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Dynamic macroeconomic implications of immigration[☆]

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ABSTRACT

International immigration flows are large, volatile, and increasing. We document the dynamic implications of immigration, and account for the differential unemployment and labor force participation rates between immigrants and natives. To quantify the effects of immigration, we use Swedish population registry data and productivity estimates from a matched employer–employee dataset. A refugee (economic) immigration shock yields large initial negative (positive but delayed) effects on GDP per capita and employment rates, substantially larger than, but with the same sign as the corresponding steady state effects. This reflects the empirical fact that labor market integration is a gradual process over many years.

1. Introduction

International immigration flows are large and volatile and have been growing in recent decades. Two prominent examples are the Syrian refugee crisis which reached its peak in 2015 and the Ukrainian refugee crisis which started in 2022. Although there is a large literature analyzing the implications of immigration in many dimensions (e.g., Borjas, 2014), this literature mainly focuses on the micro-level effects. The aggregate effects of immigration have been less studied and this is particularly true for the dynamic effects of immigration on macroeconomic aggregates. However, the fact that immigration generates dynamic responses for important aggregates such as employment, GDP, and taxes suggests that it is important to study and understand these effects for the same reasons that it is important to understand how productivity and monetary policy shocks affect the economy. Compared to most macroeconomic time series the volatility of immigration is staggering—changes in annual growth rates of ±50 percentage points are not unusual for large European countries like Spain or Germany (Eurostat, 2020).[1] The high volatility in combination with the gradual and often slow-moving nature of integration into the labor market suggest that, while steady state analysis is interesting, it might not be sufficient to fully spell out the macroeconomic implications of immigration.

In this paper, we set out to fill this gap in the literature by setting up a dynamic general-equilibrium search and matching model to quantify the fully dynamic effects of immigration on macroeconomic variables including GDP per capita, unemployment, labor force participation (LFP) and welfare. We calibrate the model using rich micro data and consider a refugee immigration shock

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[1] Refugee migration resulting from wars is one important driver of this volatility.

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corresponding to one percent of the total population, which matches both the size and composition of the actual refugee-immigration shock that hit Sweden during the refugee crisis of 2015. As we explain in more detail below, this shock implies substantial short run negative effects on GDP per capita and employment rates, and these effects are indeed much larger than the negative steady-state effects.

From a theoretical perspective, it is clear that immigration can have at least four potentially opposing effects on economic aggregates. One important driver of the fiscal effects of immigration comes from age differences between natives and migrants. If immigrants arrive early in their working age, immigration has a positive fiscal effect, typically referred to as a "demographic dividend". Such age differences also have positive effects on other aggregates, e.g., GDP and they can reduce stress on intergenerational transfer systems (pay as you go).[2]

The second effect comes from the often slow and gradual integration process into the labor market: it is a well-documented fact that employment rates for immigrants in both the U.S. and Western Europe start below the employment rates of natives and are increasing in the number of years since immigration. This pattern is even more pronounced for refugees.[3] The low initial employment rate of immigrants implies negative macroeconomic effects and may overturn the demographic dividend.

A third effect of immigration on economic aggregates concerns the productivity of immigrants relative to the natives, conditional on employment. As shown in Storesletten (2000), the lower the relative productivity of immigrants, the worse are the implications for public finances. Low initial productivity of immigrants also reduces the demographic dividend and implies negative initial effects on the macroeconomy from immigration shocks.[4]

Fourth, the fiscal effects of immigration depend crucially on the size of the welfare state. Unemployment benefits and social transfers have to be financed by distortionary taxes. If it takes a long time before immigrants become productive in the labor market and they are entitled to benefits, this imposes fiscal costs. These costs lead to an increase in taxes, in turn leading to negative effects on GDP per capita and the welfare of natives.

Relative to the existing literature, our modeling framework contains several novel aspects to capture these effects: the gradual integration process, the incorporation of direct measures of the relative productivity of employed immigrants, the use of search frictions to discipline the calibration of immigrant productivity growth , and, less novel, a welfare state. We account for heterogeneity in skill (education) by allowing for high and low skilled workers, but the central heterogeneity in our model is individual productivity within skill groups. Gradual integration is incorporated in that the individual productivity of an immigrant increases with the time that he/she has stayed in the country. As a result, the probability of being structurally unemployed is decreasing in time spent in the country. The incorporation of structural unemployment is important since this is what accounts for the gradual and slow-moving nature of integration. Any excessive frictional unemployment dissipates quickly and has a hard time explaining unemployment that remains elevated for more than a decade according to the micro data.

To calibrate our model we employ detailed Swedish data on the entire population regarding native, general immigrant, and refugee LFP and unemployment as functions of years since immigration. We also make use of unique micro data estimates of differences in labor productivity by country of birth obtained using rich matched employee–employer datasets documented in Ek (2024). These productivity differences can then account for the empirical differences between natives and different immigrant groups in e.g., wages and unemployment rates.

We first show in a simple static model that the demographic dividend dominates if the immigrants have equal or higher productivity than natives. Then the inflow results in a reduction in unemployment and improved public finances. However, if the immigrants instead have relatively low productivity, the result is an increase in structural unemployment and a higher tax leading to further increases in frictional and structural unemployment.

The results in our fully dynamic model confirm these mechanisms, in particular that the negative effect of differentials in productivity dominates. In the baseline exercise, where taxes are smoothed over time, the refugee-immigration shock corresponding to 1 percent of the population leads to a reduction in GDP per capita of 1.5 percent and an increase in aggregate unemployment of 1.5 percentage points initially. These effects are very persistent; more than half of the initial reduction in GDP per capita remains even after 20 years. The refugee immigration shock reduces welfare by 0.9 percent while the effects on aggregate wages and productivity are very limited, in line with the empirical literature. If the budget instead is balanced in each period, the effects are even larger. The tax rate then increases substantially on impact and remains elevated for an extended period. This reduces job creation and leads to sizeable negative general equilibrium effects on GDP and unemployment.

In both fiscal regimes, the maximum dynamic effects are much larger than the steady-state effects for many aggregates. This finding is one of our main results and reflects that the gradual nature of labor market integration is important.

We also contrast the effects from refugee immigration to those resulting from economic immigration from developed countries. Specifically, if the age difference is kept unchanged, but immigrants are assumed to have the same productivity and LFP as natives, then immigration yields a substantial demographic dividend that implies a higher employment rate, GDP per capita and a lower tax rate. This shows the importance of the composition of immigration for macroeconomics outcomes. A final result is that policies

[2] Indeed, the fact that immigration tends to improve the old-age dependency ratio is an important contributor to the positive welfare effects from immigration that are found in Busch et al. (2020).

[3] See Brell et al. (2020) and Busch et al. (2020) regarding employment rates for immigrants generally and for refugees. Lubotsky (2007) also documents a similar pattern for the relative earnings of immigrants.

[4] Two pieces of evidence suggest that the productivity of immigrants tends to be lower than for natives. The first reason is the direct estimates in Ek (2024) that show that the mean productivity of employed immigrants in the Swedish labor market is a factor 0.73 of natives' productivity. The second reason is the higher unemployment rates for immigrants (OECD, 2018) which plausibly are interpreted as structural, i.e. due to lower productivity.

affecting structural unemployment, are crucial to reduce the adverse effects of migration shocks, while policies aimed at reducing search frictions have only modest effects.

The paper is structured as follows. In Section 2, the related literature is outlined. Section 3 sets up a simple search and matching model to gain intuition for the main mechanisms. Section 4 describes the micro data and labor-market properties for migrants. Sections 5–7 respectively present the model, the calibration, and the results. Finally, Section 8 concludes.

2. Related literature

There is a large literature concerned with many different aspects of immigration. Most of the theoretical contributions that are related to our paper are limited to steady state analysis. Chassamboulli and Palivos (2014) uses a search and matching framework to quantify the steady-state effects on natives' wages from the inflow of skilled-biased immigrants to the United States. They find a positive effect on the net income of natives but also that there are distributional effects. Similarly, Battisti et al. (2018) uses a search and matching framework and instead focuses on the welfare effects of natives. They find mostly positive effects unless the stock of immigrants is unskilled. The steady-state implications of immigration are also studied in Ottaviano and Peri (2012) that considers immigration to the United States, and Dustmann et al. (2013). The focus on steady states in all these papers implies that the dynamic effects of immigration shocks on macroeconomic aggregates are abstracted from.

There is a literature on the effects of immigration in a dynamic macroeconomic context but in different settings relative to this paper. Smith and Thoenissen (2019) analyzes the effects of high-skilled migration shocks for the business cycle. Canova and Ravn (1998, 2000) instead study how the effects of low-skilled immigration are affected by the presence of a welfare state. Their results show that the welfare state distorts the adjustment process to the new steady state. They also show that an inflow of low-skilled immigrants can result in a gain for the natives in the absence of a welfare state and a loss with a welfare state. All these papers abstract from unemployment and the first paper also from LFP.

Similarly to us, Busch et al. (2020) studies the refugee wave around 2015. They focus on the welfare implications for various groups of natives and find that the welfare gains for high-skilled workers outweigh the welfare losses for low-skilled workers. As we will see, our results instead reveal negative aggregate welfare effects. There are (at least) two important reasons for these differences in results. The first and most important one is that, even though Busch et al. (2020) also incorporate a gradual integration process into the labor market for immigrants, they do not model unemployment benefits and welfare payments to agents who do not work.[5] As the integration process is slow, this assumption abstracts from one of the largest costs associated with immigration. Another difference is that they estimate productivity profiles from observed wages, i.e. from the subset of the population that is employed. When these estimates are used in their model, it results in a upward bias since in the model everyone works. In reality, however, the people who do not work are likely to have lower productivity because of structural unemployment and selective labor market participation. In contrast, our productivity estimates are consistent for the people who actually work, whereas those who do not will, on average, have lower productivity.[6]

Recent empirical work by Furlanetto and Robstad (2019) uses an SVAR approach to study the effects of economic immigration, i.e., their analysis only includes immigrants that start working immediately. This type of immigration shock reduces unemployment and improves public finances. Dustmann et al. (2005) quantifies the effects of immigration on labor market outcomes of the native population and find limited negative effects on natives' wages.

A key distinction between our model and the one in Battisti et al. (2018) concerns the reasons for why unemployment rates differ between immigrants and natives. In our setting, the model is fed with empirical differences in average productivity between immigrants and natives as reported in Ek (2024), and we allow for heterogeneity in productivity within skill groups. The implication is higher structural unemployment for immigrants relative to natives as well as lower average wages for immigrants—features that are supported by the data. In contrast, Battisti et al. (2018) only allows for frictional unemployment and assumes equal productivity for immigrants and natives, but lower outside options for immigrants.[7]

3. The main mechanisms

In this section, we set up a simple search and matching model with both frictional and structural unemployment and restrict the analysis to steady-state variations in order to derive analytical results. We use the model to address two specific questions: (i) how do fiscal effects from immigration affect the labor market, and (ii) how does the productivity distribution of immigrants—compositional effects—affect the labor market? Here we only present the equations that are necessary for conveying the intuition, but the model is described in detail along with all derivations in appendix A5.

Turning to the formal description of the model, workers have heterogeneous productivities ε_i and are distributed according to the cumulative distribution function G with probability density g and support I. Letting G^d and G^m (Ω^d and Ω^m) respectively denote the cumulative distribution function of individual productivities (population) for natives and immigrants, the cumulative distribution function of the entire population is given by $G(\varepsilon) = \frac{\Omega^d G^d(\varepsilon)+\Omega^m G^m(\varepsilon)}{\Omega^d+\Omega^m}$. The meeting function is Cobb–Douglas with an elasticity of ξ

5 Asylum seekers receive a one-period transfer.

6 Other contributions with a dynamic dimension but different from this paper include Stähler (2017), Liu (2010), and Malafry (2018).

7 These assumptions generate the counterfactual prediction of a lower unemployment rate for immigrants than natives. Finally, Battisti et al. (2018) assumes the same LFP for natives and immigrants, but as shown in Fig. 1, this assumption is inconsistent with the data.

with respect to unemployment, which respectively delivers job and vacancy meeting rates to be $f = \theta^{1-\xi}$ and $q = \theta^{-\xi}$, where θ is labor market tightness.

The value of a firm that employs a worker with productivity ε_i and pays the wage w_i is then given by $J_i = \varepsilon_i - w_i + \beta(1-\delta)J_i$, where β is the discount factor and δ the exogenous probability that a match is destroyed. The surplus of an employed worker with productivity ε_i is $S_i = (1-\tau)w_i - b + \beta\left(1-\delta-\tilde{f}_i\right)S_i$, where τ is a tax on labor income, b the flow payoff when unemployed, $\tilde{f}_i \equiv f\mathbb{I}\left(J_i \geq 0\right)$ the probability of finding a job, and $\mathbb{I}$ is an indicator function that captures whether a worker is employable or not.

Wages are determined by the Nash bargaining solution $(1-\tau)\eta J_i = (1-\eta)S_i$, where η is the bargaining power of the worker.[8] Finally, the job creation condition is given by $c = q\beta \int_I \frac{u_i}{u} \max\left\{J_i, 0\right\} di$, where c is the vacancy cost and $u = \int_I u_i di$.

In this model, there exists a cutoff value for individual productivity, ε^c, where the firm is indifferent between employing and not employing a worker ($J_i = 0$). This value can be shown to be given by

$$\varepsilon^c = \frac{b}{1-\tau} \equiv \tilde{b}. \tag{1}$$

Intuitively, the cutoff productivity is set so that the firm value is equal to the flow value of unemployment, net of tax. The share of employable workers is thus $1 - G(\tilde{b})$, which implies that structural unemployment is given by $G(\tilde{b})$. Denoting the employment share of the population by n, frictional unemployment is then given by $1 - n - G(\tilde{b})$. Since frictional unemployment is similar for any $\varepsilon_i \geq \varepsilon^c$, the probability density function (PDF) for workers with productivity ε_i, conditional on employability, is $g_i/(1-G(\tilde{b}))$. Finally, the average productivity among employed workers is given by $\bar{\varepsilon} \equiv \int_{i:\varepsilon_i \geq \varepsilon^c} \frac{g_i}{1-G(\tilde{b})}\varepsilon_i di$. Using these results and definitions and the solution for firm values that can be derived using the Nash solution for wages, the job creation condition can be written as

$$c = \underbrace{\frac{q\beta(1-\eta)\left(\bar{\varepsilon} - \frac{b}{1-\tau}\right)}{1-\beta(1-\delta)+\beta\eta f}}_{\Psi(\theta,\tau)} \underbrace{\frac{\delta\left(1-G\left(\frac{b}{1-\tau}\right)\right)}{\delta + fG\left(\frac{b}{1-\tau}\right)}}_{\Upsilon(\tau)}.$$

The first term, Ψ, is standard in search and matching models without structural unemployment and captures the value of filling a vacancy in such models. The second term, Υ, is an additional effect from structural unemployment on job creation. It is straightforward to verify that the partial derivatives of Ψ and Υ satisfy $\Psi_\theta(\theta,\tau) < 0$, $\Psi_\tau(\theta,\tau) < 0$ and $\Upsilon_\tau < 0$.

We are now ready to derive some results. An inflow of workers with relatively high productivity can result in a demographic dividend that allows for a lower tax, whereas the opposite may be true when productivity is relatively low. We first turn to how compositional changes in immigration affect the distribution, G while keeping distortionary taxes fixed.[9] From (1) it is clear that the cutoff $\tilde{b}$ is unaffected by such changes. Depending on the individual productivities of the immigrants, the share of workers below the employability cutoff $\tilde{b}$ as well as the average productivity among employed workers can increase or decrease. Here, we focus on two distinct cases highlighting the two different channels.

Proposition 1. *Consider an inflow of relatively unproductive migrants, modeled as a $\bar{\varepsilon}$-preserving spread with the new distribution being denoted by G', i.e., keeping the average productivity of the employable workers fixed, $\bar{\varepsilon}' = \bar{\varepsilon}$. The result is a reduction in labor market tightness and job creation and an increase in structural unemployment.*

Proof. The Proposition follows immediately from the fact that $G'(\tilde{b}) > G(\tilde{b})$, which reduces Υ. This reduction then requires an increase in Ψ, which is achieved through a fall in θ. ■

The intuition for Proposition 1 is straightforward: an increase in the share of workers that gives no surplus to the firms implies that it is less profitable to post vacancies. As a result, vacancies and job creation fall. Second, we evaluate the effects of an increase in relatively productive migrants while keeping the fraction of employable workers fixed.

Proposition 2. *Consider an increase in relatively productive migrants in the form of a $G(\tilde{b})$-preserving productivity increase of G to G', so that the share of structurally unemployed remains unchanged (i.e., $G'(\tilde{b}) = G(\tilde{b})$), while expected productivity among the employed increases (i.e., $\bar{\varepsilon}' > \bar{\varepsilon}$). Then job creation increases and frictional unemployment falls.*

Proof. The change leaves Υ and $\tilde{b}$ unchanged but increases Ψ, which implies from the job creation condition that labor market tightness and the job meeting rate both increase. ■

The intuition for Proposition 2 is simply that the employable workers become more productive on average, which induces firms to post more vacancies. As a result, job creation increases and the frictional unemployment rate falls.

If taxes are distortionary, the changes in G that are respectively described in Propositions 1 and 2 will also induce fiscal effects along the lines described in Proposition 3. Specifically, the net result of an inflow of low-skilled immigrants then results in an increase in both structural and frictional unemployment and a higher tax rate that depresses employment, whereas the opposite is true for an inflow of high-skilled immigrants. In other words, the mechanisms amplify each other. The following Proposition 3 then reveals how these tax changes affect the labor market.

[8] This follows from noting that the wage maximizes $S_i^\eta J_i^{1-\eta}$ and using the definitions of J_i and S_i.

[9] By assumption, any shortfall or increase in revenue is handled with lump sum transfers/taxes.

Proposition 3. *An increase in the tax rate decreases tightness and the job finding rate and increases both frictional and structural unemployment.*

Proof. Without structural unemployment $\Psi(\theta, \tau) = c$ and $\Psi_\tau < 0$ so tightness decreases. As a result, the job finding rate decreases, and frictional unemployment increases. It then follows from (1) that a higher tax increases $\tilde{b}$, which implies an increase in structural unemployment. The fall in Y also amplifies the reduction in tightness and the job finding rate. ■

Our full model, described in detail in Section 5, includes an explicit formulation of immigration flows and the population of natives. Also, a general technology with (imperfectly substitutable) high- and low-skilled workers is used. As we will see in Section 7, refugee immigration in the full model triggers a fall in the fraction of employable workers, which increases structural employment $G(\tilde{b})$. The resulting fiscal effects lead to an increase in tax rates, in turn increasing both frictional and structural unemployment.

4. Labor market integration in the Swedish data

To inform the fully dynamic model about the level of structural unemployment and integration of immigrants, we use data from Statistics Sweden, and specifically the STATIV/LISA database. This is a rich dataset on the entire Swedish population where we use data for individuals in the age range 20–64 years. We have access to data from 2000–2017, but for the calibration and most other purposes we limit our sample to 2000–2014, to capture the conditions before the immigration wave in 2015–2017. The dataset includes variables such as continent of birth, the date and reason for immigration, labor market status, labor income and various demographic variables, e.g., educational attainment. Estimates of productivity for immigrants from different regions of birth are based on Ek (2024). These estimates are based on a rich Swedish matched employer–employee population dataset.

Refugee residence permits in Sweden have varied between around 5000 and 70,000 per year during the period 1980–2016, with peaks in 1994, 2007 and 2016.[10] Other types of immigration, such as family reunification and work-based residence permits are generally larger and less volatile with an increasing trend over time. During the period 2000–2017, refugees and their families accounted for one-third of the immigrants living in Sweden. In total, the fraction of the population that is foreign-born is high in Sweden, around 20%.

Immigrants and refugees are different from natives in many dimensions. Some of these differences are most pronounced in the first couple of years after immigration. In Fig. 1, we document LFP and unemployment rates for all immigrants and refugees, respectively, as a function of the number of years since immigration.[11] The left graph in Fig. 1 reveals that the unemployment rate, in particular for refugees, is very high, in the first few years after the immigration date. The rate then falls slowly over time towards, but never reaching, the level of natives, which is 6.87% in the data. The right panel of Fig. 1 instead documents the LFP rate of immigrants and refugees over time. The initial difference compared to the level for native-born individuals (84%) is also very large but shrinks over time. We discuss and document in detail how these data are used in the calibration of LFP and productivity of immigrants of the model in Section 6 and in the online appendix.

These patterns in the Swedish data are fairly similar to those in continental Europe. Brell et al. (2020) provides data for nine Western countries and documents that the employment rate is an increasing function of the number of years in the country.[12] The employment rates of immigrants also fall short of those for natives for the first 10 years since immigration in all countries. Overall, the facts documented in Fig. 1 indicate that the maximum negative effect on economic outcomes like employment rates occurs initially.

5. The model

We now specify the full dynamic model. Utility is linear in consumption and agents can either be of working or non-working age. An individual starts life when entering working age. We simplify the modeling of age by using the "Model of Perpetual Youth" approach of Blanchard-Yaari (Blanchard, 1985; Yaari, 1965) where there is a constant probability of transition from working-age to retirement and from retirement to death. This captures what we are concerned with in this paper—the public-finance implications of immigration through the age-dependency ratio—equally well as less tractable OLG frameworks would.[13]

The labor market is characterized by search and matching and allows for both frictional and structural unemployment. Workers are divided into two skill groups: high (H) and low (L), which, in the data, corresponds to workers with and without a college degree. Within each skill group, workers also differ with respect to individual productivity (i.e., efficiency units of labor). Unemployed workers search for jobs within their skill-group-specific labor market. This specification generates variation in unemployment rates, wages, and labor productivities between high and low skill natives and immigrants.[14]

In contrast to the model in Section 3, we here consider a discrete distribution for individual productivity. Specifically, individual productivity of a worker with type $i \in \{1, 2, \ldots, I\}$ is denoted by ϵ_i. For natives, denoted by superscript d—as in *domestically* born—the (discrete) PDF of the productivity distribution is approximated by a log-normal distribution, and its parameters vary across skill

10 See Ruist (2018).

11 To be specific, number of years since the residence permit was issued.

12 The countries are Australia, Canada, Denmark, Finland, Germany, Norway, Sweden, United Kingdom, and the United States.

13 Specifically, the dispersion in individuals' age has no first order aggregate importance for the variables that we are concerned with.

14 For empirical differences in productivity, see Ek (2024).

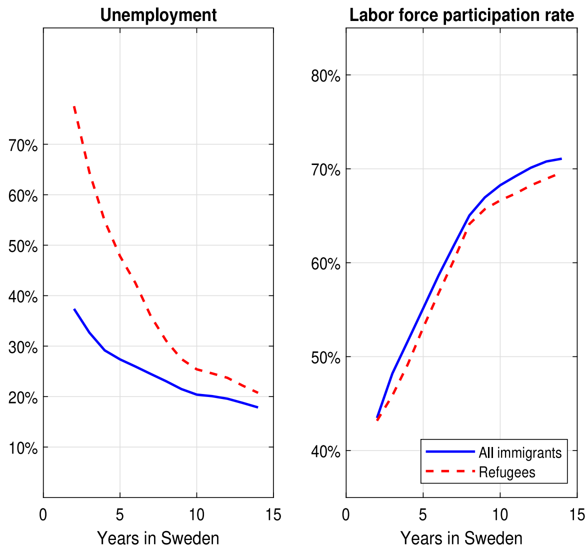

Fig. 1. Unemployment rate and labor force participation rate of immigrants and refugees as functions of the number of years in the country. The sample period is 2000–2014.

levels.

For immigrants, the productivity distribution is more complicated. When entering the country, the individual productivity of a *newly arrived* immigrant—denoted by na—also follows a log-normal distribution, but with a lower mean and a potentially different standard deviation relative to the corresponding native distribution. We then assume a gradual integration process implying that the mean of the distribution increases over time so that the productivity gap relative to natives with the same skill level is reduced. This is intended to capture improvements in local language skills, improved matching of other skills to job requirements, and a growing network of potential employers resulting in better job matches. Formally, the individual productivity for immigrants follows a Markov process where every period it remains unchanged with probability $1-\pi$, and increases by some small amount, from ε_i to ε_{i+1}, with probability π. The integration process then ends with probability ϕ and the immigrant becomes *established*, which we denote by e. Similar to native-born workers, established immigrants have constant productivity. This integration specification is able to match the empirical fact that the unemployment rate is a convex function of the number of years in the country as shown in Fig. 1. A simplification in our approach is that it does not account for productivity differences between immigrants who arrive as children or as adults.

The worker productivity distribution is determined by four means, μ_g^o, and standard deviations, σ_g^o, where $g \in \{H, L\}$ and $o \in \{d, na\}$, as well as the integration parameters π and ϕ. Finally, LFP rates for immigrants are exogenous processes that are increasing in the number of years that an individual has stayed in the country.

5.1. Search and matching

The labor market is characterized by random search within each skill group and the job meeting rate, f_g, depends on the meeting function and the unemployment, i.e., $f_g = M_g/u_g$, $g \in \{H, L\}$, where M_g is the meeting function and u_g is unemployment. The meeting function is Cobb–Douglas but modified to assure that meeting probabilities are at most one: $M_g = \min\left\{A\left(u_g\right)^{\xi}\left(v_g\right)^{1-\xi}, u_g\right\}$. Unemployment for skill group g is then simply the sum of workers with productivity i in that skill group: $u_g = \sum_{i\in I} u_{i,g}$. The vacancy meeting rate and labor market tightness are, respectively, given by $q_g = M_g/v_g$ and $\theta_g = v_g/u_g$. Firms post vacancies in the market for skilled or unskilled workers at cost c_g, and exogenous separations vary across markets and are denoted by δ_g where $g \in \{L, H\}$.

5.2. Technology

In our baseline model specification, we assume that workers *between* different skill groups and country of origin are imperfectly substitutable. These assumptions are confirmed by estimates reported in the online appendix, section A6. The baseline assumption of imperfect substitutability implies that the labor supply (in efficiency units) for skill group g depends on the country of origin and is given by $n_g = \left(\left(n_g^d\right)^{\frac{\rho_e-1}{\rho_e}} + \left(n_g^m\right)^{\frac{\rho_e-1}{\rho_e}}\right)^{\frac{\rho_e}{\rho_e-1}}$ with $n_g^o = \sum_i \varepsilon_i n_{i,g}^o$ for group $o \in \{d, m\}$, where $n_{i,g}^o$ is employment for workers in group o with skill g and productivity ε_i. The production function is of the Cobb–Douglas type, i.e.,

$$Y \equiv F\left(n_H, n_L, K\right) = A^{tfp} K^{\alpha} Z\left(n_H, n_L\right)^{1-\alpha}, \tag{2}$$

where A^{tfp} is total factor productivity, K is capital, α the capital share and Z is a CES aggregate over the two types of labor, i.e., $Z = \left(a n_H^{\frac{\rho-1}{\rho}} + (1-a) n_L^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$. The marginal products of high- and low-skilled labor of group o are, respectively, given by

$$\frac{\partial F}{\partial n^o_{i,H}} = (1-\alpha) A^{tfp} K^{\alpha} Z^{-\alpha} a \left(\frac{Y}{n_H}\right)^{\frac{1}{\rho}} \left(\frac{n_H}{n^o_H}\right)^{\frac{1}{\rho_e}} \varepsilon_i \text{ and}$$
$$\frac{\partial F}{\partial n^o_{i,L}} = (1-\alpha) A^{tfp} K^{\alpha} Z^{-\alpha} (1-a) \left(\frac{Y}{n_L}\right)^{\frac{1}{\rho}} \left(\frac{n_L}{n^o_L}\right)^{\frac{1}{\rho_e}} \varepsilon_i. \tag{3}$$

Capital is fully internationally mobile, which implies that the return to capital is determined on a world market. The capital–labor ratios of firms is then determined by the requirement that the marginal product of capital equals the international return to capital.[15]

5.3. Worker and firm values

Working age individuals transit into non-working age with a fixed probability p^o, $o \in \{d, na, e\}$. These probabilities are calibrated to match the empirically observed time spent in non-working age, which includes both retirement and childhood. However, in the model we use retirement as a shorthand for non-working age since the fiscal consequences of children and retirees are similar. This way we can capture the demographic dividend that occurs because immigrants tend to arrive young but of a working age. Individuals of working age who are outside the labor force receive z_l in government assistance, and retirees receive z_{ret}. Finally, retirees die with the exogenous probability Θ^o. Using $'$ to denote the next period's value, the value of being retired is given by $R^o = z_{ret} + \beta(1-\Theta^o) R^{o\prime}$, where β denotes the discount factor and $o \in \{d, na, e\}$.

When an unemployed worker gets a job, the worker can end up (randomly) at any of the firms in the model. Denoting the vector of employment levels of the firm by $\boldsymbol{n} \equiv \left\{ \{n_i^d\}_{i\in I,L}, \{n_i^{na}\}_{i\in I,L}, \{n_i^e\}_{i\in I,L}, \{n_i^d\}_{i\in I,H}, \{n_i^{na}\}_{i\in I,H}, \{n_i^e\}_{i\in I,H} \right\}$, the value of being unemployed for natives and established migrant workers is given by

$$U^o_{i,g} = b_{i,g} + rk^o_{i,g} + \beta(1-p^o)\left[\tilde{f}^o_{i,g} \mathbb{E}_{\boldsymbol{n}'} W^{o\prime}_{i,g}(\boldsymbol{n}') + \left(1-\tilde{f}^o_{i,g}\right) U^{o\prime}_{i,g}\right] + \beta p^o R^{o\prime}, \tag{4}$$

where $o \in \{d, e\}$, $\tilde{f}_{i,g} \equiv f_g \mathbb{I}(J_{i,g}(\boldsymbol{n}'))$ is the job finding probability and $\mathbb{E}_{\boldsymbol{n}'}$ is the expectation over firms across employment.[16] Intuitively, the value of unemployment depends on the unemployment-insurance benefit and the continuation value.

Similarly, the value of being employed for natives and established workers is given by

$$W^o_{i,g}(\boldsymbol{n}) = (1-\tau) w^o_{i,g} + rk^o_{i,g} + \beta(1-p^o)\left[\left(1-\delta_g\right) W^{o\prime}_{i,g}(\boldsymbol{n}') + \delta_g U^{o\prime}_{i,g}\right] + \beta p^o R^{o\prime}, \tag{5}$$

where $o \in \{d, e\}$.

As described above, immigrants are facing a gradual integration process. The timing of the possible transitions for immigrants is as follows. In a given time period, agents first retire with probability p^m, $m \in \{na, e\}$. Newly arrived immigrants then become established with probability ϕ. The potential productivity improvements of newly arrived immigrants are then realized, i.e., their individual productivities increase by one grid point with probability π. The value for a newly arrived worker, $W^{na}_{i,g}(\boldsymbol{n})$, of employing with productivity level ε_i is straightforward but somewhat extensive due to the integration process. For that reason, this expression has been placed in the appendix.

Turning to the firms, these are large and employ several workers. The value of a firm is

$$V(\boldsymbol{n}) = \max_{\{v_L, v_H, K\}} F\left(n_H, n_L, K\right) - \sum_{o\in\{d,na,e\}} \sum_{i=1}^{I} \sum_{g\in\{H,L\}} w^o_{i,g} n^o_{i,g} - \sum_{g\in\{H,L\}} c_g v_g - (r+\varsigma) K + \beta V(\boldsymbol{n}'), \tag{6}$$

where v_g is the number of vacancies and $r+\varsigma$ the user cost of capital. Naturally, the value is increasing in output, decreasing in factor payments, and the costs associated with posting vacancies. The value to the firm of an additional worker of group o, skill g, and productivity i is denoted by $J^o_{i,g}(\boldsymbol{n})$. This value can be computed by differentiating (6) with respect to $n^o_{i,g}$ and shown to be given by

$$J^d_{i,g}(\boldsymbol{n}) = \frac{\partial F}{\partial n^d_{i,g}}\left(n_H, n_L\right) - w^d_{i,g} + \beta\left(1-p^d\right)\left(1-\delta_g\right) J^d_{i,g}(\boldsymbol{n}'). \tag{7}$$

Similarly, the value to the firm of employing an established and a newly arrived worker each with productivity level ε_i are, respectively, given by

$$J^e_{i,g}(\boldsymbol{n}) = \frac{\partial F}{\partial n^e_{i,g}}\left(n_H, n_L\right) - w^e_{i,g} + \beta(1-p^m)\left(1-\delta_g\right) J^e_{i,g}(\boldsymbol{n}') \tag{8}$$

$$J^{na}_{i,g}(\boldsymbol{n}) = \frac{\partial F}{\partial n^{na}_{i,g}}\left(n_H, n_L\right) - w^{na}_{i,g} + \beta(1-p^m)\left(1-\delta_g\right)$$

[15] We follow Battisti et al. (2018) and assume that each individual owns an equal and constant share of capital that is independent of immigration. The marginal return to capital is equal across individuals. Allowing for gradual adjustments of capital would amplify the negative initial effects of increased immigration as the marginal product of labor temporarily would fall and result in lower employment and wages during the transition. It would also imply temporarily increased returns to capital and benefit capital owners.

[16] Specifically, it is the job meeting rate times an indicator function, $\mathbb{I}$, that takes the value one if the firm value of hiring the specific worker is positive and zero otherwise.

$$\times \left[(1-\phi) \left((1-\pi) J^{na}_{i,g}\left(\boldsymbol{n}'\right) + \pi J^{na}_{i+1,g}\left(\boldsymbol{n}'\right) \right) + \phi J^{e}_{i,g}\left(\boldsymbol{n}'\right) \right]. \tag{9}$$

With the marginal products of labor given by (3), it follows that the marginal value to the firm of a worker with productivity ε_i and skill g only depends on F, n_g and i. This is convenient in that it implies that the state space can be reduced to $\{F, n_g, i\}$ instead of the full employment vector $\mathbf{n}$.

5.4. Wage determination and job creation

As in the simple model in Section 3, wages are determined by Nash bargaining. Here, bargaining takes place between the representative firm and each worker of group $o \in \{d, na, e\}$, skill g and productivity ε_i, i.e., we have

$$(1-\tau)\eta J^{o}_{i,g}(\boldsymbol{n}) = (1-\eta)\left(W^{o}_{i,g}(\boldsymbol{n}) - U^{o}_{i,g}(\boldsymbol{n}) \right). \tag{10}$$

The wage is thus set so that the firm gets a share of the present value of the marginal surplus during the worker's tenure. In particular, wages depend on the marginal product of the worker today and in the future. Stole and Zweibel (1996) suggest an alternative formulation where bargaining (for large firms) are non-binding. The outcome implies that wages also depend on inframarginal contributions to production. As shown in Cahuc and Wasmer (2001), however, allowing for flexible capital, implies that wages only depend on the marginal contribution. The same is true if contracts are binding. Wages are then independent of inframarginal contributions and are determined along the lines of Eq. (10).[17]

A vacancy that is filled today turns into a productive match tomorrow. The optimal choice of vacancies in (6) then gives the following job creation conditions for skill groups $g \in \{L, H\}$[18]:

$$c_g = q_g \beta \mathbb{E}_{\boldsymbol{n}'} \left\{ \mathbb{E}_I \left[h^{d}_{i,g} J^{d}_{i,g} \right] + (1-\phi)\mathbb{E}_I h^{na}_{i,g} \left[\pi J^{na}_{i+1,g} + (1-\pi) J^{na}_{i,g} \right] \right.$$
$$\left. + \phi \mathbb{E}_I h^{na}_{i,g} J^{e}_{i,g} + \mathbb{E}_I h^{e}_{i,g} J^{e}_{i,g} \right\}.$$

where $J^{d}_{i,g}$, $J^{na}_{i+1,g}$, $J^{na}_{i,g}$, $J^{e}_{i,g}$ all are required to be larger or equal to zero and $\mathbb{E}_{\boldsymbol{n}}$ ($\mathbb{E}_I$) denotes the expectation over employment (productivity).

5.5. Government

Two fiscal regimes are considered: one where the government budget is balanced in each period and one with tax smoothing. Our baseline assumption is the latter case where the policymaker responds to any shock by changing the tax rate permanently to balance the intertemporal budget constraint.[19]

The government spends money on unemployment benefits, government assistance to individuals outside the labor force, retirees and administrative costs for new refugees, z_{adm}. This is financed by taxing labor income at a rate τ. When the budget is balanced period by period, taxes are chosen so that

$$\begin{aligned} &\sum_{g\in\{H,L\}} \sum_{i=1}^{I} u_{i,g} b_{i,g} + z_l \sum_{g\in\{H,L\}} \sum_{o\in\{d,na,e\}} \sum_{i=1}^{I} \left(\omega^{o}_{i,g} - l^{o}_{i,g} \right) + z_{ret} \times ret + z_{adm} \times perm \\ &\qquad = \tau \sum_{o\in\{d,na,e\}} \sum\nolimits_{g\in\{H,L\}} \sum_{i=1}^{I} n^{o}_{i,g} w^{o}_{i,g} \end{aligned} \tag{11}$$

where ret ($perm$) is the number of retirees (new refugees).

The remaining details of the model are documented in the appendix. In particular, appendices A1–A3 describe how the population, the labor force and employment evolves.

6. Calibration

In this section we describe the calibration of the model. A period is a quarter. There are quite a few parameters in the model, so we here focus on the ones that are specific to immigration and to our setting. The full calibration and its details are laid out in appendix A6. Table 1 documents how key demographic and labor-market related parameters are calibrated to match the empirical values in the data.

The working age is 24–64 years. The average age of immigrants' entry to Sweden is 30.7 and they then spend 33.3 years in working-age (on average) before retirement according to the SCB data, and this is matched with p^m. Natives are assumed to enter working age at 24 years old, which implies $p^m > p^d$. The calibration of $\Theta^m > \Theta^d$ implies longer expected time in non-working age

[17] See Westermark (2003).

[18] A more detailed expression is found in appendix A3.

[19] Note that, even though tax smoothing may appear superior from a normative perspective, many countries have fiscal rules that restrict government debt and the budget deficit. In the Swedish case, the budget balance is required to be slightly positive over the business cycle. Empirically, in Sweden tax rates show no tendency to vary annually with immigration. Specifically, we have looked at the total tax revenue as a fraction of GDP over time. This time series is available from Statistics Sweden and is quite stable at an annual frequency. Furthermore, the correlation with immigration (both refugees and total) is very low, also when lags are considered.

Table 1
Calibration of parameters set to match the data, in percent, except z_{adm}, ρ and ρ_e.

κ^d	κ^{init}	κ^m	κ^{new}	$\frac{\Omega^m}{\Omega}$	$\frac{\Omega^d_H}{\Omega^d}$	$\frac{\Omega^m_H}{\Omega^m}$	p^d	p^m	Θ^d	Θ^m	z_l, z_{ret}	z_{adm}	ρ	ρ_e
87	40	78	6.36	18	36	34	0.62	0.75	0.66	1.20	70.3	9.64	4.95	33.8

Source for κ^d, κ^{init}, κ^m, κ^{new}, Ω^m/Ω, Ω^d_H/Ω^d, Ω^m_H/Ω^m: SCB, Stativ. Details for these, as well as for ρ and ρ_e, are provided in appendix A6.

Table 2
Parameters obtained by moment-matching.

Parameter	Value	Targeted moment	Data value	Model value
A	0.5497	All unempl. rates	See below	See below
σ^d_H	0.2366	Unempl rate, d_H	3.48%	3.48%
σ^d_L	0.2536	Unempl rate, d_L	8.74%	8.79%
σ^m_H	0.2607	Unempl rate, m_H	14.32%	14.25%
σ^m_L	0.1061	Unempl rate, m_L	20.47%	20.25%
a	0.5356	Skill premium	1.26	1.28
b_H	0.1776	Repl. rate, avg in Q4	0.425	0.452
b_L	0.1660	Repl. rate, avg in Q1–Q3	0.649	0.710
μ^m	0.6048	Rel. prod of employed m	0.73	0.76
π	0.08968	Unempl for m in year 3, 11 & ≥15	$\begin{cases}37.39\%\\20.39\%\\13.08\%\end{cases}$	$\begin{cases}37.69\%\\20.40\%\\13.19\%\end{cases}$
ϕ	0.008400	Unemployment	See above	See above

All unemployment rates are computed from the LISA database from Statistics Sweden and are averages for the sample period 2000–2014. The unemployment profile of immigrants is measured for individuals who have been in the country 2–3, 10–11 and ≥15 years. The target for the skill premium is from OECD (2011). Replacement rates for income quartiles 1–3 and quartile 4 are authors' calculations using data from SCB and the Swedish Unemployment Insurance Inspectorate (IAF). Details are provided in appendix A6.

for natives. The fact that immigrants tend to be of working age when they arrive is what generates the potential for a demographic dividend.[20]

The welfare payment z_l is calibrated as a fraction of the (average) unemployment benefit level. Specifically, using welfare payments for single adult households and average unemployment benefit payments, the ratio z_l/b equals 0.703 in the data.[21] z_{adm} captures public costs of housing, supporting and administrating refugees before these are issued a residence permit. It is expressed in terms of a one-time cost. This parameter is computed by dividing such costs reported by the Swedish Migration Board by the number of refugee residence permits issued. The elasticity of substitution between skill groups, ρ, is estimated on Swedish data using the method in Ottaviano and Peri (2012).

In addition to the parameters in Table 1 and the nine parameters that are set to standard values (as shown in Table 4 in online appendix A6), there are eleven remaining parameters. For these parameters, we search jointly for the parameter values that minimize the square percent deviation between the eleven model and data moments listed in Table 2. We do this under the assumption of tax-smoothing which appears to be the empirically relevant assumption for Sweden. Where possible, the rows in Table 2 indicate the main identifying moment for each parameter, but several parameters simultaneously affect multiple moments. As can be seen, the model matches the targeted moments very well. The good match of the convex and declining empirical profile of unemployment in the number of years since immigration is illustrated in Figure 6 in the appendix, and this close match is of particular importance for the aggregate dynamics. While the profile of unemployment informs the productivity growth parameters for immigrants, the level of productivity of immigrants is informed by the estimate of exactly this object from Ek (2024).

As pointed out in Storesletten (2000), the productivity of immigrants is important for the size and sign of the effect of immigration on public finances. Hence, it is crucial to incorporate accurate measures of productivity. One important dimension where our paper differs from previous studies on immigration is that we make use of direct measures of the mean relative productivity of employed immigrants, instead of using the wage as a proxy for productivity. Specifically, we build on Ek (2024) that uses a dataset of matched employer–employee data to estimate country-of-origin-specific worker productivity, controlling for education and experience at the individual level. This dataset includes all workers and all Swedish firms with at least five employees for the years 2008–2014, and it is used to estimate firm-level production functions with value-added as the dependent variable while controlling for various characteristics of the firm.[22] Note that the moment-matching procedure matches the relative productivity of employed immigrants

[20] Specifically, immigrants then generate less childhood-related fiscal expenditures than natives in terms of, e.g., childcare and schooling. Although mechanically modeled as pension payments here, we take the relative distribution of the non-working between young and retirees into account in the calibration, as well as the relative public spending levels on the two categories. Θ^d is based on 20 years of youth and 18 in retirement, whereas the corresponding numbers for Θ^m are 2.88 and 18.

[21] This incorporates the assumption that government expenditures for retirees and children are the same.

[22] Unfortunately these productivity estimates are not available as a function of the number of years that an individual has spent in the country.

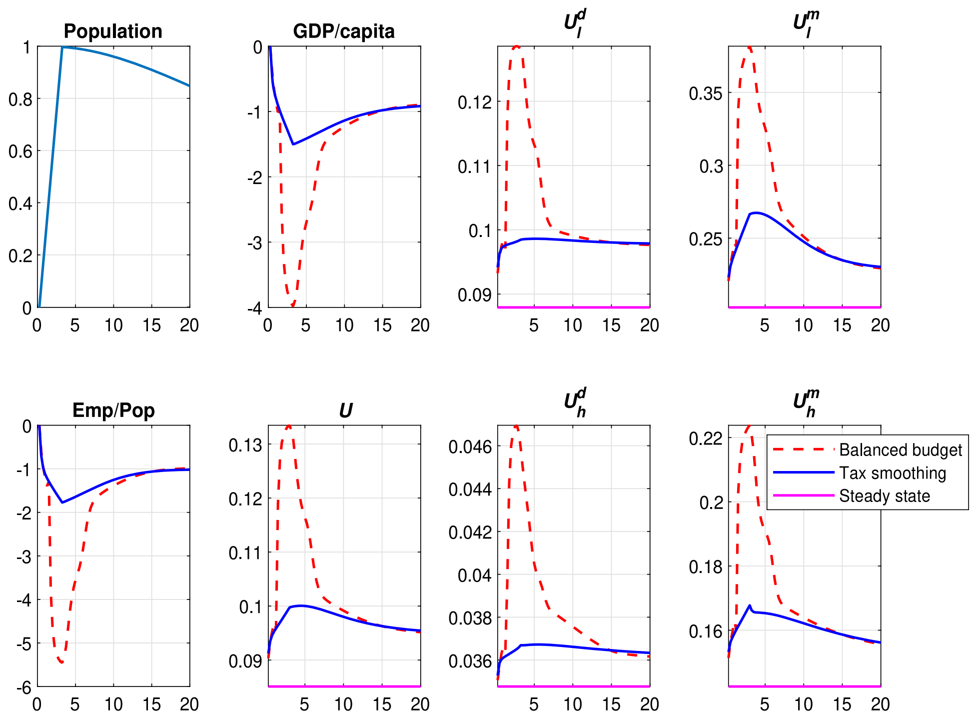

Fig. 2. The effect of a one percent refugee immigration shock on GDP, employment and unemployment. Population, GDP and employment are expressed in deviations from steady state. Unemployment (U) rates are in levels. Superscripts and subscripts denote groups as defined in the text. Annual scale on x-axis, although the plot is finer as it is generated using a quarterly model.

well.

The model is solved with global solution methods, and is set up such that the economy can be shocked by an arbitrary composition of immigrants. This means that our model is well suited to quantify the differential aggregate implications of immigration flows depending on their size and composition.

7. Results

7.1. Dynamic effects of a refugee migration shock

The experiment that we consider is a refugee immigration shock corresponding to what happened in Sweden around the refugee crisis of 2015. Empirically, the size of this shock was 100,000 people, corresponding to one percent of the population. Furthermore, the composition of this immigration in the model is aligned with the data around 2015 in terms of all observables. See appendix A7 for the details. The shock consists of an increased inflow of refugees during 12 quarters, corresponding to residence permits issued in 2015–2017. The effects of the refugee immigration shock are illustrated in Fig. 2. As we argued in Section 5.5, tax-smoothing appears to be the empirically relevant case, so we choose that as our baseline. As depicted by the solid lines, GDP per capita drops by 1.5 percent within a couple of quarters and then only slowly recovers. The employment-to-population ratio initially drops by 1.8 percent. These effects are all very persistent; more than half of the initial reduction in GDP per capita remains after 20 years. GDP per capita initially drops by marginally more than the increase in the population because of the tax increase that results from increasing expenditures, which reduces the incentives for job creation.

The immigration shock produces a demographic dividend that is coming from a reduction in the age-dependency ratio. However, this positive effect on e.g. tax rates, is dwarfed by the negative effect of the lower employment rates of the refugees. As can be seen in the bottom left graph of Fig. 2, the demographic dividend becomes more pronounced over time, but is never strong enough to drive the employment-population ratio above its steady state.

Fig. 2 also shows that aggregate unemployment increases by 1.50 percentage points and then decreases slowly. This increase is fast but not immediate: it takes a few quarters for native unemployment to peak as a result of the reduced job creation induced by the refugee-immigration shock. Aggregate unemployment then remains elevated by approximately 1 percentage point even after twenty years. For immigrants, unemployment increases strongly on impact for both skill groups and then gradually falls back towards the steady state level. Finally, the figure shows that for natives, mainly unemployment for low skill workers is affected by immigration.

The results for a balanced government budget are illustrated with dashed lines in Fig. 2. As can be seen there, the maximum decrease in the employment-population ratio is three times as large with a balanced budget relative to the baseline. The effects on

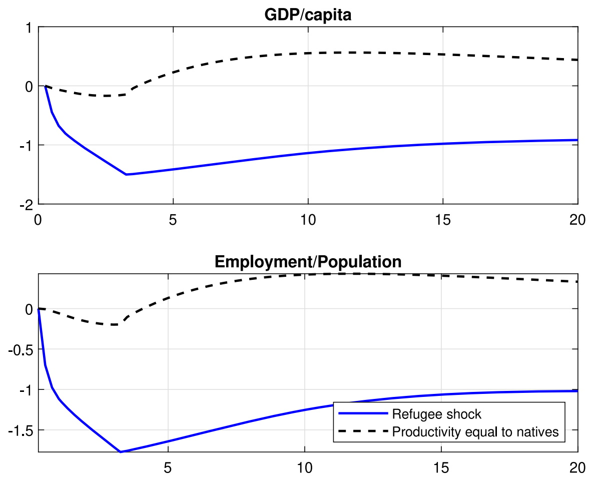

Fig. 3. An immigration shock where the labor force participation rate and productivity distribution of immigrants are the same as for the natives. Variables are expressed in terms of percentage deviations from steady state. Annual scale on x-axis.

GDP are 2.7 times larger. The costs are thus larger and, consequently, welfare decreases by more (−1.01 percent). The differences between the two fiscal regimes are driven by general equilibrium effects—mainly through taxes—that initially amplifies the negative effects of refugee immigration. With tax smoothing, taxes increase on impact and then remain constant at this level. With a balanced budget, the tax rate initially spikes by 4.55 percentage points to finance the transfers to the entering immigrants.[23] The higher income tax then reduces job creation incentives—which increases frictional unemployment—and raise the productivity cutoff for employability—which increase structural unemployment. These are the same effects that are identified and stated in Proposition 3 for the simple model. Moreover, the increase in both types of unemployment leads to higher public expenses and a higher tax rate. This, in turn, reduces the incentives for job creation, leading to further increases in unemployment. This vicious circle induced by the balanced budget leads to substantially lower employment and GDP relative to the tax smoothing case.

7.2. The composition of immigration

In this section, we contrast the baseline scenario to one where the immigrants instead are more similar to the natives. Specifically, we consider an immigration shock equal to one percent of the population where the immigrants have the same productivity distribution as natives. This shock, which can be thought of as an increase in work-related immigration from nearby countries, resembles the Swedish experience in the post-war period up to the 1970’s.[24] The results (along with those in the baseline) are presented in Fig. 3 and show that this type of immigration shock generates a substantial demographic dividend: the employment-to-population ratio rises above the steady state level after four years and GDP per capita increases. The higher productivity and the resulting lower (structural) unemployment, enables a reduction of the tax by 0.14 pp. These results are in line with Proposition 2, and with the empirically documented fiscal effects of immigration to Sweden in the 1960s and 1970s; see Ekberg (2009).

7.3. Steady state effects of refugee immigration

The great majority of the literature that studies the macroeconomic effects of immigration is restricted to steady state analysis but as the above results indicate, the dynamics are rich and long-lasting. To document differences between dynamics and steady state, we now compare the peak effects of a permanent increase in the share of refugee immigrants in the population to those from the shock. In both cases, the increase is one percentage point.

The results are presented in Table 3 with the first column providing the steady state effects. The second column gives the maximum dynamic effects in the baseline exercise and, as can be seen, the dynamic effects are substantially larger than in steady state: the effects on GDP, unemployment and fiscal transfers to immigrants are 1.4–2 times larger. The differences for the tax rate is, however, modest. Regarding welfare, the steady state effect and dynamic effect approximately coincide at −0.98 and −0.90 percent. The reason for the similarity is simply that welfare is a forward-looking variable that puts limited weight on the short run. The welfare effect of a temporary shock is marginally smaller than a permanent change as the temporary shock implies a slightly smaller increase in the tax rate.

[23] Taxes and debt are plotted in Figure 7 in the online appendix.

[24] Ekberg (2009) employs data on wages and the employment rate in 1978 and documents that the average wage for immigrants was 98% of the average wage for natives and that the employment rate was the same for immigrants and natives, which indicates that the productivity of immigrants indeed was similar to natives during that period.

Table 3
Steady state vs. dynamic effects of refugee immigration.

	Steady state effect	Tax smoothing	Balanced budget
GDP/capita	−1.05%	−1.50% (1.43)	−3.98% (3.80)
GDP/working age	−1.19%	−2.29% (1.92)	−4.76% (3.99)
Labor income tax rate	+0.89 pp	+0.82 pp (0.92)	+4.55pp (5.13)
Aggregate unemployment	+1.09 pp	+1.49 pp (1.37)	+4.84pp (4.42)
Net fiscal transfers	+0.34 pp	+0.57 pp (1.65)	+2.17 pp (6.30)
Welfare of natives	−0.98%	−0.90% (0.92)	−1.01% (1.03)

Maximum effects of immigration. The terms in parenthesis show the ratio between the maximum dynamic effect and the steady state effect. Welfare is the discounted value of current and future consumption, and consumption is output less vacancy posting costs.

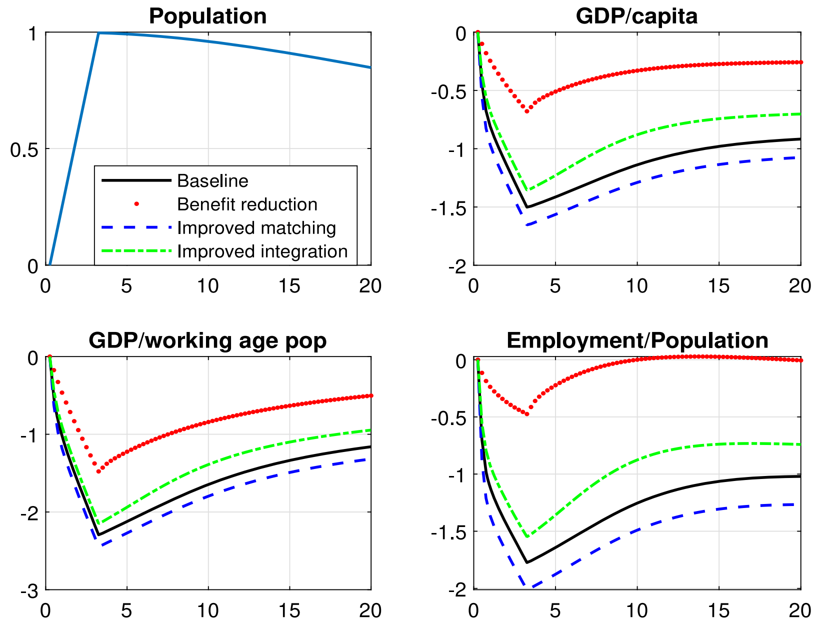

Fig. 4. The effect of a refugee immigration shock under various policies. Variables are expressed in terms of deviations from steady state. Annual scale on x-axis.

In the last column of Table 3 we document the results for the case with a balanced budget. The maximum effects on GDP and unemployment are now 4–5 times larger. We thus conclude that the model confirms what the micro data indicates, i.e., that the steady state effect generally is a bad proxy for the short and medium term effects of immigration.

7.4. Policies reducing the impact of the shock

We now evaluate three policies that potentially can be used to alleviate the effects of the immigration shock. First, we consider a reduction in the unemployment benefit parameters, b, of 5%. Second, we analyze the effects of policies aimed at improving integration. We are not specific about exactly how this can come about, but we assume that the policy results in an increase of π by 50%. Finally, we consider a policy that would increase the matching efficiency A of 5%.

The results are presented in Fig. 4. Starting with the reduction in unemployment benefits, this policy substantially reduces both the magnitude and the persistence of the effects of the shock on GDP and employment. Lower benefits reduce the cutoff productivity for being employable, which leads to lower unemployment and tax rates. An additional effect (not visible in the figure) is the lower steady-state level of unemployment. The improved integration policy has qualitatively similar effects as the reduction in benefits but, quantitatively, the effects are less beneficial. The policy of improved matching, finally, has limited effects.

7.5. Robustness

In appendix A12, we provide several exercises documenting the robustness of our results to changes in the assumptions. First, we document that downskilling, i.e. that some fraction of high skill immigrants end up in the low skill labor market, only has limited implications for the response of the aggregate economy to immigration. Second, we document the relative importance of frictional and structural unemployment for the consequences of refugee immigration. Third, we document that the importance of the composition of the unemployment pool is limited. Finally, we consider the distributional effects of immigration for native skill groups. It is outside the scope of this paper to account for how some outside-of-the-model forces like societal sentiments towards immigration affect labor market integration.

8. Conclusions

We construct a general equilibrium dynamic model to quantify the effects of a refugee immigration shock corresponding to one percent of the total population. The shock yields an initial reduction in GDP per capita of 1.5 percent and an initial increase in aggregate unemployment of 1.5 percentage points. These effects are large and highly persistent. The lower productivity of immigrants in combination with the slow integration into the labor market dwarfs the demographic dividend.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://ars.els-cdn.com/content/image/1-s2.0-S0304393225000182-mmc1.pdf.

Data availability

The authors do not have permission to share data.

References

Battisti, Michele, Felbermayr, Gabriel, Peri, Giovanni, Poutvaara, Panu, 2018. Immigration, search and redistribution: A quantitative assessment of native welfare. J. Eur. Econom. Assoc. 16 (4), 1137–1188.
Blanchard, Olivier, 1985. Debt, deficits, and finite horizons. J. Polit. Econ. 93 (2), 223–247.
Borjas, George, 2014. Immigration economics. Harvard University Press.
Brell, Courtney, Dustmann, Christian, Preston, Ian, 2020. The labor market integration of refugee migrants in high-income countries. J. Econ. Perspect. 34 (1), 94–121.
Busch, Christopher, Krueger, Dirk, Ludwig, Alexander, Popova, Irina, Iftikhar, Zainab, 2020. Should Germany have built a new wall? Macroeconomic lessons from the 2015-18 refugee wave. J. Monetary Econ. 113, 28–55.
Cahuc, Pierre, Wasmer, Etienne, 2001. Does intrafirm bargaining matter in the large firm's matching model? Macroecon. Dyn. 5, 742–747.
Canova, Fabio, Ravn, Morten, 1998. Crossing the Rio Grande: Migrations, business cycles and the welfare state. CEPR discussion paper 2040.
Canova, Fabio, Ravn, Morten, 2000. The macroeconomic effects of german unification: Real adjustments and the welfare state. Rev. Econ. Dyn. 3, 423–460.
Chassamboulli, Andri, Palivos, Theodore, 2014. A search-equilibrium approach to the effects of immigration on labor market outcomes. Internat. Econom. Rev. 55 (1), 111–129.
Dustmann, Christian, Fabbri, Francesca, Preston, Ian, 2005. The impact of immigration on the British labour market. Econom. J. 115, 324–341.
Dustmann, Christian, Frattini, Tommaso, Preston, Ian, 2013. The effect of immigration along the distribution of wages. Rev. Econ. Stud. 80, 145–173.
Ek, Andreas, 2024. Cultural values and productivity. J. Polit. Econ. 132 (1), 295–335.
Ekberg, Jan, 2009. Invandringen och de offentliga finanserna. ESO-Rapport 2009:3.
Eurostat, 2020. International migration statistics, immigration by age and sex.
Furlanetto, Francesco, Robstad, Ørjan, 2019. Immigration and the macroeconomy: some new empirical evidence. Rev. Econ. Dyn. 34, 1–19.
Liu, Xiangbo, 2010. On the macroeconomic and welfare effects of illegal immigration. J. Econom. Dynam. Control 34, 2547–2567.
Lubotsky, Darren, 2007. Chutes or ladders? A longitudinal analysis of immigrant earnings. J. Polit. Econ. 115 (5), 820–867.
Malafry, Laurence, 2018. Immigration shocks, equilibrium unemployment and inequality. mimeo, Stockholm University.
OECD, 2011. Education at a glance 2011: OECD indicators.
OECD, 2018. Settling in 2018 - indicators for immigrant integration.
Ottaviano, Gianmarco, Peri, Giovanni, 2012. Rethinking the effect of immigration on wages. J. Eur. Econom. Assoc. 10 (1), 152–197.
Ruist, Joakim, 2018. Tid för integration – En ESO-rapport om flyktingars bakgrund och arbetsmarknadsetablering. ESO-rapport 2018:3.
Smith, Christie, Thoenissen, Christoph, 2019. Skilled migration and business cycle dynamics. J. Econom. Dynam. Control 109, 1–24.
Stähler, Nikolai, 2017. A model-based analysis of the macroeconomic impact of the refugee migration to Germany. Discussion Paper Deutsche Bundesbank, No 05/2017.
Stole, Lars, Zweibel, Jeffrey, 1996. Intra-firm bargaining under non-binding contracts. Rev. Econ. Stud. 63 (3), 375–410.
Storesletten, Kjetil, 2000. Sustaining fiscal policy through immigration. J. Polit. Econ. 108 (2), 300–323.
Swedish Migration Board, 2000-2022. Annual reports 2000–2022, Sweden.
Westermark, Andreas, 2003. Bargaining, binding contracts, and competitive wages. Games Econom. Behav. 43, 296–311.
Yaari, Menahem, 1965. Uncertain lifetime, life insurance, and the theory of the consumer. Rev. Econ. Stud. 32 (2), 137–150.