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Abstract

Immigration policies are generally protectionist, yet positive immigration quotas often exist for workers in specific occupations where the native labor supply is scarce. This paper determines occupation-specific immigration quotas in a political economy framework with endogenous prices and compares them to the social optimum. It shows that positive quotas for specific occupations can be the political outcome, even when total welfare effects of immigration are negative. Two of the main findings are that the (unique) voting outcome on immigration quotas is i) positive, if workers are immobile across occupations, and ii) negative (positive) for occupations where the native labor supply is sufficiently large (small), if workers are mobile across occupations.

Key words: immigration, occupational mobility, majority voting, welfare.

JEL codes: F22, D72, J31.

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1 Introduction

Immigration policy is one of the pressing issues in countries that face large and growing numbers of immigrants, and it is just as controversial. While immigration in general is typically opposed among the native population[1], immigration is often promoted in specific occupations (nursing, agricultural or construction work, for example) where domestic labor supply is scarce (see, for example, the special issue of the OECD International Migration Outlook (2006) on immigration quotas). In Europe, it is a standard procedure to subject potential immigrants to an employment test, where an employer needs to declare his need of the immigrant for a job that cannot be filled by any resident qualified candidate. In the United Kingdom, a labor shortage list facilitates immigration in specific occupations such as hotels and catering or food manufacturing (Institute for Employment Studies (2006)). In Australia, potential immigrants in required occupations receive extra points in the immigrant selection process (Miller (1999)). Overall, the number of immigrants of a particular occupation admitted clearly is a function of labor market needs.

In this paper, I take a new modeling approach to determine quotas on occupation-specific immigration in general equilibrium, which allows me to derive not only wage effects but also price effects of immigration. Current policies suggest that price effects are important: in a situation of high labor demand, an increase of labor supply via immigration can contribute to a decrease in prices. The empirical relevance of such effects has been documented in Cortes (2008) for the U.S., Frattini (2008) for the U.K. and Zachariadis (2012) for a panel of countries across the world during 1990 to 2006. Using a stylized specific-factors model, Felbermayr and Kohler (2007) find that price effects play a quantitatively important role and can even overturn welfare results of immigration derived without the explicit consideration of prices. Arguably, any immigration policy that aims at increasing native welfare has to consider both effects, as it is real wages, not nominal ones, which determine the overall welfare impact of immigration on natives. This paper is the first to the best of my knowledge to determine immigration policy in a political economy framework where goods prices are endogenous.

In this setting, it is of interest to distinguish between three groups of natives, the young - working in one of two occupations - and the retired. Intuitively, one would expect that the retired have a stronger preference for migration than workers, since they do not experience potentially negative wage effects but benefit from the positive price effects. Furthermore, one would expect that the retired have a weaker preference for migration to be specific to one or the other occupation in the economy compared to workers, whose wages are directly affected by the occupation-specific structure of the migration flow. I show that the retired support positive - albeit smaller - immigration into both occupations, while workers oppose immigration into 'their' occupation.

Using majority voting as a simple mechanism for aggregating preferences, I find that positive quotas for specific occupations can be a political economy outcome, even though wage effects of immigration are negative. The number of immigrants supported in political equilibrium depends on the size of the native

[1] According to the International Social Survey Programme (ISSP) or the World Value Survey (WVS).

labor supply in the respective occupation: it is greater the smaller the native labor supply, and vice versa. Furthermore, I find that the degree of mobility of native workers across occupations is important for the political outcome. Interestingly, if workers can change from one occupation to another as a response to a change in wage differentials due to immigration, then their preferred amount of immigration is smaller. This is because, via crowding-out, they now experience a negative wage effect not only from immigration into their own occupation but also from immigration into the other occupation. In consequence, immigration quotas can be zero in the case of endogenous occupation choice. However, I find that if (depending on parameter values) the negative wage effect is sufficiently small, then immigration quotas are positive and the same as in the case of fixed occupation choice.

I also compare the welfare effects of immigration in the two regimes of fixed and endogenous occupation choice of natives. In particular, one might expect that occupation-specific immigration is a substitute, in terms of social welfare, for native mobility across occupations. This expectation is inherent in a number of recent policy proposals that suggest enhancing the mobility of native workers as an alternative to immigration when dealing with labor supply shortages.[2] I show that the relative welfare effect of immigration with and without native mobility depends on the relative occupational labor supply. I then identify conditions under which the substitutability result does, and does not, hold.

The paper contributes to the growing political economy literature on immigration policy according to which immigration policy emerges as a result of different effects of immigrants on natives. In the existing literature, such effects typically stem from the factor endowment of immigrants as compared to natives. In this vein, Benhabib (1996) and Facchini and Willmann (2005) derive policies that select immigrants by the complementarity of their factors (capital, skilled or unskilled labor) in a majority vote and a game among agencies, respectively, in order to maximize natives' income. Hillman and Weiss (1999) determine conditions for a majority support of illegal immigration according to factor complementarity. All of these studies identify various interests for or against immigration of a particular type but not the actual size of the optimal inflow. Dolmas and Huffman (2004) and Ortega (2005) can determine the size of immigration quotas by considering the effect of future immigrant voting on native utility.

This paper, in comparison, takes on a new approach and derives the size of immigration quotas in political equilibrium as a consequence of domestic labor market needs. This contribution is particularly policy-relevant, as labor shortages in specific occupations seem to be a central feature in current immigration policies and, in view of the ongoing population aging in developed countries, are likely to become even more prominent in the future. It is therefore important to analyze the determinants and welfare effects of such policies, and the role of specific features of the domestic labor market such as the share of current and retired workers as well as the inter-occupational mobility of workers.

Apart from the political economy literature, this paper also relates to the literature on the welfare effects of immigration that takes policy as given. Felbermayr and Kohler (2007) derive sufficient conditions

[2] See Zimmermann et al. (2007), p.73., who suggest financial incentives such as tax exemptions for relocation or commuting costs as a way to increase inter-occupational native mobility.

for a positive welfare effect of immigration in a general model with production complementarities and endogenous goods price adjustment. Similar to this paper, they take a unified look at two important effects of immigration that have been treated separately in the literature before, namely wage effects, which have been subject to extensive analysis in, for example, Borjas (1999), Card (2001), Borjas, Grogger and Hanson (2012) and Ottaviano and Peri (2012), and price effects via the terms of trade as highlighted, for example, in Davis and Weinstein (2002). In contrast to their paper, however, I assume that natives and migrants are homogeneous within occupations, since I am interested in selective immigration policies targeted at specific occupations. Furthermore, none of these papers endogenizes immigration policy, even though they recognize the policy relevance of the analyzed effects. Similar to all these papers, I abstract from potential welfare state effects of immigration, since the aim of the present analysis is to determine immigration policy driven by labor demand.

The key mechanisms of this paper are consistent with existing empirical evidence on the role played by various population groups in shaping immigration policy. For example, Facchini and Mayda (2008) find that lobbying of workers leads to a reduction of immigration in the same occupations and an increase of immigration in different occupations in the U.S.[3] Similarly, Facchini, Mayda and Mishra (2011) find that worker (business) interest groups shape immigration policy across sectors in the U.S. towards becoming more (less) restrictive. Correspondingly, in this paper, natives oppose immigration in their own occupation due to negative wage effects, while as consumers they favor immigration due to positive price effects.

The paper proceeds as follows. Section 2 describes the model and derives prices and wages in general equilibrium. Section 3 determines the majority voting outcome on occupation-specific immigration, first for the case where natives workers are immobile and then for the case where they are mobile across occupations. Section 4 presents a social welfare analysis of occupation-specific immigration that can be used as a benchmark to be compared with the majority voting outcomes. Section 5 provides a calibration of the model with realistic parameter values to highlight the relative quantitative importance of parameters (e.g., spending shares), to illustrate the various possible outcomes of majority voting and to contrast them with the social optimum. Section 6 concludes.

2 The model

Consider a two-country, two-period economy where each individual lives for two periods, young and retired age. At any time period, one generation of young coexists with one generation of the retired. At the beginning of the next period, the retired die off, the young retire themselves and a new generation of young is born.

Each young agent is endowed with one unit of inelastically supplied labor. Labor is perfectly substitutable within occupations. The total native labor endowments of countries I and II are $\mathrm{N} > 0$ and $\mathrm{M} > 0$,

[3] They, however, contribute these effects to the substitutability and complementarity between workers, respectively.

respectively, and constant over time.[4] Immigration policy in country I can lead to a shift of some of the labor endowment of country II to country I as described in more detail below.[5]

2.1 Production

In country I, there are two different occupations. The output of occupation A (X_A) is non-tradable and hence can be consumed only in country I. The output of occupation B (X_B) is tradable and hence can be consumed in both countries. In country II, there is only one occupation whose output (X_C) is tradable.[6][7] The production in each occupation is subject to a constant-returns-to-scale technology:

$$X_i = L_i^{\gamma_i} K_i^{1-\gamma_i}, \quad \gamma_i \in (0,1), \quad i \in \{A, B, C\}, \tag{1}$$

where L_i and K_i denote labor and capital input used by occupation i, respectively. Each occupation is under perfect competition: the unit price of a production factor is equal to the value of its marginal product. Therefore, the occupational wages are

$$w_i \equiv p_i \partial X_i / \partial L_i = p_i \gamma_i \left(\frac{K_i}{L_i} \right)^{1-\gamma_i}, \tag{2}$$

where p_i is the unit price of the output by occupation i. I assume that capital is perfectly mobile across occupations such that there is only one interest rate that is equal to the value of the marginal product of capital in every occupation, i.e., $\forall i$,

$$r \equiv p_i \partial X_i / \partial K_i = p_i (1-\gamma_i) \left(\frac{L_i}{K_i} \right)^{\gamma_i}. \tag{3}$$

Note that, even though the interest rate is constant, wages are not necessarily constant as well, because goods prices are not given but determined in equilibrium (see below).

2.2 Consumption

Each agent in country I has the following inter-temporal utility function:

$$u_{\mathrm{I}} \left(\mathbf{x}\left(1\right) \right) + \frac{1}{1+\delta} u_{\mathrm{I}} \left(\mathbf{x}\left(2\right) \right), \tag{4}$$

[4] The set-up of a dynamic model that would allow to consider population growth over time could be an interesting avenue for further research.

[5] Immigrants can retire in the host country or return to their home country after retirement. This does not affect results, as shown below.

[6] Results would not change, if non-tradables were also produced in country II.

[7] This production structure is chosen because it allows to analyze inter-sectoral mobility of natives in country I (introduced later) and to focus on the effects of occupational labor supply shortages.

where $\delta \geq 0$ is the common rate of discounting future consumption, adjusted for some probability of dying at the end of the first period m that is common, constant over time and known to all agents.[8] [9] $\mathbf{x}(1) = (x_A(1), x_B(1), x_C(1))$ is the first-period consumption bundle; and $\mathbf{x}(2) = (x_A(2), x_B(2), x_C(2))$ is the second-period consumption bundle. It implies that utility is invariant and additive over time. We assume $\partial u_{\mathrm{I}}/\partial x_i > 0$ and $\partial^2 u_{\mathrm{I}}/\partial^2 x_i < 0$. More specifically,

$$u_{\mathrm{I}}(\mathbf{x}) \equiv \alpha \ln x_A + \beta \ln x_B + (1-\alpha-\beta)\ln x_C, \quad \alpha, \beta, \alpha+\beta \in (0,1). \tag{5}$$

The objective of the agent is to maximize the utility function subject to $\mathbf{p}(1)\cdot\mathbf{x}(1) \leq w + b - s$ and $\mathbf{p}(2)\cdot\mathbf{x}(2) \leq (1+r)s$, where b is the per capita amount inherited from the agents who died at the end of their working life (see below) and s is savings. Due to non-satiating utility, the combined budget constraint is $\mathbf{p}(1)\cdot\mathbf{x}(1) + \mathbf{p}(2)\cdot\mathbf{x}(2)/(1+r) = w + b$. The wage w equals either w_A or w_B depending on occupational job preferences of natives (see below).
The interest rate to the first-period savings is paid in the very beginning of the second period. The first-period savings are used as capital input in the first period, and the interest rate is determined via equation (3) in the same period.

For each agent in country II, we replace u_{I} in (4) by

$$u_{\mathrm{II}}(\mathbf{x}) \equiv \theta \ln x_B + (1-\theta)\ln x_C, \quad \theta \in (0,1), \tag{6}$$

because the output of occupation A in country I is not tradable.

Accordingly, we obtain the following demand functions:

$$\begin{array}{ll}
x_A^i(1) = c\alpha \frac{w_i(1)+b_i(1)}{p_A(1)}, & x_A^i(2) = (1-c)\,\alpha \frac{w_i(1)+b_i(1)}{p_A(2)}\,(1+r(1)), \\
x_B^i(1) = c\beta \frac{w_i(1)+b_i(1)}{p_B(1)}, & x_B^i(2) = (1-c)\,\beta \frac{w_i(1)+b_i(1)}{p_B(2)}\,(1+r(1)), \\
x_C^i(1) = c(1-\alpha-\beta)\,\frac{w_i(1)+b_i(1)}{p_C(1)}, & x_C^i(2) = (1-c)(1-\alpha-\beta)\,\frac{w_i(1)+b_i(1)}{p_C(2)}\,(1+r(1)), \quad i \in \{A,B\},
\end{array}$$

$$\begin{array}{ll}
x_B^C(1) = c\theta \frac{w_C(1)+b_C(1)}{p_B(1)}, & x_B^C(2) = (1-c)\,\theta \frac{w_C(1)+b_C(1)}{p_B(2)}\,(1+r(1)), \\
x_C^C(1) = c(1-\theta)\,\frac{w_C(1)+b_C(1)}{p_C(1)}, & x_C^C(2) = (1-c)(1-\theta)\frac{w_C(1)+b_C(1)}{p_C(2)}\,(1+r(1)),
\end{array}$$

where $c \equiv (1+\delta)/(2+\delta)$ and the superscript indicates the employment occupation, e.g., $x_A^B(1)$ is the first-period demand for the output of occupation A by an agent who is employed in occupation B. Assuming that the savings of agents who died are distributed equally between agents of the next generation in each country, we have $b_A(1) = b_B(1) = (1-c)m(w_A(0)L_A(0) + w_B(0)L_B(0))/(L_A(1)+L_B(1))$ and $b_C(1) = (1-c)m w_C(0)L_C(0)/L_C(1)$, where $L_i, i \in \{A,B,C\}$ is labor supply in each occupation i as

[8] I introduce this probability of dying, which can be small, to avoid the uninteresting case where the population size of young and retired voters is the same (due to the abstraction from population growth) and the retired thus cannot not be outvoted in any majority vote.

[9] Thus we have an adjusted discount factor $\frac{1}{1+\delta} = \frac{1-m}{1+\bar{\delta}}$, where m is the probability of dying and $\bar{\delta}$ is the actual discount rate.

described below.[10] In the second period, agents use their first-period savings plus interest for consumption.

2.3 Factor supply

The demand functions imply that individual savings s_i form a fixed fraction $1-c$ of each agent's income w_i+b_i. Each agent inelastically supplies one unit of labor in the first period of life. Accordingly, in each period, total capital is equal to total savings given by

$$\sum_i K_i = \sum_i s_i L_i = (1-c)\sum_i (w_i+b_i)L_i. \tag{7}$$

To model occupation-specific labor supply, I analyze a labor market that is segmented into two occupations, where natives exhibit occupation-specific job preferences: for given job characteristics, they require a compensating wage differential (see Rosen 1986) for working in one occupation rather than in the other.[11][12] In reality, job preferences are of course only one reason for wage differentials to exist in the absence of productivity differences. The model applies equally to the case where there are geographic moving costs between jobs in different occupations, or costs associated with the loss of occupation-specific human capital or the necessary acquisition of new human capital.[13] Natives are heterogeneous in terms of the amount of their required wage differential or moving cost.

In country I, agents choose one of the two domestic occupations for work in the first life-period. Let $\omega_h \in (-\infty,\infty)$ denote the wage differential between occupations A and B required by young agent h to work in occupation A. Young agent h chooses to work in occupation A, if $w_A - \omega_h > w_B$ and in occupation B otherwise. We assume a continuous cumulative distribution function $\Phi(\cdot)$ of young agents with respect to the required wage differential.[14] Denote the wage differential by

$$\omega \equiv w_A - w_B. \tag{8}$$

Since young agent h with $\omega_h < \omega$ chooses to work in occupation A, $\Phi(\omega)$ gives the fraction of country I's young native population choosing to work in occupation A.

We assume that the wage in country II is low compared to country I such that country I can face a large number of country-II workers who want to work in either occupaton A or B. We let country I decide on the optimal number of immigrant workers to admit into occupations A and B. In doing so, the country also decides on the number of workers that would be left in occupation C residually, since we assume an inelastic supply of labor and full employment.

[10] Changing the way in which bequests are distributed does not qualitatively change results because they just increase demand of the young by an amount that is predetermined and thus independent of current immigration.

[11] Klaver and Visser (1999) find for different sectors in the Dutch economy that their image is not good enough, at the going wage rate, to attract a sufficient number of workers, even if supply is abundant. See OECD (2003, p. 104).

[12] Borjas (2007) mentions in his blog the health sector in the UK as an example of a 'low-wage ghetto', which 'drives natives into alternative, better-paid options and fulfills the prophecy that there are some jobs that natives just won't do.'

[13] According to Zimmermann et al. (2007), there is evidence for regional and sectoral wage differentials even within occupations, which suggests that mobility is insufficient even within a relatively homogeneous labor market (see DeNew and Schmidt 1994, Möller and Bellmann 1996 and Haisken-DeNew and Schmidt 1999 for Germany).

[14] Let us assume the corresponding density function is non-degenerate, i.e. $\phi(\cdot) > 0 \forall \omega_h$.

Accordingly, at given wage rates and a given number of migrants into the two occupations, M_A and M_B, labor supply in each occupation is given by

$$L_A = N\Phi(\omega) + M_A \geq 0, \tag{9}$$
$$L_B = N(1-\Phi(\omega)) + M_B \geq 0, \tag{10}$$
$$L_C = M - M_A - M_B \geq 0. \tag{11}$$

Let $N\Phi(\omega) \equiv N_A$ and $N(1-\Phi(\omega)) \equiv N_B$ in the following.

2.4 Equilibrium

We set the supply of each occupation's output given by equation (1) equal to each occupation's demand expressed by the individual demand functions times the respective population sizes given by equations (9)-(11), weighted by the survival probability in case of the retired. Note that this includes demand by immigrants, which is the same as the demand of respective natives both in the first and second period once they are in country I. In any given period t, the following relationships hold:

$$\begin{aligned} X_A(t) &= c\alpha\frac{(w_A(t)+b_A(t))L_A(t)+(w_B(t)+b_B(t))L_B(t)}{p_A(t)} \\ &+(1-c)\alpha(1-m)\frac{(w_A(t-1)+b_A(t-1))L_A(t-1)+(w_B(t-1)+b_B(t-1))L_B(t-1)}{p_A(t)}(1+r(t-1)), \end{aligned} \tag{12}$$

$$\begin{aligned} X_B(t) &= c\beta\frac{(w_A(t)+b_A(t))L_A(t)+(w_B(t)+b_B(t))L_B(t)}{p_B(t)} + c\theta\frac{(w_C(t)+b_C(t))L_C(t)}{p_B(t)} \\ &+(1-c)\beta(1-m)\frac{(w_A(t-1)+b_A(t-1))L_A(t-1)+(w_B(t-1)+b_B(t-1))L_B(t-1)}{p_B(t)}(1+r(t-1)) \\ &+(1-c)\theta(1-m)\frac{(w_C(t-1)+b_C(t-1))L_C(t-1)}{p_B(t)}(1+r(t-1)), \end{aligned} \tag{13}$$

$$\begin{aligned} X_C(t) &= c(1-\alpha-\beta)\frac{(w_A(t)+b_A(t))L_A(t)+(w_B(t)+b_B(t))L_B(t)}{p_C(t)} + c(1-\theta)\frac{(w_C(t)+b_C(t))L_C(t)}{p_C(t)} \\ &+(1-c)(1-\alpha-\beta)(1-m)\frac{(w_A(t-1)+b_A(t-1))L_A(t-1)+(w_B(t-1)+b_B(t-1))L_B(t-1)}{p_C(t)}(1+r(t-1)) \\ &+(1-c)(1-\theta)(1-m)\frac{(w_C(t-1)+b_C(t-1))L_C(t-1)}{p_C(t)}(1+r(t-1)), \end{aligned} \tag{14}$$

where the $X_i(t)$, $i \in \{A, B, C\}$ are given by (1).

By substituting wages given by (2) into these and solving the system, we obtain the equilibrium prices:

$$p_i = \frac{\psi_i}{X_i}, \tag{15}$$

where in any given period t, $\psi_i(t)$ depends only on r, m and ψ_i in the previous period $t-1$.[15] This in turn

[15] The expression for $\psi_i(t)$ is too long for inclusion in the main text and is left to the Appendix.

implies that the value of output in each occupation $p_i X_i$ is predetermined in any period: a change in labor supply in a given occupation due to immigration changes the output and the price in that occupation such that the value of output remains constant ψ_i.[16] The price in any period depends only on initial as well as current capital and labor supply in each occupation. Note that this implies that immigration affects neither the total amount of capital in the world, nor its distribution across occupations, nor the interest rate. The resource constraint (7) implies, by using (2) and (15),

$$\sum_i K_i = (1-c)\left[\sum_i \gamma_i \psi_i + (1-c)m \sum_i \gamma_i \psi_i\right]. \tag{16}$$

Total capital in each period is a constant share of the occupational output values ψ_i in that and the previous period, which, in turn, depend on the values of output in the period before. This implies that total capital and labor supply in the initial period completely determine total capital in subsequent periods. Furthermore, by substituting (15) into (3) we get

$$\frac{K_i}{K_j} = \frac{\psi_i}{\psi_j}\frac{1-\gamma_i}{1-\gamma_j}, \quad i,j \in \{A,B,C\}, \quad i \neq j, \tag{17}$$

for any given period. The capital ratio between occupations is thus predetermined.

Note that, whereas with given prices a constant interest rate would imply a constant capital-labor ratio, which in turn would imply constant wages as well, this is not the case here. Instead, from substituting for prices using (15) in the expression for the interest rate (3) we find that the interest rate is constant, if the amount of capital is constant in each occupation. For the interest rate to be the same in each occupation, the distribution of capital across occupations then needs to be constant. At the same time, this does not imply that wages are constant as well, because they depend on the amount of labor (and, therefore, on the amount of immigration) in each occupation, which can be seen from substituting for prices using (15) in the expression for wages (2).

3 Majority voting outcomes

In the following, I examine the outcome of a referendum[17] on immigration into occupations A and B in country I. Thereby, I distinguish between two cases: one where some native workers change occupation and one where no worker changes occupation.[18] As immigration changes the wage differential between occupations A and B, it will also change the distribution of natives across occupations, if the cost of changing occupation is sufficiently small. Natives will not change occupation otherwise.[19]

[16]This result remains robust in case of different degrees of total factor productivity across occupations.

[17]The referendum is once-and-for-all. The possibility of future referenda would not affect results here, as immigrants today would not change the median voter tomorrow even if they could vote, as will be seen.

[18]Note that the latter case can be seen as one where the compensating wage differentials have a specific form where they increase very steeply at the margin between working in occupation A and B such that no worker would not ever want to change occupation.

[19]Dixit and Rob (1994) develop a related model of endogenous labor immobility across occupations with switching costs. In their model, incentives to switch do not arise from immigration but from technological shocks that affect wages in the

3.1 Workers do not change occupation

Proposition 1. *Assume workers do not change occupation. Then, in the absence of an absolute majority of any one group, majority voting on immigration in the two occupations results in the choice of the immigration quotas that is preferred by the retired:*
$(M_A^o, M_B^o) = \left(\frac{\alpha\gamma_A[M+N_B]-[\beta\gamma_B+(1-\alpha-\beta)\gamma_C]N_A}{\alpha\gamma_A+\beta\gamma_B+(1-\alpha-\beta)\gamma_C}, \frac{\beta\gamma_B[M+N_A]-[\alpha\gamma_A+(1-\alpha-\beta)\gamma_C]N_B}{\alpha\gamma_A+\beta\gamma_B+(1-\alpha-\beta)\gamma_C}\right)$, $M_A^o \geq 0$ *and* $M_B^o \geq 0$.

Proof. We derive individual indirect utility of young natives in country I by substituting the demand functions, wages (2) and prices (15) into the utility function (4). We have, for $i \neq C$ and $t = 1$,

$$\begin{aligned} v_i^y(1) \equiv{}& \alpha \ln\left(c\alpha\frac{w_i(1)}{p_A(1)}\right) + \beta\ln\left(c\beta\frac{w_i(1)}{p_B(1)}\right) + (1-\alpha-\beta)\ln\left(c(1-\alpha-\beta)\frac{w_i(1)}{p_C(1)}\right) \\ &+ \frac{1}{1+\delta}\left[\alpha\ln\left((1-c)\alpha\frac{w_i(1)}{p_A(2)}(1+r(1))\right) + \beta\ln\left((1-c)\beta\frac{w_i(1)}{p_B(2)}(1+r(1))\right)\right. \\ &\left.+(1-\alpha-\beta)\ln\left((1-c)(1-\alpha-\beta)\frac{w_i(1)}{p_C(2)}(1+r(1))\right)\right], \end{aligned} \tag{18}$$

where superscript y denotes young.
The indirect utility of a retired native worker is simply the one-period lag of the fourth term in the above expression without the discounting:

$$\begin{aligned} v^o(1) \equiv{}& \alpha\ln\left((1-c)\alpha\frac{w(0)}{p_A(1)}(1+r(0))\right) + \beta\ln\left((1-c)\beta\frac{w(0)}{p_B(1)}(1+r(0))\right) \\ &+(1-\alpha-\beta)\ln\left((1-c)(1-\alpha-\beta)\frac{w(0)}{p_C(1)}(1+r(0))\right), \end{aligned} \tag{19}$$

where superscript o denotes retired (old).[20]
For the first derivative of indirect utility of a young native in occupation A with respect to immigration into that occupation, we get

$$\frac{\partial v_A^y}{\partial M_A(1)} = \frac{1}{w_A(1)}\frac{dw_A(1)}{dM_A(1)} - \frac{\alpha}{p_A(1)}\frac{dp_A(1)}{dM_A(1)} - \frac{1-\alpha-\beta}{p_C(1)}\frac{dp_C(1)}{dM_A(1)} + \frac{1}{(1+\delta)w_A(1)}\frac{dw_A(1)}{dM_A(1)},$$

where the first and fourth terms are the wage effects. Note that the wage effect in the fourth term occurs in the second period of lifetime (it can be very small and even zero, depending on the discount rate). The second and third terms are the terms-of-trade effects: the former is the occupation-A (export) price effect, and the latter is the occupation-C (import) price effect. We can drop time indices and use (2) and (15) to reduce the expression to

$$\frac{\partial v_A^y}{\partial M_A} = -\frac{1}{cL_A} + \frac{\alpha\gamma_A}{L_A} - \frac{(1-\alpha-\beta)\gamma_C}{L_C}. \tag{20}$$

two occupations differently.

[20] I omit the occupation subscript from v and w in (19) because only the three output prices are affected by immigration in this expression, which enter utility in the same way regardless of whether an agent worked in occupation A or B in the previous period.

The first derivatives of the indirect utility of young natives in occupation B and the retired with respect to M_A (1) are the same:

$$\frac{\partial v_B^y}{\partial M_A} = \frac{\partial v^o}{\partial M_A} = \frac{\alpha\gamma_A}{L_A} - \frac{(1-\alpha-\beta)\,\gamma_C}{L_C}. \tag{21}$$

That is, immigration into occupation A affects workers in occupation B and the retired only via the price effects: a decrease in the occupation-A price and an increase in the occupation-C price. Therefore, the wage effect represented by the first term of (20) is missing in (21).
Analogously, regarding immigration into occupation B, we have

$$\frac{\partial v_B^y}{\partial M_B} = -\frac{1}{cL_B} + \frac{\beta\gamma_B}{L_B} - \frac{(1-\alpha-\beta)\,\gamma_C}{L_C} \tag{22}$$

and

$$\frac{\partial v_A^y}{\partial M_B} = \frac{\partial v^o}{\partial M_B} = \frac{\beta\gamma_B}{L_B} - \frac{(1-\alpha-\beta)\,\gamma_C}{L_C}. \tag{23}$$

Immigration into occupation A (B) affects utility of workers already in the occupation in three ways, namely via (i) a decrease in the wage (first term on the right-hand side of (20) and (22)), (ii) a decrease in the occupation-A (B) price (second term) and (iii) an increase in the occupation-C price (third term). The total effect is negative because the negative wage effect dominates the positive occupation-A (B) price effect, i.e., $1/c > \alpha\gamma_A$ and $1/c > \beta\gamma_B$. Young natives in occupation A (B) therefore oppose immigration into their own occupation. Their optimal amount of M_A (M_B) is zero.
Immigration into occupation A (B) affects utility of young natives in the other occupation and the retired only via the price effects. (21) and (23) indicate a decrease in the occupation-A (B) price and an increase in the occupation-C price. The relative size of the price effects depends on the relative size of the native population in occupation A (B) and the foreign population M. In particular, the relative size of the price effect in occupation C is small, if the foreign population M is large relative to the native population $N_A + N_B$.[21]

According to the first-order conditions (20)-(23), we know that - for given M_A - the young in occupation A and the retired prefer the same M_B, which is greater than the M_B preferred by the young in occupation B. Likewise - for given M_B - the young in occupation B and the retired prefer the same M_A, which is greater than the M_A preferred by the young in occupation A. Hence, the young in each occupation form a majority with the retired on immigration into the occupation other than their own. As a result, the median voter represents the preferences of the retired in any one vote on M_A or M_B.[22]

Now, in a majority vote on a pair of immigration quotas into the two occupations, the policy space

[21] Assume that the population in country II is large relative to the population in country I. Then, the positive price effect initially dominates the negative price effect. Young natives support immigration into the occupation that is not their own, and the retired support immigration into both occupations. With an increase in M_A or M_B, this positive net effect of immigration decreases and eventually becomes negative.

[22] Remember that the populations of the young and retired are constant over time.

is two-dimensional as voters vote simultaneously on both M_A and M_B. Therefore, for the retired to dominate the voting outcome, we need to show that their preferred pair of immigration quotas in the two occupations will be supported by a majority against either of the pairs preferred by the young. For this, we compute the optimal pair (M_A, M_B) for each group of voters and determine the outcome of a majority vote among the resulting three alternatives as follows.

Young natives in occupation A choose M_B by setting $M_A = 0$ and solving

$$\frac{\beta\gamma_B}{L_B} = \frac{(1-\alpha-\beta)\,\gamma_C}{L_C}. \tag{24}$$

Young natives in occupation B choose M_A by setting $M_B = 0$ and solving

$$\frac{\alpha\gamma_A}{L_A} = \frac{(1-\alpha-\beta)\,\gamma_C}{L_C}. \tag{25}$$

Retired natives choose M_A and M_B such that

$$\frac{\alpha\gamma_A}{L_A} = \frac{\beta\gamma_B}{L_B} = \frac{(1-\alpha-\beta)\,\gamma_C}{L_C}. \tag{26}$$

By substituting (9)-(11) into these, we find the choice by young natives in occupation A is

$$\left(M_A^A, M_B^A\right) = \left(0, \frac{\beta\gamma_B M - (1-\alpha-\beta)\,\gamma_C N_B}{\beta\gamma_B + (1-\alpha-\beta)\,\gamma_C}\right). \tag{27}$$

The choice by young natives in occupation B is

$$\left(M_A^B, M_B^B\right) = \left(\frac{\alpha\gamma_A M - (1-\alpha-\beta)\,\gamma_C N_A}{\alpha\gamma_A + (1-\alpha-\beta)\,\gamma_C}, 0\right). \tag{28}$$

The choice by retired natives is a pair of

$$M_A^o = \frac{\alpha\gamma_A\,[M + N_B] - [\beta\gamma_B + (1-\alpha-\beta)\,\gamma_C]\,N_A}{\alpha\gamma_A + \beta\gamma_B + (1-\alpha-\beta)\,\gamma_C} \tag{29}$$

and

$$M_B^o = \frac{\beta\gamma_B\,[M + N_A] - [\alpha\gamma_A + (1-\alpha-\beta)\,\gamma_C]\,N_B}{\alpha\gamma_A + \beta\gamma_B + (1-\alpha-\beta)\,\gamma_C}. \tag{30}$$

Given $M_A^o \geq 0$ and $M_B^o \geq 0$, we find that $M_A^B > M_A^o \geq M_A^A$ and $M_B^A > M_B^o \geq M_B^B$. It follows that there is no pair of immigration quotas that is preferred by a majority over the pair preferred by the retired (M_A^o, M_B^o). In other words, there will always be a majority against any move from (M_A^o, M_B^o): the young in B (together with the retired) are against a further increase in M_B or a further decrease in M_A or any positive linear combination of these and, likewise, the young in A (together with the retired) are against a further increase in M_A or a further decrease in M_B or any positive linear combination of these. In this two-dimensional vote, a median voter exists because the tastes of voters who are not the median voter are diametrically opposed.[23]

■

To sum up, in this model the young in both occupations oppose immigration into their respective occupation because such immigration depresses their wages: these negative effects dominate any positive price effect. However, they desire immigration into the other occupation up to the point where the marginal benefit from the decrease in the respective output price is equal to the marginal cost from the increase in the price of output produced in country II.

The retired desire immigration into both occupations such that the marginal benefit from the decrease in the respective prices is equal to the marginal cost from the increase in the price of output produced in country II. They do not care about the wage effect of immigration.[24] The pair of immigration levels chosen by the retired represents the median position because the young each form a majority with the retired against any move from the pair of immigration levels preferred by the retired. The majority voting outcome on immigration into occupations A and B is equal to M_A^o and M_B^o for $M_A^o \geq 0$ and $M_B^o \geq 0$.

Note that, in the special case where $1-\alpha-\beta = 0$, natives would not derive utility from the good produced in country II and would therefore not import and consume the good. In consequence, the marginal cost from an increase in the price of that good to natives would be zero, and they would choose not to restrict immigration. The young would prefer zero immigration in their own occupation and all immigration into the other occupation: $\left(M_A^A, M_B^A\right) = (0, M)$ and $\left(M_A^B, M_B^B\right) = (M, 0)$ according to (27) and (28), and the retired would prefer a distribution of immigration across occupations according to (29) and (30), where $M_A^o + M_A^o = M$. Again, it would be true that $M_A^B > M_A^o \geq M_A^A$ and $M_B^A > M_B^o \geq M_B^B$ and the majority voting outcome would be determined by the retired.

3.2 Workers change occupation

The effects of immigration on each of the three groups will be different, if some workers change occupation in response to immigration. We compute the change in total occupational labor supply using the expressions for labor demand (2) and labor supply (10)-(11). These determine the equilibrium distribution of migrant and native workers across occupations A and B. Labor supply in occupations A and B is defined implicitly by the following two equations:

$$F_A \equiv N\Phi\left(\frac{\psi_A\gamma_A}{L_A} - \frac{\psi_B\gamma_B}{L_B}\right) + M_A - L_A = 0, \tag{31}$$

$$F_B \equiv N\left(1 - \Phi\left(\frac{\psi_A\gamma_A}{L_A} - \frac{\psi_B\gamma_B}{L_B}\right)\right) + M_B - L_B = 0, \tag{32}$$

[23] See Plott (1967).

[24] We abstract from public finance effects of immigration, which could represent either net benefits or net costs to both the native young as well as the retired.

where we substituted for ω by using (8), (2) and (15).

Lemma. *Immigration into a given occupation increases labor supply in both occupations A and B. But the increase in a given occupation is larger when immigrants enter that occupation than when they enter the other occupation.*

Proof. Since

$$det \begin{pmatrix} \frac{\partial F_A}{\partial L_A} & \frac{\partial F_A}{\partial L_B} \\ \frac{\partial F_B}{\partial L_A} & \frac{\partial F_B}{\partial L_B} \end{pmatrix} = 1 + N\Phi(\omega)\left(\frac{\psi_A \gamma_A}{L_A^2} + \frac{\psi_B \gamma_B}{L_B^2}\right) \neq 0,$$

we apply Cramer's rule to the system (31)-(32) to get

$$\frac{\partial L_A}{\partial M_A} = \frac{1 + N\Phi(\omega)\frac{\psi_B \gamma_B}{L_B^2}}{1 + N\Phi(\omega)\left(\frac{\psi_A \gamma_A}{L_A^2} + \frac{\psi_B \gamma_B}{L_B^2}\right)} \in (0,1) \tag{33}$$

$$\frac{\partial L_B}{\partial M_A} = \frac{N\Phi(\omega)\frac{\psi_A \gamma_A}{L_A^2}}{1 + N\Phi(\omega)\left(\frac{\psi_A \gamma_A}{L_A^2} + \frac{\psi_B \gamma_B}{L_B^2}\right)} \in (0,1) \tag{34}$$

$$\frac{\partial L_A}{\partial M_B} = \frac{N\Phi(\omega)\frac{\psi_B \gamma_B}{L_B^2}}{1 + N\Phi(\omega)\left(\frac{\psi_A \gamma_A}{L_A^2} + \frac{\psi_B \gamma_B}{L_B^2}\right)} \in (0,1) \tag{35}$$

$$\frac{\partial L_B}{\partial M_B} = \frac{1 + N\Phi(\omega)\frac{\psi_A \gamma_A}{L_A^2}}{1 + N\Phi(\omega)\left(\frac{\psi_A \gamma_A}{L_A^2} + \frac{\psi_B \gamma_B}{L_B^2}\right)} \in (0,1) \tag{36}$$

These expressions imply that $\frac{\partial L_A}{\partial M_A} > \frac{\partial L_A}{\partial M_B}$ and $\frac{\partial L_B}{\partial M_B} > \frac{\partial L_B}{\partial M_A}$.

■

As a response to immigration, some natives choose to change occupation. Immigration into occupation A, for example, decreases the wage in that occupation such that the wage differential becomes too small for some to compensate them for working in occupation A. They choose a job in occupation B rather than A. Immigration into occupation B, on the other hand, increases the wage differential, such that more natives are now willing to work in occupation A than before. Immigration into a given occupation thus causes a movement of natives away from that occupation, partially offsetting the initial wage decrease. Immigration is not totally offset by the occupation change of natives. This is because, while immigration into a given occupation decreases the wage there, the ensuing occupation change by natives results in a wage decrease also in the other occupation. As a result, labor supply increases in both occupations, and the respective wages and prices decrease.

Also note that the increase in labor supply in any given occupation is different depending on whether immigrants enter occupation A or B. Natives are, therefore, not indifferent as to the location of the migrants, even if fully mobile. This is due to their preferences for working in the different occupations as expressed by their compensating wage differentials. If immigrants enter occupation A, this changes the actual wage differential between occupations A and B to an extent different from how it would change, if immigrants entered occupation B. Hence, the number of natives choosing to change their location is different.

Proposition 2. *Assume some workers change occupation in response to immigration. Then, in the absence of an absolute majority of any one group and in the absence of a majority against immigration or a voting cycle as described below, majority voting on immigration in the two occupations results in the immigration quotas that is preferred by the retired and the same as in the case where workers do not change occupation:*
$(M_A^o, M_B^o) = \left(\frac{\alpha\gamma_A[M+N_B]-[\beta\gamma_B+(1-\alpha-\beta)\gamma_C]N_A}{\alpha\gamma_A+\beta\gamma_B+(1-\alpha-\beta)\gamma_C}, \frac{\beta\gamma_B[M+N_A]-[\alpha\gamma_A+(1-\alpha-\beta)\gamma_C]N_B}{\alpha\gamma_A+\beta\gamma_B+(1-\alpha-\beta)\gamma_C}\right)$, $M_A^o \geq 0$ *and* $M_B^o \geq 0$.

Proof. Expressions (18) and (19) together with (33)-(36) imply the following derivatives with respect to immigration into occupation A:

$$\frac{\partial v_A^y}{\partial M_A} = \left(\alpha\gamma_A - \frac{1}{c}\right)\frac{1}{L_A}\left[\frac{1+N_A\frac{\psi_B\gamma_B}{L_B^2}}{1+N_A\left(\frac{\psi_A\gamma_A}{L_A^2}+\frac{\psi_B\gamma_B}{L_B^2}\right)}\right]+\frac{\beta\gamma_B}{L_B}\left[\frac{N_A\frac{\psi_A\gamma_A}{L_A^2}}{1+N_A\left(\frac{\psi_A\gamma_A}{L_A^2}+\frac{\psi_B\gamma_B}{L_B^2}\right)}\right]-\frac{(1-\alpha-\beta)\gamma_C}{L_C} \tag{37}$$

$$\frac{\partial v_B^y}{\partial M_A} = \frac{\alpha\gamma_A}{L_A}\left[\frac{1+N_A\frac{\psi_B\gamma_B}{L_B^2}}{1+N_A\left(\frac{\psi_A\gamma_A}{L_A^2}+\frac{\psi_B\gamma_B}{L_B^2}\right)}\right]+\left(\beta\gamma_B - \frac{1}{c}\right)\frac{1}{L_B}\left[\frac{N_A\frac{\psi_A\gamma_A}{L_A^2}}{1+N_A\left(\frac{\psi_A\gamma_A}{L_A^2}+\frac{\psi_B\gamma_B}{L_B^2}\right)}\right]-\frac{(1-\alpha-\beta)\gamma_C}{L_C} \tag{38}$$

$$\frac{\partial v^o}{\partial M_A} = \frac{\alpha\gamma_A}{L_A}\left[\frac{1+N_A\frac{\psi_B\gamma_B}{L_B^2}}{1+N_A\left(\frac{\psi_A\gamma_A}{L_A^2}+\frac{\psi_B\gamma_B}{L_B^2}\right)}\right]+\frac{\beta\gamma_B}{L_B}\left[\frac{N_A\frac{\psi_A\gamma_A}{L_A^2}}{1+N_A\left(\frac{\psi_A\gamma_A}{L_A^2}+\frac{\psi_B\gamma_B}{L_B^2}\right)}\right]-\frac{(1-\alpha-\beta)\gamma_C}{L_C} \tag{39}$$

Analogously for derivatives with respect to immigration into occupation B.

We observe that, as a result of natives changing occupations, immigration into a given occupation not only has a negative wage effect and a positive price effect in that respective occupation, but also a negative wage effect and a positive price effect in the other occupation. Compared to the case of fixed occupation choice, workers experience an additional positive price effect of own-occupation immigration on goods produced in the other occupation, represented by the second term in (37). They also experience a negative wage effect and a positive price effect of immigration into the other occupation in their own occupation, represented by the second term in (38). The retired experience an additional positive price effect, represented by the second term in (39).

The size of the price and wage effects in occupations A and B is smaller compared to the case where native workers do not change occupation, because the change in occupational labor supply due to immigration is smaller: with no change in occupation, the marginal immigrant increases occupational labor supply by 1, $\frac{\partial L_A}{\partial M_A} = 1$ and $\frac{\partial L_B}{\partial M_B} = 1$, while with a change in occupation, he increases occupational labor supply by less than 1, $0 < \frac{\partial L_A}{\partial M_A} < 1$ and $0 < \frac{\partial L_B}{\partial M_B} < 1$, because of the crowding-out effect on native occupational labor supply. In other words, the occupational change of natives mitigates price and wage effects of immigration.

For the voting equilibrium on immigration into the two occupations, we again compute the optimal pairs of immigration levels (M_A, M_B) for each of the three groups of voters. To do so, we solve simultaneously for the respective first-order conditions, subject to the lower and upper bound constraints $M_A > 0$, $M_B > 0$, $M_A + M_B < M$.

We know that for the young, the lower constraints on immigration will always be binding, because for any $M_A \geq 0$ and $M_B \geq 0$, marginal utility from immigration into workers' own occupation is always smaller than marginal utility from immigration into the other occupation. In sum, young natives in occupation A choose $(0, M_B^A)$, young natives in occupation B choose $(M_A^B, 0)$ and retired natives choose (M_A^o, M_B^o), where M_B^A, M_A^B, M_A^o and M_B^o are equal to the solutions to the respective first-order conditions, if positive and smaller in sum than the upper bound M, and equal to zero otherwise.[25] There will be a voting equilibrium for zero immigration, if this is the preferred level of immigration for at least two of the three groups of voters. Furthermore, there will be a voting cycle unless $M_A^B > M_A^o > M_A^A$ and $M_B^A > M_B^o > M_B^B$, as described in the proof to Proposition 1.[26]
So the case where $M_A^B > M_A^o > M_A^A$ and $M_B^A > M_B^o > M_B^B$ is the only case with a unique voting outcome for positive immigration, analogously to the case for fixed occupation choice. As before, this outcome of a majority vote among the three alternatives is determined by the retired, because there will always be a majority against any of the other pairs of immigration quotas than the one preferred by the retired (M_A^o, M_B^o).

Optimal immigration for the retired is the same whether native workers change occupation or not, as first-order conditions are the same. This can be seen by using the first-order condition of the retired for immigration into occupation A (39) together with the respective expression for immigration into occupation B (not shown) to find that $\frac{\alpha\gamma_A}{L_A} = \frac{\beta\gamma_B}{L_B}$. Using this to substitute for $\frac{\beta\gamma_B}{L_B}$ in (39), we find that (39) is just the same as (21); analogously for immigration into occupation B. As a result, the outcome of a majority vote that is determined by the retired is the same with or without occupational change of natives.

[25]Note that the workers who change occupation as a response to immigration are indifferent as the marginal effect on their utility is zero (see section 4.2).

[26]Take for example the case where $M_A^o > M_A^B > M_A^A$ and $M_B^o > M_B^A > M_B^B$. There will always be a majority against any of the three given pairs of immigration quotas (voting cycle). For example, the young in both occupations will vote against (M_A^o, M_B^o), the young in A and the retired will vote against (M_A^B, M_B^B) and the young in B and the retired will vote against (M_A^A, M_B^A).

■

Proposition 2 shows that, given that the voting outcome on immigration quotas is unique, it is negative (positive) for occupations where the native labor supply is sufficiently large (small), in the case where workers are mobile across occupations. However, the exact majority voting outcome depends on parameter values, and I will report numerical solutions for voting outcomes for different parameter values in Section 5 below. To give a brief outlook, I find that the negative effects on workers' wages and on price C dominate the positive price effects of immigration for low rates of domestic consumption (c), spending shares (α, β) and wage shares (γ_A, γ_B). In this case, the young in both occupations vote against immigration not only into their own occupation, but also into the other occupation ($M_A^B = 0$ and $M_B^A = 0$), and the outcome of a majority vote is $M_A = 0$ and $M_B = 0$. I also show cases where the majority voting outcome is indeterminate or positive.

4 Social welfare analysis

In the previous section, I determined the outcome of a majority vote of natives on the amount of occupation-specific immigration. For comparative purposes, I now determine the amount of immigration that is socially optimal for natives, that is the amount chosen by a benevolent social planner who simultaneously determines immigration into occupations A and B.

In the following, I use as welfare criterion the sum of individual utilities in the standard utilitarian form:

$$W(M_{\mathrm{i}}) = v_{\mathrm{A}}^{\mathrm{y}} N_{\mathrm{A}} + v_{\mathrm{B}}^{\mathrm{y}} N_{\mathrm{B}} + v^{\mathrm{o}} N_{\mathrm{o}} \quad i \in \{A, B\}. \tag{40}$$

4.1 Workers do not change occupation

Without occupation change, the marginal social welfare effects of immigration into occupations A and B equal:

$$\frac{\partial W}{\partial M_{\mathrm{A}}} = \frac{\partial v_{\mathrm{A}}}{\partial M_{\mathrm{A}}} N_{\mathrm{A}} + \frac{\partial v_{\mathrm{B}}}{\partial M_{\mathrm{A}}} N_{\mathrm{B}} + \frac{\partial v^{\mathrm{o}}}{\partial M_{\mathrm{A}}} N_{\mathrm{o}}. \tag{41}$$

and

$$\frac{\partial W}{\partial M_{\mathrm{B}}} = \frac{\partial v_{\mathrm{A}}}{\partial M_{\mathrm{B}}} N_{\mathrm{A}} + \frac{\partial v_{\mathrm{B}}}{\partial M_{\mathrm{B}}} N_{\mathrm{B}} + \frac{\partial v^{\mathrm{o}}}{\partial M_{\mathrm{B}}} N_{\mathrm{o}}. \tag{42}$$

Using the marginal effects of immigration on utility (20)-(23) to substitute in (41) and (42) gives

$$\frac{\partial W}{\partial M_{\mathrm{A}}} = \left[-\frac{1}{cL_A} + \frac{\alpha\gamma_A}{L_A} - \frac{(1-\alpha-\beta)\gamma_C}{L_C} \right] N_A + \left[\frac{\alpha\gamma_A}{L_A} - \frac{(1-\alpha-\beta)\gamma_C}{L_C} \right] (N_B + N_o) \tag{43}$$

and

$$\frac{\partial W}{\partial M_{\mathrm{B}}} = \left[\frac{\beta\gamma_B}{L_B} - \frac{(1-\alpha-\beta)\gamma_C}{L_C}\right](N_A+N_o) + \left[-\frac{1}{cL_B} + \frac{\beta\gamma_B}{L_B} - \frac{(1-\alpha-\beta)\gamma_C}{L_C}\right]N_B. \tag{44}$$

Immigration into occupation A(B) has a positive price effect on good A(B) and a negative price effect on good C for all three groups of voters, and it has a negative wage effect for the group of natives working in occupation A(B).
In optimum, the marginal welfare of immigration into occupation A via its effect on the wage and price in A (if positive) equals its (negative) marginal welfare via the effect on the price in C. Similarly, a positive marginal welfare of optimal immigration into occupation B via its effect on the wage and price in B equals its negative marginal welfare via the effect on the price in C.

Proposition 3. *Assume young natives do not change occupation. Then, socially optimal immigration equals* (M_A^*, M_B^*) *for* $-\frac{1}{c}N_A + \alpha\gamma_A(N_A+N_B+N_o) > 0$ *and* $-\frac{1}{c}N_B + \beta\gamma_B(N_A+N_B+N_o) > 0$*; it equals* $(0, M_B^*)$ *for* $-\frac{1}{c}N_A + \alpha\gamma_A(N_A+N_B+N_o) < 0$ *and* $-\frac{1}{c}N_B + \beta\gamma_B(N_A+N_B+N_o) > 0$*; and it equals* $(M_A^*, 0)$ *for* $-\frac{1}{c}N_A + \alpha\gamma_A(N_A+N_B+N_o) > 0$ *and* $-\frac{1}{c}N_B + \beta\gamma_B(N_A+N_B+N_o) < 0$*,* $M_A^* > 0$ *and* $M_B^* > 0$*. Socially optimal immigration into both occupations is zero, otherwise.*

Proof. We simultaneously solve for (43)=0 and (44)=0 with respect to M_A and M_B subject to their lower and upper bounds $M_A \geq 0$, $M_B \geq 0$ and $M_A + M_B \leq M$. Given $M_A \geq 0$, $M_B \geq 0$ and $M_A + M_B \leq M$, the marginal welfare effect of immigration into occupation A can only be positive, if $-\frac{1}{c}N_A + \alpha\gamma_A(N_A + N_B + N_o) > 0$. Analogously, the marginal welfare effect of immigration into occupation B can only be positive, if $-\frac{1}{c}N_B + \beta\gamma_B(N_A+N_B+N_o) > 0$, as can be seen by transforming (43) and (44). See the Appendix for the explicit expressions for $M_A^* > 0$ and $M_B^* > 0$.

■

Socially optimal immigration will be smaller than any strictly positive majority voting outcome on immigration. This is because the retired choose immigration such that the net marginal gain from the price effects is zero (see the first-order conditions for the retired (21) and (23)). If the young were also only affected by these price effects, this majority voting outcome would correspond to the social optimum. However, the young additionally experience a negative wage effect (see the first-order conditions for the young (20) and (22)). As the marginal gain from immigration via the price effects is decreasing in immigration, the socially optimal amounts M_A^* and M_B^* are smaller than the respective (positive) majority voting outcomes, which is confirmed by simulation results reported in Table 1.

4.2 Workers change occupation

When some native workers change occupation, the marginal social welfare effects of immigration into occupation A equals:

$$\begin{aligned}\frac{\partial W}{\partial M_{\mathrm{A}}} &= \frac{\partial v_{\mathrm{A}}}{\partial M_{\mathrm{A}}}N\Phi(w_{\mathrm{A}}-w_{\mathrm{B}})+v_{\mathrm{A}}N\Phi(\frac{\partial w_{\mathrm{A}}}{\partial M_{\mathrm{A}}}-\frac{\partial w_{\mathrm{B}}}{\partial M_{\mathrm{A}}}) \\ &+\frac{\partial v_{\mathrm{B}}}{\partial M_{\mathrm{A}}}N[1-\Phi(w_{\mathrm{A}}-w_{\mathrm{B}})]-v_{\mathrm{B}}N\Phi(\frac{\partial w_{\mathrm{A}}}{\partial M_{\mathrm{A}}}-\frac{\partial w_{\mathrm{B}}}{\partial M_{\mathrm{A}}}) \\ &+\frac{\partial v_{\mathrm{o}}}{\partial M_{\mathrm{A}}}N_{\mathrm{o}}. \qquad (45)\end{aligned}$$

and analogously for immigration into occupation B.

Using (37)-(39) to substitute in (45) gives

$$\begin{aligned}\frac{\partial W}{\partial M_{\mathrm{A}}} &= \left[\frac{\alpha\gamma_A}{L_A}\frac{\partial L_A}{\partial M_A}+\frac{\beta\gamma_B}{L_B}\frac{\partial L_B}{\partial M_A}-\frac{(1-\alpha-\beta)\gamma_C}{L_C}\right](N_A+N_B+N_o) \\ &-\frac{1}{c}\left[\frac{N_A}{L_A}\frac{\partial L_A}{\partial M_A}+\frac{N_B}{L_B}\frac{\partial L_B}{\partial M_A}\right] \\ &+(v_A-v_B)N\Phi\left[-\frac{\psi_A\gamma_A}{L_A^2}\frac{\partial L_A}{\partial M_A}+\frac{\psi_B\gamma_B}{L_B^2}\frac{\partial L_B}{\partial M_A}\right] \qquad (46)\end{aligned}$$

where we can further substitute for the change in total occupational labor supply due to immigration using (33)-(34). Results are derived analogously for immigration into occupation B.

The first square bracket gives the price effects of immigration: positive effects on prices A and B and a negative effect on price C, affecting all three groups of voters: the young in occupations A and B as well as the retired. The second term gives the negative wage effects on the young in occupations A and B. The third term gives the effect on utility of the young that change occupation due to immigration, for given wages.[27] One can show that the third square bracket is negative - that is, immigration into occupation A reduces wage A more strongly than wage B. As a consequence, natives switch from occupation A to occupation B. Now, given equal job conditions in both occupations, utility is higher in the occupation where the wage is higher. However, we have assumed that wage differentials compensate for job conditions that are worse in the occupation where the wage is higher. Therefore, at the margin, utility derived from wages adjusted for job conditions does not change for those who change occupation.[28] The marginal effect of immigration for natives who change occupation is zero.

In order to solve for socially optimal immigration in the case where some native workers change occupation, we again simultaneously solve for the first-order conditions for immigration into occupation A (46)

[27] The third term comes from the fact that we compute the derivative of the products of group-specific indirect utilities with group sizes, both of which depend on immigration. Applying the product rule, we get the derivative of indirect utilities times group size (terms 1 and 2) plus the derivatives of group sizes times indirect utilities (term 3).

[28] $v_{\mathrm{i}}(\mathbf{x}^{\mathrm{i+z}}) = v_{\text{-i}}(\mathbf{x}^{\text{-i}})$, where $\mathbf{x}$ is the consumption good bundle purchased with money and expressed in terms of occupation-specific wages and the prices, and z is the compensating variation for working in occupation i and not in the other occupation. See Rosen (1986).

and B (not shown) with respect to M_A and M_B subject to their lower bounds $M_A \geq 0$, $M_B \geq 0$ and upper bound $M_A + M_B \leq M$. The solutions to M_A, M_B are quadratic due to the quadratic terms in the first-order conditions. I report numerical solutions in Table 1 below. As before in the case of no occupational change, socially optimal amounts of immigration M_A^* and M_B^* are smaller than the respective majority voting outcomes determined by the retired, M_A^o and M_B^o, who do not take the negative wage effects of immigration into account.

Corollary. *If native workers can change occupation, then socially optimal immigration into a given occupation is smaller (greater) compared to the case where occupation is fixed, if the net marginal social gain from immigration is greater (smaller) in that occupation than in the other occupation.*

Socially optimal immigration into a given occupation can be greater or smaller in the case where natives change occupation in response to immigration compared to the case where they do not. The marginal social welfare effect of immigration into occupation A decreases (increases) with native mobility, if the positive price effect (net of the negative wage effect) in A is greater (smaller) than the positive price effect (net of the negative wage effect) in B:

$$\frac{\alpha\gamma_A}{L_A}(N_A + N_B + N_o) - \frac{N_A}{cL_A} > \frac{\beta\gamma_B}{L_B}(N_A + N_B + N_o) - \frac{N_B}{cL_B},$$

as can be derived from a comparison of (43) with (46). Analogously for immigration into occupation B. Thus, the crowding-out effect of immigration into a given occupation only proves to be beneficial, if there is more to be gained from immigration (or an increase in the labor force in general, for that matter) in the other occupation.

■

To sum up, occupational change of natives decreases (increases) the social desirability of immigration into a given occupation, if there is more (less) to be gained from an increase in the labor force in that occupation than in the other occupation. In other words, native mobility can be a substitute for immigration, if this immigration is targeted at the right (relatively labor-scarce) occupation. However, as long as there are social gains from an increase in the labor force (because of positive price effects dominating the negative wage effects), immigration will be efficient.

5 Simulation of immigration quotas

The optimal immigration quotas as derived above depend on the parameter values of our stylized model. In the case of endogenous choice of occupation, the expressions for optimal immigration can only be derived numerically. I therefore use existing parameter estimates to provide a sense of the magnitude of optimal immigration into occupations, both for the groups of young and retired, as well as for society overall. This way, it is also easy to compare the outcome of a majority vote with the social optimum.

5.1 Parameter choice

For the relative size of the native labor force $N = N_A + N_B$ and the foreign labor force M that comprises potential immigrants, I choose a ratio of 1. Depending on the countries considered, this ratio can of course be greater or smaller than 1[29], and I will vary the relative size of the native and foreign labor force in the simulations to show its effect on results. I choose $N = 1$ such that results on immigration quotas can be easily interpreted as shares of the total native labor force. I further assume that the number of workers in the tradables occupation B and in the non-tradables occupation A is the same and use $N_A = 0.5$ and $N_B = 0.5$. The relative size of the retired within the native population is set to $N_o = 0.9$ since, according to ILO (2007) statistics, the share of the retired is almost equal to that of the working population in a typical OECD country.[30]

For spending shares in consumption, I use estimates of the shares of spending on tradables and non-tradables in a typical OECD country from the Penn World Table. For domestic demand, I use $\alpha = 0.5$ for the non-tradable good produced in occupation A and $\beta = 0.4$ for the tradable good produced in occupation B, which implies $1 - \alpha - \beta = 0.1$ for the imported good produced in occupation C. For foreign demand, I use $\theta = 0.5$ for the good imported from occupation B, which implies $1 - \theta = 0.5$ for the good produced in occupation C. For wage shares in production, I use estimates for a typical OECD country from ILO (2000). I set $\gamma_A = 0.7$, $\gamma_B = 0.7$ and $\gamma_C = 0.7$ in the three occupations A, B, C.

I choose a discount rate of 1.2 that corresponds to a yearly discount rate of 2 percentage points for the length of a working life of 40 years. Adjusting the corresponding discount factor for the probability of dying before reaching retirement age $m = 0.1$ gives a discount rate of $\delta = 1.4$ and a consumption rate $c = \frac{1+\delta}{2+\delta}$ of 0.7, which I use for the simulations.[31] For the cost of capital r, I use 0.15.[32] I calibrate p_A and, as implied by relative prices, p_B and p_C as well as capital stocks K_A, K_B and K_C according to a previous-period interest rate r_{t-1} of 0.15, equal to the current interest rate.

I also show simulations for different values of the relative size of the native labor force, the labor intensity in domestic production and the consumption rate.

Table 1 summarizes the baseline parameter values described above and reports corresponding equilibrium values of the model.

5.2 Simulation results

Table 2 reports simulation results on immigration quotas for no occupational change (panel a) and for occupational change (panel b) of native workers. For each case, group-specific quotas as well as the social optimum for immigration into both occupations A and B are shown. Quotas that are preferred by a majority and, therefore, correspond to the majority voting outcome are in bold. For no occupational change, I find that retired natives occupy the median position, as stated in Proposition 1. They prefer more

[29] The labor force in Mexico, for example, is smaller than in the U.S.

[30] This implies that a constant share of 10 per cent of the young die before they retire, as I abstract from population growth in the model.

[31] The $\delta = 1.4$ is derived according to $\frac{1}{1+\delta} = \frac{1-m}{1+\bar{\delta}}$, where $\bar{\delta} = 1.2$.

[32] The cost of capital is the sum of the world interest rate and the rate of capital depreciation.

immigration into a given occupation than young natives working in that occupation, but less immigration than young natives working in the other occupation. Their preferred amount of immigration is strictly positive for all chosen parameter values, whereas socially optimal immigration is positive only in columns 4 and 5 (see discussion below).
For occupation change, I find that depending on parameter values there is a majority for zero immigration into both occupations (columns 1 and 2), a voting cycle (column 3) or a voting outcome that is dominated by the retired (columns 4 and 5), as stated in Proposition 2. I also find that the optimal amounts of immigration for the retired are the same as in the case of no occupational change. The young in both occupations still vote against immigration into their own occupation, because the positive price effects from immigration are still not large enough to cover the negative wage effect. Besides, they may now also vote against immigration into the other occupation, if the negative effect on their wage due to occupational crowding-out is not compensated by the two positive price effects. In any case, they will vote for a smaller amount of immigration into the other occupation compared to the case of no occupational change. This is because the positive price effect in that occupation is now smaller, while the (new) positive price effect in their own occupation is dominated by the (new) negative wage effect in their own occupation.[33]

In columns 2-5 of the table, I show results for variations of parameter values, so that they can be compared with results for the baseline in column 1. In column 2, the native work force in occupation B is greater than in the baseline: $N_A = 0.6$. We can see that, as a result, retired natives and young natives in occupation B prefer less immigration into occupation A in case of no occupational change. The reason is that the marginal effect of immigration into occupation A on the respective price is now smaller for any given level of immigration. Since the retired and the young in occupation B choose immigration into occupation B such that marginal price effect in A equals the marginal price effect in C, which remains the same, optimal immigration into occupation A is smaller. Note also that optimal immigration into occupation B for the retired is greater, because optimality requires that the marginal price effects in occupations A and B are the same (both are smaller). Overall, optimal levels of immigration for the retired are smaller, the greater the size of the native relative to the foreign labor force, to compensate for the decrease in the positive domestic price effects relative to the negative foreign price effect of immigration. With occupational change, optimal immigration for the retired is the same in both occupation as without occupational change because due to the crowding-out effect of immigration on natives domestic price effects remain the same. Optimal immigration for the young is zero in both occupations as the negative wage effects dominate the positive price effects. Therefore, the majority voting outcome on immigration in both occupations is zero just as in the baseline in column 1.

In column 3, the wage share in occupation B is greater, $\gamma_B = 0.8$. In this case, the effect of a price decrease in B is greater, and optimal immigration into occupation B increases for both the retired as well as the young in occupation A in case of no occupational change. As a consequence, optimal immigration into occupation A decreases for the retired, who equate marginal price effects in A and B. In the case of occupational change, an increase in γ_B increases the positive effect on the price in occupation B relative

[33]Compare (21) with (41) for immigration into occupation A and (23) with (43) for immigration into occupation B.

to the negative effect on the price in occupation C. This effect is large enough for natives in occupation B to derive positive net marginal utility from immigration into occupation A, whereas net marginal utility from immigration into occupation B is still negative for natives in occupation A. As a consequence, natives in B now vote for positive immigration into occupation A (even though their preferred amount is smaller compared to the case with no occupational change), and natives in A vote for zero immigration into occupation B as before. The outcome of a majority vote on immigration into the two occupations is indeterminate, as there will be a majority against any given pair of immigration levels that is proposed.

Last, I consider an increase in the consumption rate: $c = 0.9$ in column 4. As a result, the negative effect of immigration on wages decreases. Without occupational change, the wage effect of immigration into one's own occupation always dominates the positive price effect as long as $c \leq 1$[34], while immigration into a given occupation has no wage effect in the other occupation or on the retired. Therefore, preferred levels of immigration remain the same. With occupational change, the young in each occupation prefer a greater amount of immigration into the other occupation compared to the baseline. They also prefer a greater amount than the retired, who in turn prefer a greater amount than the young in the occupation of immigration (whose preferred amount remains zero). In this case, the majority voting outcome is determined by the retired, who prefer strictly positive immigration into both occupations. The decrease in the negative wage effects due to a large consumption rate also causes the social net welfare effect of immigration into occupation A to become positive. The decrease in wage effects does not suffice for the net welfare effect of immigration into occupation B to become positive, because the positive price effect in B is smaller than in A due to a smaller domestic spending share ($\alpha > \beta$). Also, socially optimal immigration in A is slightly smaller with than without occupational change (see Corollary 1).

In column 5, I switch parameter values for domestic spending shares such that the spending share in B is now greater than in A: $\beta > \alpha$, while the consumption rate remains the same as in column 4. As a result, preferred levels of immigration are reversed in case of no occupational change: the level of immigration that was preferred for occupation A in column 4 is now preferred for occupation B and vice versa. In case of occupational change, the young in each occupation still prefer a positive amount of immigration into the other occupation that is greater than the amount preferred by the retired, but levels are different. This is because with a change in occupational spending shares, the effect of immigration on the distribution of the native labor force changes[35] and, therefore, price and wage effects change. In consequence, socially optimal amounts of immigration change as well, and optimal immigration into occupation B is now positive while optimal immigration into occupation A is zero. Further, socially optimal immigration in B is now slightly greater with than without occupational change.

These simulation results show that the relative effect of immigration on domestic wages and prices is important not only for individual welfare of the young but also for social welfare overall. In particular, unless the decline in real wages is quite small (for example due to a large consumption rate), optimal immigration is zero for the young and for the total population.

[34] See Section 3.
[35] See (33)-(36).

6 Conclusion

I determine the outcome of a majority vote on occupation-specific immigration as well as the respective socially optimal amounts. I assume that natives require a compensating wage differential for working in one occupation rather than in another, mapping situations of occupational labor supply shortages that are present in many OECD countries. To analyze immigration policy in this context, I focus on immigrants who are selected to serve as substitutes for natives in a given occupation and determine the outcome of a majority vote on occupational immigration as well as optimal immigration quotas. I identify both the wage and the price effects of immigration in a model with three different groups of voters: young natives working in occupation A, young natives working in occupation B, and retired natives.

I find that the young are against immigration into their own occupation, because the negative wage effect always dominates the positive price effect. The retired are affected by immigration only via price effects but not via wage effects and, therefore, support immigration. Finally, if natives do not change their occupation in response to immigration, the young are affected by immigration into the other occupation only via price effects but not via wage effects just as the retired. Therefore, while they are against immigration into their own occupation, they support a positive amount of immigration into the other occupation together with the retired. The retired turn out to represent the median voter and determine the outcome of a majority vote on strictly positive immigration into both occupations.
If some natives change occupation due to immigration, immigration into a given occupation does not only have price and wage effects in that occupation but also in the other occupation. Then, the young in that occupation vote for a smaller amount of immigration into the other occupation compared to the case with no occupational change. This amount of immigration can be positive or zero, depending on parameter values. As a result, the outcome of a majority vote on occupation-specific immigration can be zero, indeterminate, or strictly positive and determined by the retired, in which case the voting outcome is the same as with no occupational change.

Social welfare effects of immigration are greater the smaller the negative wage effects are and the larger the positive price effects. Using existing parameter estimates to simulate optimal immigration quotas for a range of plausible parameter values, I find that optimal occupation-specific immigration is positive in case of high rates of domestic consumption (which reduce the negative wage effects) together with high spending shares on domestic immigrant-intensive goods and high domestic wage shares in production (which increase the positive price effects). Optimal quotas can be greater with or without occupational change depending on parameter values, but they are always smaller than the respective majority voting outcome, if that is positive.

Immigration policies targeted at alleviating labor supply shortages in specific occupations are common in OECD countries. Typically, these involve work permits that are issued for a specific occupation or even employer, and are often only temporary. For example, work permits in Sweden are restricted to a specific occupation and employer during the first two years. The non-professional occupation-based work permits in the UK are valid for one year and may not be renewed (but may be resumed after having spent two months away from Britain). The temporary nature of such occupation-specific work permits should make it harder for migrants to move on to new jobs in occupations different from the targeted one. Even so, a movement of immigrants across occupations may be possible, in particular in the long run. In my analysis, such a mobility of immigrants across occupations would make it harder for retired voters to gain the support of either group of young voters for their preferred immigration quotas, similar to the case where natives change occupations.

The model is based on a number of simplifying assumptions. For example, I abstract from population dynamics and assume a constant ratio of the native to foreign labor force. As shown in Section 5, optimal immigration can be expected to increase, if this ratio decreases, for example due to population aging in developed countries. A dynamic model could be used to derive equilibrium outcomes on immigration in the presence of demographic change. I also do not account for any second-generation effects of immigration or possible complementarities of labor across occupations, which could potentially increase optimal immigration. Furthermore, I abstract from other factors that may shape policies on immigration quotas, both economic (resulting from the public budget or labor market imperfections) and non-economic (resulting from societal or cultural preferences). The aim of the present paper is to derive a prediction of the size of immigration quotas based on the trade-offs between wage and price effects, since these seem to be particularly relevant in this context. However, additionally considering other factors could be an interesting avenue for further research.

Appendix: Occupation-specific output values

In Section 2, we derived occupational equilibrium prices p_i as functions of the constants ψ_i and occupation outputs X_i, i=A, B, C:

$$p_i = \frac{\psi_i}{X_i}. \tag{15'}$$

It can easily be seen that the values of occupation-specific outputs are equal to the constants, expressions of which (for a given period t) are given by the following:

$$\begin{aligned}
\psi_{At} &= z\left[\alpha(1 - c\gamma_C(1-\theta))x + \alpha c\gamma_B\theta y\right] \\
\psi_{Bt} &= z\left[(\beta(1 - c\gamma_C) + c\gamma_C\theta(1-\alpha))x + (1 - c\gamma_A\alpha)\theta y\right] \\
\psi_{Ct} &= z\left[(1-\alpha-\beta)x + ((1 - \alpha c\gamma_A - \beta c\gamma_B)(1-\theta) + c\gamma_B\theta(1-\alpha-\beta))y\right],
\end{aligned}$$

where

$$x = (\gamma_A\psi_{At-1} + \gamma_B\psi_{Bt-1})(cm + (1+r_{t-1})(1-m)) + (\gamma_A\psi_{At-2} + \gamma_B\psi_{Bt-2})(1-c)m(1-m),$$

$$y = \gamma_C\psi_{Ct-1}(cm + (1+r_{t-1})(1-m)) + \gamma_C\psi_{Ct-2}(1-c)m(1-m),$$

$$z = \frac{(1-c)}{[(1 - c\alpha\gamma_A - c\beta\gamma_B)(1-(1-\theta)c\gamma_C) - (1-\alpha-\beta)c^2\gamma_B\gamma_C\theta]}.$$

As the constants and, therefore, occupational output values, only depend on previous-period output values and exogenous parameters, they are exogenous in any given period and determined by initial occupational output values ψ_{A0}, ψ_{B0} and ψ_{C0}.

Proposition 3.

Assume young natives do not change occupation. Then, socially optimal immigration (M_A^*, M_B^*) *equals*

$$\left(\frac{M\left[-\frac{1}{c}N_A+\alpha\gamma_A(N_A+N_B+N_o)\right]+(N_A+N_B+N_o)[\alpha\gamma_A N_B-N_A(\beta\gamma_B-(1-\alpha-\beta)\gamma_C)]}{-\frac{1}{c}(N_A+N_B)+[\alpha\gamma_A+\beta\gamma_B+(1-\alpha-\beta)\gamma_C](N_A+N_B+N_o)},\right.$$
$$\left.\frac{M\left[-\frac{1}{c}N_B+\beta\gamma_B(N_A+N_B+N_o)\right]+(N_A+N_B+N_o)[\beta\gamma_B N_A-N_B(\alpha\gamma_A-(1-\alpha-\beta)\gamma_C)]}{-\frac{1}{c}(N_A+N_B)+[\alpha\gamma_A+\beta\gamma_B+(1-\alpha-\beta)\gamma_C](N_A+N_B+N_o)}\right).$$

for $-\frac{1}{c}N_A+\alpha\gamma_A(N_A+N_B+N_o)>0$ *and* $-\frac{1}{c}N_B+\beta\gamma_B(N_A+N_B+N_o)>0$. *It equals*

$$\left(0, \frac{M\left[-\frac{N_B}{c}+\beta\gamma_B(N_A+N_B+N_o)\right]-(1-\alpha-\beta)\gamma_C N_B(N_A+N_B+N_o)}{-\frac{N_B}{c}+(\beta\gamma_B+(1-\alpha-\beta)\gamma_C)(N_A+N_B+N_o)}\right)$$

for $-\frac{1}{c}N_A+\alpha\gamma_A(N_A+N_B+N_o)<0$ *and* $-\frac{1}{c}N_B+\beta\gamma_B(N_A+N_B+N_o)>0$. *And it equals*

$$\left(\frac{M\left[-\frac{N_A}{c}+\alpha\gamma_A(N_A+N_B+N_o)\right]-(1-\alpha-\beta)\gamma_C N_A(N_A+N_B+N_o)}{-\frac{N_A}{c}+(\alpha\gamma_A+(1-\alpha-\beta)\gamma_C)(N_A+N_B+N_o)}, 0\right)$$

for $-\frac{1}{c}N_A+\alpha\gamma_A(N_A+N_B+N_o)>0$ *and* $-\frac{1}{c}N_B+\beta\gamma_B(N_A+N_B+N_o)<0$, *given* $M_A^*>0$ *and* $M_B^*>0$, *respectively. Socially optimal immigration into both occupations is zero, otherwise.*

Tables

Table 1. Benchmark - Calibration and Equilibrium

	Functional forms	Parameters	Quantities	Prices
Household utility per period: Cobb-Douglas				
Home	$u_{\mathrm{I}} = \alpha \ln x_A + \beta \ln x_B + (1-\alpha-\beta) \ln x_C$			
good produced in occupation A		α=0.5	X_A^d=0.60	p_A=0.78
good produced in occupation B		β=0.4	X_B^d=0.43	p_B=0.88
good produced in occupation C		$1-\alpha-\beta$=0.1	X_C^d=0.29	p_C=0.33
Foreign	$u_{\mathrm{II}} = \theta \ln x_B + (1-\theta) \ln x_C$			
good produced in occupation B		θ=0.5	X_B^d=0.20	
good produced in occupation C		$1-\theta$=0.5	X_C^d=0.55	
Technology: Cobb-Douglas				
Home				
good produced in occupation A	$X_A = L_A^{\gamma_A} K_A^{1-\gamma_A}$			
wage share		γ_A=0.7	X_A^s=0.60	p_A=0.78
good produced in occupation B	$X_B = L_B^{\gamma_B} K_B^{1-\gamma_B}$			
wage share		γ_B=0.7	X_B^s=0.63	p_B=0.88
Foreign				
good produced in occupation C	$X_C = L_C^{\gamma_C} K_C^{1-\gamma_C}$			
wage share		γ_C=0.7	X_C^s=0.84	p_C=0.33
Labor endowment and allocation				
mortality rate		m=0.1		
Home				
workers in occupation A		N_A=0.5		w_A=0.67
workers in occupation B		N_B=0.5		w_B=0.79
retired		N_o=0.9		
Foreign				
workers in occupation C		M=1		w_C=0.19
Capital endowment and allocation				
Home				
Consumption rate		c=0.7 (δ=1.4)		
occupation A	$p_A X_A'(K_A) = r$		K_A=0.95	$r = 0.15$
occupation B	$p_B X_B'(K_B) = r$		K_B=1.13	$r = 0.15$
Foreign				
occupation C	$p_C X_C'(K_C) = r$		K_C=0.56	$r = 0.15$

Note: I assume that the occupational population and the interest rate remain unchanged from the previous periods, and that p_{At-1}=p_{At-2}=1, p_{Bt-1}=p_{Bt-2}=1.5, p_{Ct-1}=p_{Bt-2}=0.8. Then, ψ_{At-1}=ψ_{At-2}=0.67, ψ_{Bt-1}=ψ_{Bt-2}=1.20 and ψ_{Ct-1}=ψ_{Ct-2}=0.97. Implied values of occupational output in period t are ψ_{At}=0.47, ψ_{Bt}=0.56, ψ_{Ct}=0.28.

Table 2. Results on immigration quotas (as shares of the total native labor force)

	(1) Baseline	(2) Greater native labor force in occ. A	(3) Greater wage share in occ. B	(4) Greater consumption rate	(5) Greater cons. rate and reverse spending shares on occ. A and B
			(a): No occupational mobility		
Immigration into occ. A					
Group-specific optimum					
Workers in occupation A	0	0	0	0	0
Workers in occupation B	0.75	0.73	0.75	0.75	0.7
Retired natives	**0.5**	**0.45**	**0.44**	**0.5**	**0.3**
Social optimum	0	0	0	0.17	0
Immigration into occ. B					
Group-specific optimum					
Workers in occupation A	0.7	0.7	0.73	0.7	0.75
Workers in occupation B	0	0	0	0	0
Retired natives	**0.3**	**0.34**	**0.36**	**0.3**	**0.5**
Social optimum	0	0	0	0	0.04
			(b): Occupational mobility		
Immigration into occ. A					
Group-specific optimum					
Workers in occupation A	**0**	**0**	0	0	0
Workers in occupation B	**0**	**0**	0.5	0.67	0.62
Retired natives	0.5	0.45	0.44	**0.5**	**0.3**
Social optimum	0	0	0	0.1	0
Immigration into occ. B:					
Group-specific optimum					
Workers in occupation A	**0**	**0**	0	0.56	0.62
Workers in occupation B	**0**	**0**	0	0	0
Retired natives	0.3	0.34	0.36	**0.3**	**0.5**
Social optimum	0	0	0	0	0.06

Note: Equilibrium (median-voter elected) outcomes are in bold. There is no equilibrium outcome in case of occupational mobility in column (3), see Proposition 2. In column (2), the native labor force in A is $N_A = 0.6$. In column (3), the wage share in occupation B is $\gamma_B = 0.8$. In columns (4) and (5), the consumption rate is $c = 0.9$. In column (5) the domestic spending shares on occupations A and B are reversed: $\alpha = 0.4$ and $\beta = 0.5$.

References

Benhabib, J., 1996, On the Political Economy of Immigration, *European Economic Review* **40**(9), 1737-1743.

Borjas, G.J., 1999, The Economic Analysis of Immigration, in: O. Ashenfelter and D. Card, eds., *Handbook of Labor Economics 3A*, Ch. 28, Elsevier Science BV, Amsterdam.

Borjas, G.J., 2007, Clinical Lessons from the UK, The Borjas Blog, July 09, http://borjas.typepad.com/the_borjas_blog/.

Borjas, G.J., J. Grogger and G. Hanson, 2012, Comment: On Estimating Elasticities of Substitution, *Journal of the European Economic Association* **10**(1), 198-210.

Card, D., 2001, Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration, *Journal of Labor Economics* **19**, 22-64.

Cortes, P., 2008, The Effect of Low-Skilled Immigration on US Prices: Evidence from CPI Data, *Journal of Political Economy* **116**(3), 381-422.

Davis, D.R. and D.E. Weinstein, 2002, Technological Superiority and the Losses from Migration, NBER Working Paper 8971.

DeNew, J. and C. Schmidt, 1994, The Industrial Structure of German Earnings 1980-1990, *Allgemeines Statistisches Archiv* **78**, 141-159.

Dixit, A. and R. Rob, 1994, Switching Costs and Sectoral Adjustments in General Equilibrium with Uninsured Risk, *Journal of Economic Theory* **62**(1), 48-69.

Dolmas, J. and G.W. Huffman, 2004, On the Political Economy of Immigration and Income Redistribution, *International Economic Review* **45**(4), 1129-1168.

Facchini, G. and G. Willmann, 2005, The Political Economy of International Factor Mobility, *Journal of International Economics* **67**(1), 201-219.

Facchini, G. and A.M. Mayda, 2008, From Individual Attitudes Towards Migrants to Migration Policy Outcomes: Theory and Evidence, *Economic Policy* **23**(56), 651-713.

Facchini, G., A.M. Mayda and P. Mishra, 2011, Do Interest Groups Affect US Immigration Policy?, *Journal of International Economics* **85**(1), 114-128.

Felbermayr, G. and W. Kohler, 2007, Immigration and Native Welfare, *International Economic Review* **48**(3), 731-760.

Frattini, T., 2008, Immigration and prices in the UK, CReAM, mimeo.

Haisken-DeNew, J. and C. Schmidt, 1999, Industry Wage Differentials Revisited: A Longitudinal Comparison of Germany and USA (1984-1996), DIW Discussion Paper No. 178. Berlin.

Heston, A., R. Summers and B. Aten, 2006, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.

Hillman, A. and A. Weiss, 1999, A Theory of Permissible Illegal Immigration, *European Journal of Political Economy* **15**, 585-604.

Institute for Employment Studies, 2006, Employers' Use of Migrant Labour, Home Office Online Report 03/06.

International Labor Organization (ILO), 2000, Productivity and Unit Labor Cost Comparisons: A Database, International Labor Office, Geneva.

International Labor Organization (ILO), 2007, Key Indicators of the Labour Market (KILM), fifth edition.

Klaver, J. and E. Visser, 1999, Evaluatie Wet Arbeid Vreemdelingen, Ministry of Social Affairs and Employment, The Hague, Netherlands.

Mayda, A.M., 2006, Who is Against Immigration? A Cross-country Investigation of Individual Attitudes Toward Immigrants, *The Review of Economics and Statistics* **88**(3), 510-530.

Miller, P.W., 1999, Immigration Policy and Immigration Quality: the Australian Points System, *American Economic Review P&P* **89**(2): 192-197.

Möller, J. and L. Bellmann, 1996, Qualifikations- und industriespezifische Lohnunterschiede in der Bundesrepublik Deutschland, ifo-Studien, 42, 235-272.

OECD, 2003, Labour Shortages and the Need for Immigrants: A Review of Recent Studies, in: *Trends in International Migration 2003.*

OECD, 2006, Managing Migration - Are Quotas and Numerical Limits the Solution?, in: *International Migration Outlook, Sopemi 2006.*

Ortega, F., 2005, Immigration Quotas and Skill Upgrading, *Journal of Public Economics*, **89**(9-10), 1841-1863.

Ottaviano, G.I.P. and G. Peri, 2012, Rethinking the Effects of Immigration on Wages, *Journal of the European Economic Association*, **10**(1), 152-197.

Plott, C.R., 1967, A Notion of Equilibrium and Its Possibility under Majority Rule, *American Economic Review* **57**(4), 787-806.

Rosen, S., 1986, The Theory of Equalizing Differences; in Ashenfelter, O., Layard, R., eds., 1986, *Handbook of Labor Economics*, Vol.1, Chap.12, Elsevier Science.

Zachariadis, M., 2012, Immigration and International Prices, *Journal of International Economics* **87**, 298-311.

Zimmermann, K.F., H. Bonin, R. Fahr and H. Hinte, 2007, Immigration Policy and the Labor Market - the German Experience and Lessons for Europe, Forschungsinstitut zur Zukunft der Arbeit (IZA), Bonn, Germany, Springer Verlag.