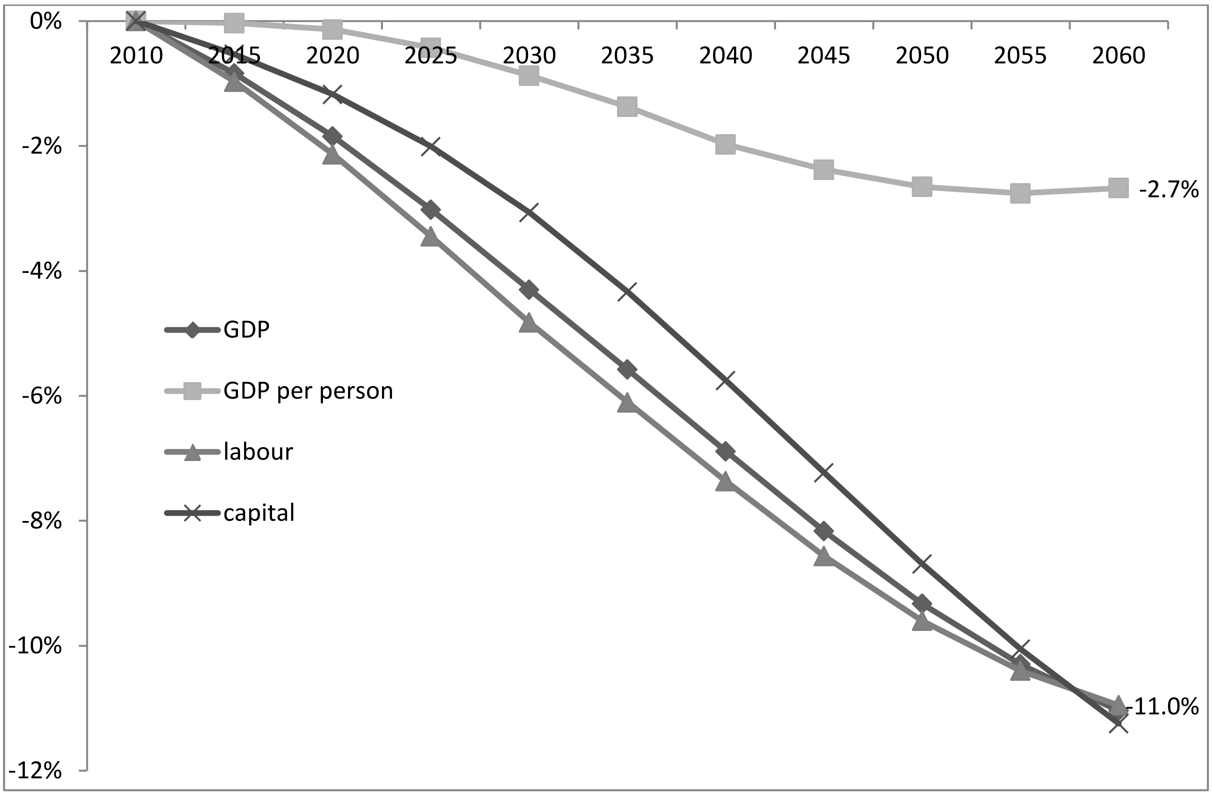
Figure 4. Population age structure in 2060



Source: simulation results

The results presented in the following figures show the percentage difference between the lower migration scenario and the baseline scenario unless otherwise specified. Figure 5 depicts the difference in factors of production and in GDP between the two scenarios. In the low migration scenario by 2060, the productivity adjusted level of labour supply (i.e., taking into account age-specific employment rates, age-productivity profiles and qualification distribution) is about 11% lower than in the baseline scenario. The same is true regarding the level of GDP and the capital stock. GDP per person falls to a much lower extent as lower net migration leads to a general decrease in population. Nevertheless, GDP per person is 2.7% lower in the low migration scenario.

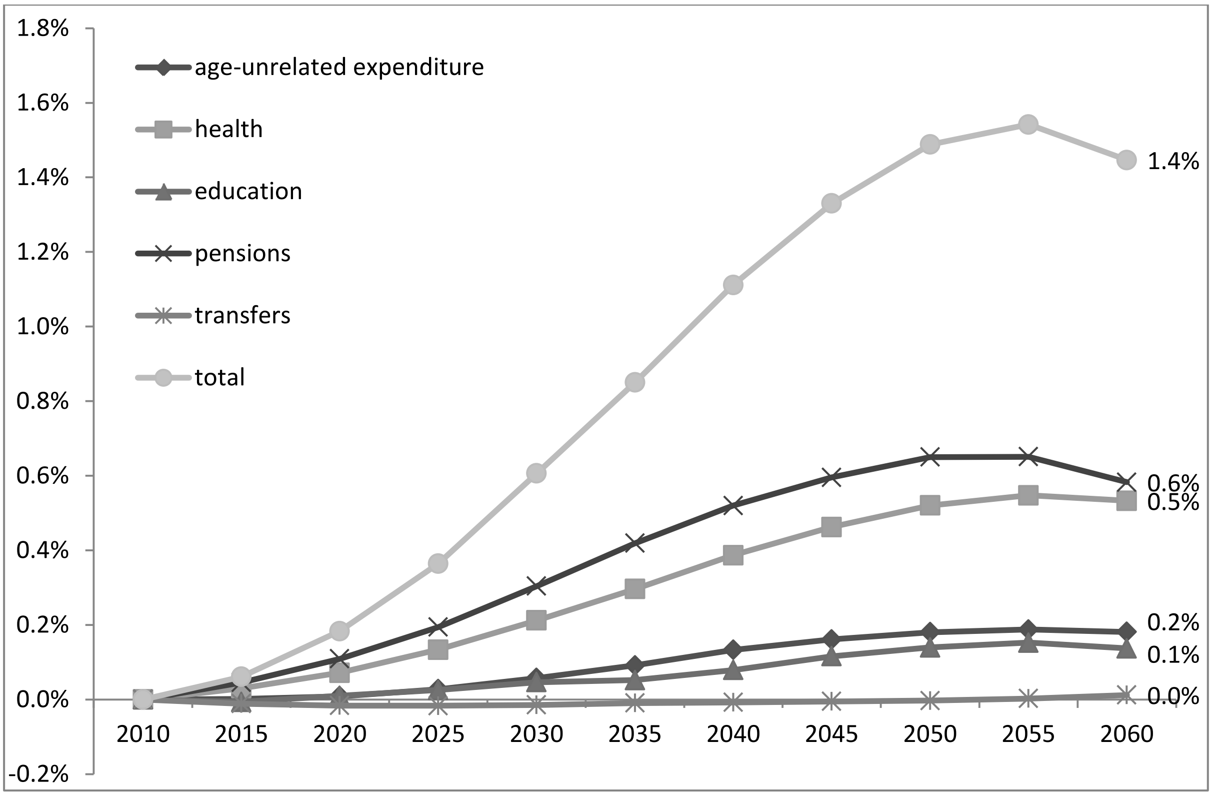
Figure 5. GDP and factors of production



Source: simulation results

Given our assumption that different categories of government expenditures depend on the size of the relevant population groups, government spending is lower in the low migration scenario relative to the baseline scenario because there are less people. However, if expressed as a share of GDP, government expenditures are increasing. Figure 6 shows trajectories of change for different categories of government spending as a percentage points difference between the two scenarios. The categories that are most affected are pensions and health expenditures. This is due to the fact that both of these categories of spending are concentrated in the older age groups and immigrants being generally younger than native population help to alleviate this burden. The total level of government spending is about 1.4 percentage points of GDP higher in the low migration scenario by 2060.

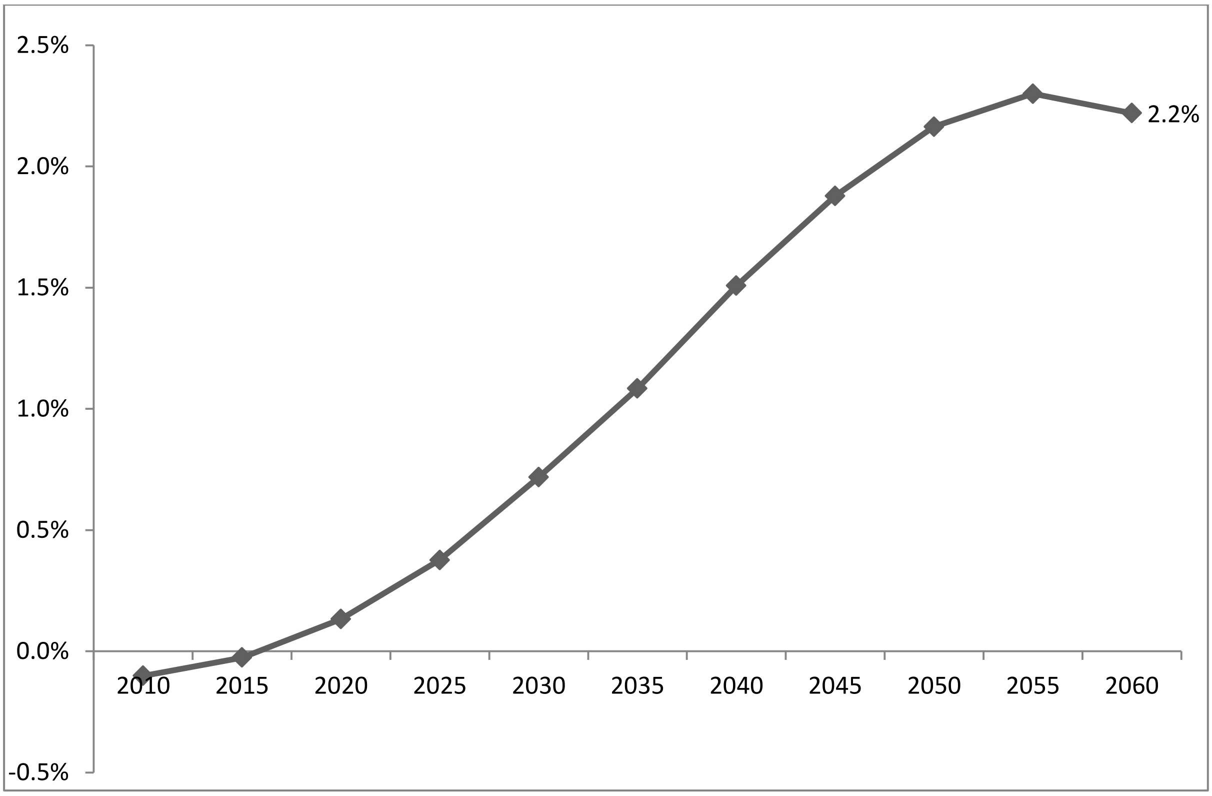
Figure 6. Government spending as a share of GDP, percentage points



Source: simulation results

Because of the additional strain that faster ageing population puts on government finances in the low migration scenario, the effective labour income tax rate required to keep the government's budget balanced is higher in this scenario (see Figure 7). Given the assumption of fixed total debt, fixed consumption tax rate and fixed pension contribution rates throughout the simulations, the only fiscal instrument that can adjust to achieve a balanced budget in every period is the effective labour income tax rate. The reason for that is the relative size of total government expenditure and revenue. On the revenue side, the labour income tax base suffers significant erosion after the change in migration policy. Aggregate consumption is also reduced in the low migration scenario, which results in relatively weaker consumption tax revenues. At the same time, government expenditures on, for example, health and pensions, decrease significantly less than revenues. Thus, the effective labour income tax rate needs to be higher with lower migration in order to compensate for the increase in the old-age dependency ratio.

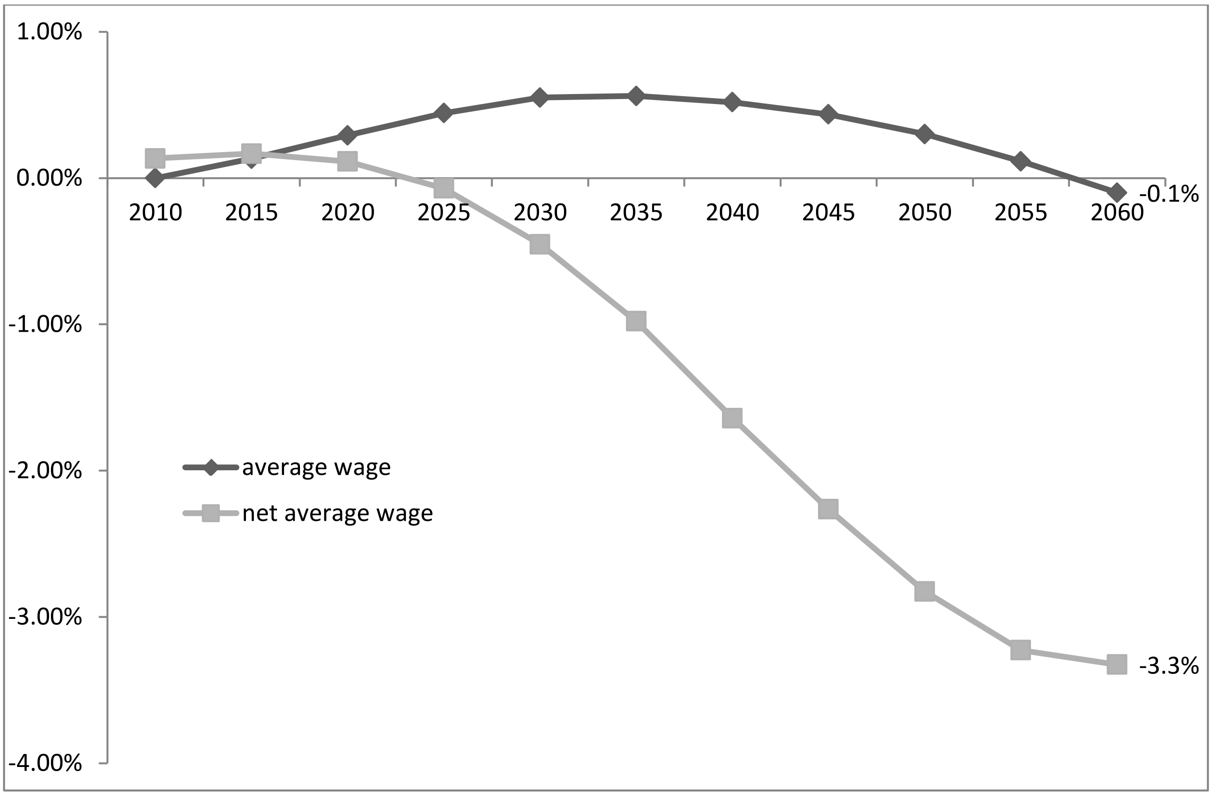
Figure 7. Effective labour income tax rate



Source: simulation results

Figure 8 depicts the path followed by the average wage index as well as the net average wage. The equilibrium gross wage composite becomes slightly higher after the lower migration shock, due to the reduction in overall labour supply, which leads to higher capital labour ratio. On the other hand, the evolution of net wage captures the difference over time between gross wage and total labour income tax payments. As is apparent, the increase in the effective labour income tax rate offsets the initial increase in the gross wage once the migration shock takes place, thereby causing a reduction in the net wage and hence a reduction in the households' disposable income.

Figure 8. Wage and net wage



Source: simulation results

4.1 Decomposition of the effects

The results presented above show the effects of reduced migration, taking into account all of the differences between the native- and foreign-born population that we have identified from the data. However, different labour market characteristics have different importance. In this section we provide a decomposition of the aggregate effects presented in the previous section. Table 2 summarises differences in GDP per person and the effective labour income tax rate that arise if we vary only one labour market parameter at a time. It also includes the case if foreigners are identical to the native-born population in their labour market characteristics (but not in age structure). As before, in each case we are comparing two scenarios – one with a baseline level of net migration, and one with a lower net migration. In the case of GDP per person, the results are a percentage difference between the two scenarios. In the case of the effective labour income tax rate, it is a percentage points difference.

Table 2. Effects for different labour market characteristics in 2060.

	GDP per person	Effective labour income tax rate
Foreigners are like natives	-2.8%	2.4%
Different productivity	-2.2%	2.1%
Different employment rates	-1.8%	1.8%
Different qualification distribution	-4.1%	2.9%
All characteristics are different (baseline scenario)	-2.7%	2.2%

Source: simulation results

Because foreign-born individuals have lower earnings, which as we assume reflect their lower productivity, and lower employment rates than native-born population, changing only these two characteristics diminishes the negative effect from lower migration compared with the scenario in which foreigners and natives share the same labour market characteristics. However, foreigners are more educated and thus changing only their qualification distribution significantly increases the negative effect of reduced migration. Combining all three labour market characteristics (baseline scenario) results in the overall effect which is lower than in the case if foreign-born possess the same labour market characteristics as native-born, but not by very much. Thus, higher qualification of foreigners almost compensates their lower productivity (proxied by lower wages) and lower employment rates.

4.2 Sensitivity to quality of migrants

As the previous section showed, overall results depend not only on a reduction in the number of foreign-born migrants but also on their "quality", as described by their labour market characteristics. Here we would like to investigate this further by concentrating on one group of recent migrants with very distinctive characteristics. These are migrants from the so called A8 countries. Table 3 summarises how different this group is from an "average" migrant.

Table 3. Labour market characteristics of all immigrants and of A8 migrants

	All foreign-born	A8-born
Employment rate	70%	85%
High qualification	41%	37%
Medium qualification	36%	53%
Low qualification	23%	10%

Source: LFS, Q2:2008-Q1:2013

This group of migrants has substantially higher employment rates in all age groups, and a higher proportion of medium qualified workers than all foreign-born population on average. In addition to this, they are 13% less likely to claim government benefits compared with the native-born population, while for the foreign-born population as a whole this probability is only 4.5% lower. We could not calculate age-specific earnings profiles by qualification for A8 migrants because of insufficient number of observations containing earnings data. We use for them the same age-earnings profiles as for all migrants.

Table 4 compares results from the main simulations with the hypothetical scenario of all future foreign-born migrants having the same labour market characteristics as recent A8 migrants. As in the decomposition exercise, age structure and the size of the net migration flows is the same as in main simulations. The results are a percentage difference between the two scenarios in the case of GDP per person and a percentage points difference in the case of the effective labour income tax rate.

Table 4. Difference between scenarios with A8 migrants and average migrants

	GDP per person	Effective labour income tax rate
A8 migrants	-3.4%	2.5%
All migrants (baseline scenario)	-2.4%	-2.1%

Source: simulation results

In the case of all future foreign-born migrants having the same labour market characteristics as A8 migrants that came into the UK recently, the negative effect of reduced migration is stronger by about 14-40% (depending on macro variable).

5. Conclusions

In this paper we employed an OLG-CGE model for the UK to illustrate the long-term effects of migration on the economy. As an illustration, we used the recent UK Conservative Party migration target to reduce net migration "from hundreds of thousands to tens of thousands". Achieving this target would translate into a reduction in recent net migration numbers by a factor of 2. In our analysis, we compare the impact of such a migration policy with a baseline scenario which is built in line with the 2010-based principal ONS population projection.

A number of results arise when conducting this policy experiment. First, we find that the significant reduction in net migration has strong negative effects on the economy. By 2060 in the low migration scenario aggregate GDP decreases by 11% and GDP per person by 2.7% compared to the baseline scenario. Second, this policy has a significant negative impact on the public finances, owing to the shift in the demographic structure after the shock. The total level of government spending expressed as a share of GDP increases by 1.4 percentage points by 2060. This effect requires an increase in the effective labour income tax rate for the government to balance its budget in every period. By 2060 the required increase is 2.2 percentage points. Third, the effect of the higher labour income tax rate is felt at the household level, with average households' net income worsening with lower migration because of the higher income tax despite the initial increase in gross wages due to lower labour supply. By 2060 net wage is 3.3% lower in the low migration scenario.

As with any modelling exercise there are a number of caveats. From a purely technical point of view, our estimates arguably provide a lower bound of the potential effects. First, we chose the least strict interpretation of the migration target. "Tens of thousands" is not very precise but we decided that a level just below 100 thousand is sufficient to satisfy it. Second, the model does not take into account potential positive productivity effects from higher levels of immigration. Two potential positive productivity effects that attracted more attention recently are potential effects on total factor productivity growth (e.g., Rolf et al, 2013) and imperfect substitution between natives and immigrants (Manacorda et al, 2012). Third, we are using a closed economy model for these simulations, which in the case of the low migration scenario results in lower capital-labour ratio and lower returns on capital. If we used an open economy with perfect capital mobility, downward pressure on interest rates would lead to capital outflow and even stronger negative effects of reduced migration. Fourth, while we take into account the direct impact of migration on population and hence public expenditure, including capital spending, we do not capture negative externalities resulting from congestion. Finally, of course, these simulations necessarily do not take into account the potential social impacts of higher immigration. This is a hotly debated area, which is beyond the scope of our study, but should be considered when formulating migration policy.

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