Immigration and Government Spending in OECD Countries

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Abstract

This paper evaluates the fiscal effect of international migration. It first estimates a structural Vector Autoregressive model on a panel of 19 OECD countries over the period 1980-2015, in order to quantify the impact of a migration shock. Empirical results suggest that international migration had a positive impact on the economic and fiscal performance of OECD countries. It then proposes an original theoretical framework that highlights the importance of both the demographic structure and the intergenerational public transfers. Hence, OECD countries seems to have benefited from a "demographic dividend" of international migration since 1980.

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1 Introduction

According to the UN (2017), OECD countries host more than 40% of all immigrants worldwide. Moreover, the share of immigrants in the population of those countries has increased from 7% in 1990 to 13% in 2017. As global population trends foresee a concentration of young people in Africa, immigration figures are likely to rise. According to World Bank projections, by 2050, Sub-Saharan Africa alone will contain nearly one-third of the world's 15-24-year-olds. Since this population boom far exceeds the absorption capacity of local labor markets (Margolis and Yassine, 2015), large migration flows might soon no longer be exceptional but indeed become the norm.

This article analyzes the effects of international migration on the macro-economic situation of host countries and in particular on their public finances. This is an important question for two reasons. First, most OECD countries structurally run public deficits. Second, opinion polls show that whatever the position of natives towards immigrants, the cost for public finances appears as the main economic concern associated to international migration.[1]

The effect of international migration on public finances has been examined in articles that may be classified by methodology (Liebig and Mo, 2013; Preston, 2014). The main group is based on accounting techniques following the pioneer work of Blau (1984). Static studies (as e.g. Dustmann and Frattini, 2014) have calculated the costs and benefits of immigrants for public finances for a given year. It is, however, an oversimplification to restrict analysis to a single year, as immigrants are likely to live some time in the host country and may raise a family there. Auerbach and Oreopoulos (1999) point out that a dynamic approach is needed to calculate the net contribution to public finances of immigrants and their descendants over their duration of residence in the host country. Preston (2014) notes that immigrants' contribution changes over time as they stay longer as they gradually acquire the specific skills needed to join the labour market in that country. The National Research Council (1997) report includes a pioneering study by Lee and Miller (1997) that forecasts immigrants' net contributions over time. This approach has since developed using generational accounting tools to determine the net present value of immigrants' contributions (Auerbach and Oreopoulos, 1999; Lee and Miller, 2000). Its results show that the net contribution is relatively low, which can be explained by the demographic weight of the population concerned. If immigrants represent only 10% of the total population, their impact on public finances can only be low. More importantly, externalities, complementarities and, more broadly, any general equilibrium effect, are

[1] For instance, according to the European Social Survey (2014), 52% of European natives say they agree to allow many or some immigrants from poorer countries outside Europe coming to live in their home country. Among them, 30% think that immigrants take out more (in terms of health and welfare services used) than they put in (in terms of taxes payed), on balance, while 18 % think that immigrants generally take jobs away from native workers. Among those who say they want few or none immigrants, the proportions are 61% and 45%, respectively.

not included in those accounting approaches.

A second group of studies consequently seeks to complement these results with applied general equilibrium models (Storesletten, 2000, 2003). This research does include the interactions between variables, but the results are heavily dependent on non-observable and hard-to-calibrate parameters such as the degree of complementarity between native-born and immigrants in the production process. These general equilibrium models are sometimes used to make forecasts, but they crucially hinge on assumptions about the future development of incomes and population (Blau and Mackie, 2016).

More recently, some studies have proposed to estimate a structural vector autoregression (VAR) model that include migration flows (d'Albis *et al.*, 2016, 2018; Furlanetto and Robstad, 2016). Since the initial article by Blanchard and Perotti (2002), this approach has been widely used for fiscal studies (Alesina *et al.*, 2002; Beetsma *et al.*, 2006, 2008; Monacelli *et al.*, 2010; Beetsma and Guiliodori, 2011; Brückner and Pappa, 2012). It has also been used to assess the economic effects of population change (Eckstein *et al.*, 1985; Nicolini, 2007; Kim and Lee, 2008; Fernihough, 2013). This method's multivariate dynamic structure seems to us to be appropriate for assessing the fiscal effects of international migration. In particular, it proposes an identification strategy for assessing the dynamic effect of an exogenous migration shock on the economic and public finances of the host country. This strategy is suitable for macroeconomic studies, which complement micro-economic one that address the endogeneity issue with instrumental variables[2].

The closest paper to our study is d'Albis *et al.* (2018), where we estimated a VAR model for a panel of 15 European countries for 1985-2015 to analyze the impacts of flows of asylum seekers and permanent migrants on public finances. In the present paper, we extend the analysis in several directions while focusing on permanent migrants. First, we consider a panel of 19 OECD countries with annual data for 1980-2015. We estimate a VAR model that includes international migration into the VAR model used in the fiscal policy literature. The validity of our model is obtained by the replication of the results from recent studies on the macro-economic effects of fiscal stimulus (Beetsma *et al.*, 2006, 2008 and Beetsma and Guiliodori, 2011). We find that international migration is beneficial to host country. In response to exogenous shock that increases net flow of migrants by 1 person per 1000 of the population, GDP per capita rises significantly by 0.25 percent on impact and peaks at 0.31 percent after one year; and fiscal balance improves by 0.12 percentage points of GDP at its peak, which occurs on impact and one year after the shock. The estimates confirm those found for European countries in d'Albis *et al.* (2018) and many other studies using different methodology and data (Clemens , 2011; Ager and Brückner, 2013; Ortega and Peri, 2014).

A second contribution of the paper is to develop an analytical model to understand

[2] For a discussion on the difficulties arising with the choice of a relevant instrument see Clemens and Hunt (2017).

the main mechanisms. It relies on an original overlapping three-generation model in which immigrants arrive as adults. It shows the crucial importance of the "demographic dividend" of international migration, specifically the impact of the increase in the proportion of the working population on host country economies. This "replacement migration" (UN, 2016) is a central mechanism: when migrants arrive, they are of an age when their net contribution to public finances is positive. To highlight this mechanism in the model, we make no further assumptions that may lead to positive effects for international migration, such as complementarity between migrants and native-born, even when these are identified in the literature (Blau and Mackie, 2016). We lay out the simple conditions under which the demographic effect of net flow of migrants is positive for per capita income, savings and net taxes. In particular, we show that the effect is positive if the population growth rate is low and the share of public expenditure dedicated to youth and old populations is high. Since OECD economies typically have aging populations and often have large intergenerational transfers, we deduce that the model help understanding the positive effect of international migration found in our empirical analysis. These results reinforce the findings of the previous studies that highlighted the role of the age structure of the population on macroeconomic performances (Boucekkine *et al.*, 2002; Beaudry and Collard, 2003; d'Albis, 2007; Lee, Masson *et al.*, 2014).

Our third contribution is to propose a decomposition of public spending and analyze the impact of a migration shock on some of its components. In particular, we show that net flow of migrants reduces old age spending while it increases family spending. This suggest that the "demographic dividend" of international migration goes through public finances. Moreover, active labor market programs spending increases with net flow of migrants while public spending associated to unemployment benefits decreases. This can be explained by the fact that international migration significantly reduces the unemployment rate of the host countries.

The article is structured as follows. Section 2 describes the data. Section 3 presents the econometric methodology and shows that our baseline model reproduces the results of the literature on fiscal multipliers. Section 4 present our main empirical results and provide a discussion of them with an overlapping-generation model. Section 5 concludes.

2 Data

Our sample includes yearly observations from 1980 to 2015 for 19 OECD countries that are selected in order to have a set of long-span data. We consider all the OECD Member countries who signed the Convention on the OECD before 1980 for which the fiscal data are available over the whole sample period in Economic Outlook databases[3]. Our sample

[3] New-Zealand, Greece, Luxembourg and Switzerland are not considered here because their fiscal data before 1990 (before 1986 for New-Zealand) for are not provided in the Economic Outlook database.

includes 4 OECD non-European countries : Australia, Canada, Japan and United States; and the 15 Western European countries that are considered in d'Albis *et al.* (2018): Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Iceland, Italy, Netherlands, Norway, Spain, Sweden, Portugal and United Kingdom. These OECD countries, except Japan, are also the main destinations countries for international migrants. According to the UN (2017) estimates for 2015, 45% of all international migrants lived in one of the 19 OECD countries we consider in our sample.

2.1 Fiscal and Economic Data

Fiscal variables are obtained from the OECD Economic Outlook databases(OECD, 2016). We consider three main variables: government purchases, transfers paid and revenues received by the general government. In line with the literature on fiscal multipliers (Beetsma *et al.*, 2006, 2008; Beetsma and Guiliodori, 2011), we compute the first fiscal variable, government purchases, as the sum of general government final consumption expenditure and general government fixed capital formation. The second variable, transfers paid by the general government, are computed as the sum of social security benefits and other current payments. The third variable, tax revenues collected by the general government, include direct and indirect taxes on production and imports, social security contributions and other current transfers receipts. All variables are expressed in real terms using the appropriate deflator.

Out of those three variables, we define (i) the net taxes as the difference between tax revenues received and transfers paid by the general government; (ii) the public spending as the sum of the government purchases and transfers, and (iii) the fiscal balance as the difference between general government revenues and spending.

We also consider social public spending from the OECD Social Expenditure database (SOCX), which provides comparable data on public and private social expenditure for the 19 countries of our sample (OECD, 2018a; Adema *et al.*, 2011). In SOCX database, expenditure for social purposes are grouped along nine social policy areas. In our estimates, we consider four of them that are the most relevant for our analysis: old age, family, active labor market program, and unemployment spending.

Economic data that are used in this study are the GDP and the unemployment rate, which both are taken from the OECD Economic Outlook databases.

2.2 Demographic Data

Demographic variables are from the Demographic Balance and Crude Rates at National Level database of Eurostat for the European countries and from OECD (2017) for the OECD non-European countries. We use the annual average population to express the economic and fiscal variables in per capita terms. Net flow of migrants is evaluated using net migration data, expressed as a rate of per 1000 population. The net migration is calculated by Eurostat and OECD (2017) as the difference between the total change and the natural change of the "usual resident" population. Net migration then accounts for the difference between the number of immigrants and the number of emigrants. It does not make a distinction between nationals and foreigners[4].

Our data allows for an analysis of the fiscal impact of international migration over time. This complements the branch of the literature that uses data on the stock of migrants and detailed fiscal information that distinguish fiscal contributions and benefits of immigrants and natives. Due to comparability issues, most of these studies are country-specific except Liebig and Mo (2013) which is based on 27 OECD countries using data collected around 2008.

2.3 Descriptive Statistics

Table 1 provides the mean values of our main variables over the period 1980-2015. GDP per capita in constant 2010 USD ranges from $18,534 for Portugal to $73,420 for Norway. The sample averages of government purchases and transfers per capita in constant 2010 USD range respectively from $4,071 and $4,314 in Portugal to $17,882 and $17,815 in Norway. Tax revenues per capita in constant 2010 USD ranges on average from $6,926 for Portugal to $40,080 for Norway. The minimum and maximum levels of unemployment rate, on average over the period 1980-2015, are observed in Iceland (3.64%) and Spain (15.8%). Japan has the lowest level of net flow of migrants (-0.08 per 1,000 population), followed by the Portugal (0,05 per 1,000 population) while the highest levels are recorded in Australia, Canada and Spain (6.55, 5,22 and 3,90 per 1,000 population, respectively).

Figure 1 displays the evolution of the net migration rate over time, for each country under consideration. It shows that this rate has significantly varied over time in almost all countries.

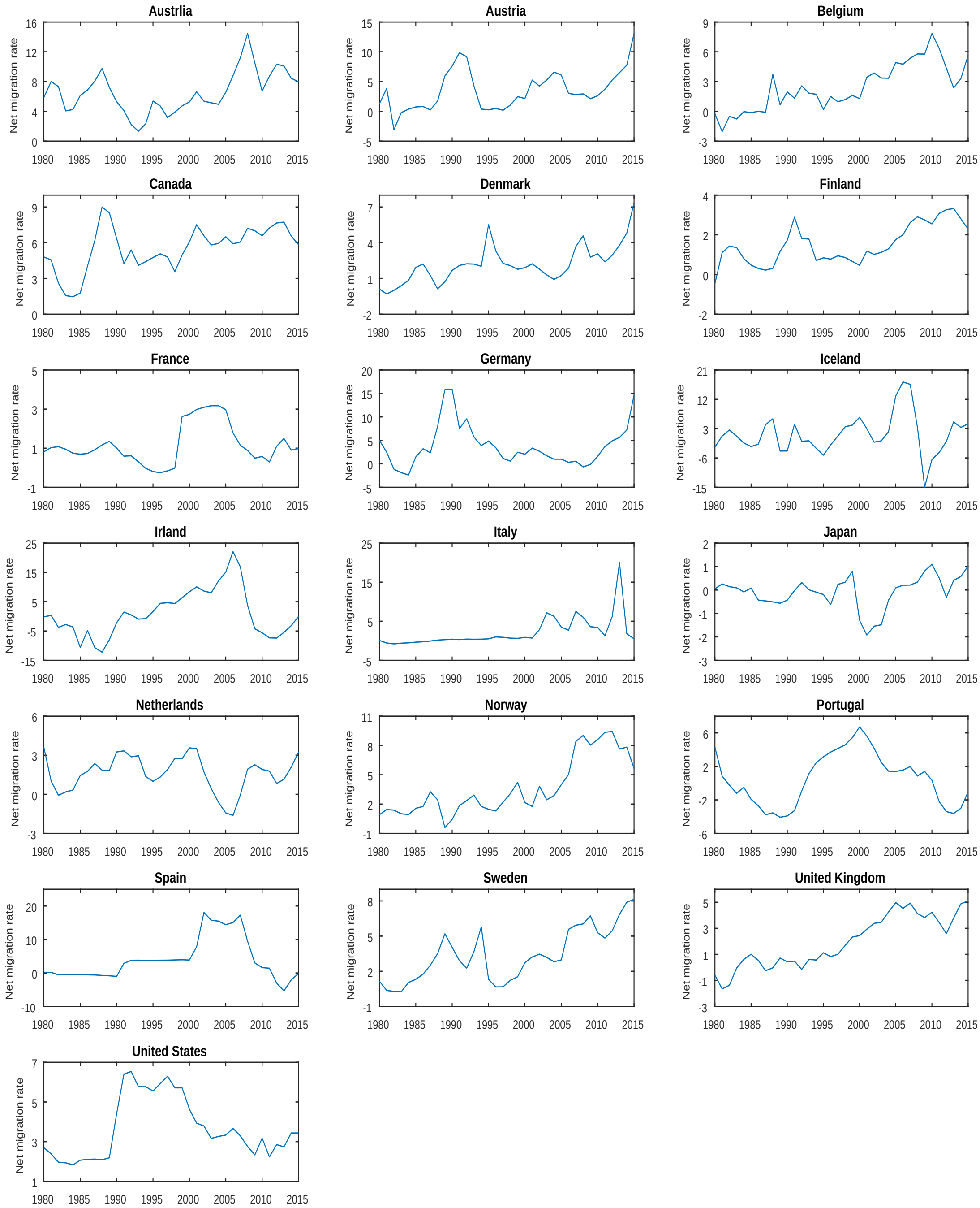
[4] It should be pointed out that the decomposition by country of birth of net migration from Eurostat is only available since 2008. The temporal dimension is thus insufficient to run a VAR model on these data.

Table 1: **Summary statistics, averages per country over the sample period (1980-2015)**

Country	Net flow of migrants (per 1,000)	GDP per capita (PPP, 2010 US$)	Unemp. rate (in %)	Gov Purchases per capita (PPP, 2010 US$)	Transfers per capita (PPP, 2010 US$)	Revenues per capita (PPP, 2010 US$)	Fiscal Balance to GDP ratio (in %)
Austria	3.53	38771	4.15	8815	11780	19058	-4.04
Belgium	2.41	37106	8.42	9195	10938	17894	-6.68
Denmark	2.20	50736	6.21	14296	14755	27245	-3.89
Finland	1.51	37245	8.66	9553	10548	19428	-1.69
France	1.16	35549	8.80	9505	10078	17505	-5.76
Germany	3.82	35951	6.99	7692	9187	15757	-3.17
Iceland	1.26	35212	3.35	9117	5560	14296	-0.86
Ireland	1.00	35902	10.85	7170	7060	12610	-5.00
Italy	2.14	32428	9.06	7139	9122	13824	-7.93
Netherlands	1.64	41322	6.70	11186	9647	18622	-5.45
Norway	3.67	73420	3.59	17882	17815	40080	5.34
Portugal	0.50	18535	7.85	4071	4314	6926	-7.80
Spain	3.90	25283	15.47	5443	5104	9280	-4.99
Sweden	3.41	42471	6.50	12896	12149	23159	-4.82
United Kingdom	1.97	32722	7.74	6883	6614	12048	-4.28
15 European Countries	2.31	38508	7.70	9390	9645	17849	-4.07
Australia	6.55	47251	6.95	9990	7552	16125	-3.24
Canada	5.52	40955	8.43	10108	8653	16531	-5.82
Japan	-0.08	39303	3.53	8363	6215	12265	-5.53
United States	3.67	41073	6.43	8047	8551	13228	-8.20
19 OECD countries	2.65	39346	7.42	9334	9244	17152	-4.41

Source: Authors' computations based on data from Eurostat and, OECD (2016), OECD (2017) and OECD (2018b) databases.

Figure 1: Net Flow of migrant (per 1,000 inhabitants)



Source: Authors' computations based on data from Eurostat database and OECD (2017).

3 Empirical Strategy

We set up a structural VAR model to draw inference on the economic and fiscal effects of international migration, following a methodology developed in the empirical fiscal policy literature that started with the seminal paper of Blanchard and Perotti (2002). Given the available time-series data on international migration, we consider a panel VAR that allows us to obtain an adequate sample size using OECD annual data as in Alesina *et al.* (2002).

3.1 Empirical model

Our empirical model is specified as follows:

$$
\begin{aligned}
Z_{it} &= A(L)Z_{it} + v_i + \lambda_i t + f_t + \varepsilon_{it} \\
&= \sum_{s=1}^{p} A_s Z_{it-s} + v_i + \lambda_i t + f_t + \varepsilon_{it} \quad \text{for} \quad i = 1, ..., N \text{ and } t = 1, ..., T
\end{aligned} \tag{1}
$$

where $Z_{it} = (z_{it}^1, ..., z_{it}^K)'$ is a vector of K endogenous variables, $A(L)$ is a matrix polynomial in the lag operator L with coefficients given by the fixed $(K \times K)$ matrices, A_s, $v_i = (v_i^1, ..., v_i^K)'$ is the vector of country fixed-effects, $\lambda_i t$ represent country-specific time trends, f_t is the common time-specific effect, and $\varepsilon_{it} = (\varepsilon_{it}^1, ..., \varepsilon_{it}^K)'$ is the $(K \times 1)$ vector of residuals satisfying $E(\varepsilon_{it}) = 0$ and $E(\varepsilon_{it}\varepsilon'_{i\tau}) = \Omega.\mathbb{1}\{t = \tau\}$ $\forall i$ and t.

Thus, the potential heterogeneity in our panel data setting is mitigated both by considering OECD economies that are somewhat similar, and by including country-fixed effects (v_i) and country-specific time trends ($\lambda_i t$). Moreover, we account for cross-country contemporaneous interdependence by introducing year-specific effects (f_t), as in Beetsma *et al.* (2006, 2008) and Beetsma and Guiliodori (2011)[5].

Our panel VAR will be estimated with $N = 19$ and $T = 36$. In order to deal with the short-T dynamic panel data bias (also known as the Nickell bias, Nickell, 1981), we estimate our panel VAR using the bias-corrected fixed-effects technique developed by Hahn and Kuersteiner (2002). This technique is appropriate when the sizes of, respectively, the time dimension T and the cross-sectional dimension N are of the same order of magnitude, i.e. when $0 < limN = T < \infty$(as here). As argued by Hahn and Kuersteiner (2002), since their approach does not require a preliminary consistent estimator, it may therefore be perceived as an implementable version of Kiviet's (1995) bias-corrected fixed-effects estimator of the single equation. More importantly, it is suitable for VAR(p) models with higher order $p > 1$ using the fact that any higher order VAR(p) process can be rewritten in VAR(1) form, by imposing blockwise zero and identity restrictions (Hahn and Kuersteiner, 2002; Lütkepohl, 2005, p. 15).[6] Moreover, the Monte Carlo experiment conducted by Hahn and Kuersteiner (2002) showed that the efficiency of the bias-corrected estimator measured by the root mean squared error (RMSE) often dominates that of the

[5]We are aware that using common time effects may absorb the cross-country co-movement in structural shocks (Beetsma *et al.*, 2006). The estimation without the common time effect are available under request to the authors. As shown in d'Albis *et al.* (2018), ignoring the time effect in the estimation does not alter our findings.

[6] See Juessen and Linnemann (2012) and d'Albis *et al.* (2018) for examples of applying this bias-correction in panel VAR frameworks.

GMM estimator.

Using AIC (Akaike information criterion) and BIC (Bayesian information criterion), we set the lag length of the system to two so as to eliminate any autocorrelation in the residuals. The results are insensitive to any lag length greater than two.

3.2 Baseline specification

Following the literature on fiscal multipliers that use annual data (Beetsma *et al.*, 2006, 2008; Beetsma and Guiliodori, 2011), we identify structural shocks via Choleski decomposition. For our baseline model, we consider the following system $Z_{it} = [m_{it}, g_{it}, nt_{it}, y_{it}]'$, where m_{it} is the logarithm of net migration as a share of the population[7], g_{it} is the logarithm of per capita government purchases (which is the sum of real government consumption and real government investment), nt_{it} is the logarithm of per capita net taxes (i.e. tax revenues less transfers expressed in real terms) and y_{it} is the logarithm of the per capita real GDP.

Panel unit root tests fail to accept the null hypothesis of the unit root on detrending the variables (with country-specific linear trend). We then consider, a VAR model on variables in levels while controlling for country heterogeneity (by including country-specific effects and country-specific time trends) and cross-country interdependence (by including year-specific effects). The corresponding structural VAR (SVAR) is given by the following specification:

$$B_0 \begin{pmatrix} m_{it} \\ g_{it} \\ nt_{it} \\ y_{it} \end{pmatrix} = B(L) \begin{pmatrix} m_{it} \\ g_{it} \\ nt_{it} \\ y_{it} \end{pmatrix} + B_0.v_i + B_0.\lambda_i t + B_0.f_t + \begin{pmatrix} e^m_{it} \\ e^g_{it} \\ e^{nt}_{it} \\ e^y_{it} \end{pmatrix} \tag{2}$$

where B_0 is a $(K \times K)$ matrix such that $e_{it} = (e^m_{it}, e^g_{it}, e^{nt}_{it}, e^y_{it})' = B_0\varepsilon_{it}$ or $\varepsilon_{it} = B^{-1}e_{it}$, where e_{it} stands for the vector of structural shocks that are mutually uncorrelated, i.e. $E(e_{it}e'_{it}) = B_0\Omega B'_0 = I_K$; $B(L)$ is a matrix polynomial in the lag operator L.

In our Choleski decomposition, structural shocks are identified by choosing B_0^{-1} as the unique lower-triangular Choleski factor of Ω, i.e. $\Omega = B_0^{-1}\left(B_0^{-1}\right)'$ and,

$$B_0 = \begin{pmatrix} \beta^{mm} & 0 & 0 & 0 \\ \beta^{gm} & \beta^{gg} & 0 & 0 \\ \beta^{ntm} & \beta^{ntg} & \beta^{ntnt} & 0 \\ \beta^{ym} & \beta^{yg} & \beta^{ynt} & \beta^{yy} \end{pmatrix}, \tag{3}$$

this identifying scheme relies on the assumption that variables ordered first in the VAR can impact the other variables contemporaneously, while variables ordered later can affect those ordered first only with lags. It assumes, therefore, that international migration may

[7]To handle negative values on net migration, we use log(1+net migration as a share of the population).

contemporaneously impact the economic and fiscal performances of the host country and may respond to them only with a lag. This assumption is supported by an international migration process where the decision to migrate is generally taken on the basis of the host country's economic conditions over the previous years (Boubtane *et al.*, 2013; d'Albis *et al.*, 2016, 2017, 2018). Following the standard practice in the literature on the effect of fiscal policy, we assume that government purchases can impact contemporaneously net taxes and GDP, while changes in net taxes and GDP can at best impact government purchases with a lag. Net taxes are allowed to have contemporaneous impact on GDP, and may at best be influenced by GDP only with a lag. This identifying assumption is justified by institutional knowledge on fiscal policy that is as follows: (i) decisions on changing government purchases are generally taken in the Budget Act that is presented before the new fiscal year, while adjustments during the current year may be considered as negligible (Beetsma *et al.*, 2006, 2008; Beetsma and Guiliodori, 2011) and; (ii) net taxes include both cyclically-sensitive components (some spending items such as social benefits and other current receipts) and discretionary components under the government's control that are also determined in the Budget Act before the new fiscal year.

The response of the fiscal balance, defined as $(NT_t - G_t)/Y_t$, is computed as:

$$\frac{NT_t}{Y_t}\left[\hat{NT} - \hat{Y}_t\right] - \frac{G_t}{Y_t}\left[\hat{G}_t - \hat{Y}_t\right], \tag{4}$$

where Y, G and NT are per capita, real GDP, public spending and net taxes, respectively, and where $\hat{Y}$, $\hat{G}$ and $\hat{NT}$ are the impulse responses of the corresponding variables. The ratios G/Y and NT/Y are approximated by the overall sample mean.

We are aware that transfers include some items that are cyclically-sensitive. The estimation of the baseline model using cyclically-adjusted net taxes instead of unadjusted net taxes is available under request to the authors. As discussed in d'Albis *et al.* (2018), the use of the cyclically-adjusted net taxes gives roughly the same impulse responses to a shock on government purchases for all variables except for net taxes[8].

3.3 The effects of a shock on government purchases

We aim first at establishing the suitability of our baseline estimated model by analyzing the responses of OECD economies to an increase in government purchases and by comparing them with those found in the fiscal policy literature. We computed the impulse responses to an increase in government purchases representing 1% of GDP. Table 2 reports the coefficients for some periods after the shock. For per capita, GDP, government purchases and net taxes, the responses are expressed in percentage change, while for the fiscal balance the responses are in percentage point of GDP change. In response to its

[8]See Beetsma and Guiliodori (2011) for more discussion of this issue.

own shock, government purchases shock strongly increases by 4.23 percent on impact (which is the peak) and fades out gradually. The government purchase shock leads to a significant increase in GDP per capita by 2.76 percent on impact (the peak), remaining significant during four years after the shock. Net taxes per capita rise significantly until the sixth year after the shock, by 3.10 on impact and 3.15 one year after the shock (the peak). Consequently, government purchases increase causes a fiscal deficit that is significant during two years after the shock and represents -0.28 percentage points of GDP on impact (the peak).

Table 2: Responses to a government purchase increase of 1% of GDP

(a) Baseline on 19 OECD countries, sample period 1980-2015						
	Year 0	Year 1	Year 2	Year 3	Year 5	Year 10
Gov. purchases per capita	4.23*	3.71*	2.99*	2.41*	1.60*	0.50*
Net taxes per capita	3.10*	3.15*	2.79*	2.35*	1.47*	0.12
GDP per capita	2.79*	2.23*	1.69*	1.24*	0.64*	-0.02
Fiscal balance/GDP	-0.28*	-0.17*	-0.10	-0.06	-0.07	-0.10*
(b) Baseline on 15 EU countries, sample period 1980-2015						
	Year 0	Year 1	Year 2	Year 3	Year 5	Year 10
Gov. purchases per capita	4.14*	3.83*	3.01*	2.35*	1.49*	0.35*
Net taxes per capita	2.80*	3.03*	2.80*	2.40*	1.43*	-0.12
GDP per capita	2.38*	2.07*	1.48*	1.01*	0.41	-0.20
Fiscal balance/GDP	-0.34*	-0.23*	-0.10*	-0.05	-0.05	-0.12*
(c) Beetsma and Guiliodori (2011) on 14 EU countries, sample period 1970-2004						
	Year 0	Year 1	Year 2	Year 3	Year 5	Year 10
Gov purchases per capita	4.15*	4.45*	N/A	3.26*	2.13*	N/A
Net taxes per capita	1.16*	2.34*	N/A	1.83*	0.57	N/A
GDP per capita	1.18*	1.52*	N/A	1.25*	0.73*	N/A
Fiscal balance/GDP	-0.78*	-0.60*	N/A	-0.42*	-0.41*	N/A

Notes: Year 0 stands for the year of the shock. * denotes statistical significance at the 10% level. For per capita, GDP, government purchases and net taxes, the responses are expressed in percentage change; for fiscal balance/GDP, the responses are in percentage points change. Panel (*c*) reports the impulses responses from Beetsma and Guiliodori (2011) p.F19, panel (*d*) of Table 4.

Our evidence of the stimulating effect of government purchases increase in a SVAR that includes the net flow of migrants is in line with the findings of previous studies (Blanchard and Perotti, 2002; Perotti, 2005; Beetsma *et al.*, 2006, 2008; Beetsma and Guiliodori, 2011). Most notably, our spending multiplier is similar to estimates found by Beetsma and Guiliodori (2011), who use a panel VAR on 14 European countries (Austria, Belgium, Denmark, Finland, France, Ireland, Italy, Germany, Greece, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom) over the period 1970-2004. They report a 1.18 percent increase in GDP per capita on impact, 1.52 percent after one year, 1.25 percent after three years in their specification including unadjusted net taxes (i.e. panel *(d)* of Table 4 p.F19). We present their results in Table 2, panel *(c)* and compare them to a subset of our sample that include 15 European countries (Table 2, panel *(b)*). Our estimates are quite similar to those of Beetsma and Guiliodori (2011) as we find a 2.38 percent increase in GDP per capita on impact, 2.07 percent after one year, 1.48 percent after two years and 1.01 percent after three years. We conclude that extending the SVAR model to international migration does not alter the dynamic responses to fiscal shocks.

4 Main Results

We now analyze the macroeconomic and fiscal impacts of international migration. We present our estimates and then interpret them with the help of a theoretical framework.

4.1 Immigration, output and public finance

We first present our basic estimates of the dynamic consequences of a migration shock on economic and fiscal outcomes of host countries. The size of the migration shock is set to 1 person per 1,000 inhabitants. The responses are shown in Table 3.

Table 3: Responses to migration shock in baseline model

	Year 0	Year 1	Year 2	Year 5	Year 10
Gov. purchases per capita	0.22*	0.44*	0.47*	0.26*	0.03
Net taxes per capita	0.85*	1.11*	0.90*	0.14	-0.09
GDP per capita	0.25*	0.31*	0.26*	0.03	-0.06
Fiscal balance/GDP	0.12*	0.12*	0.07	-0.03	-0.03

Notes: Year 0 stands for the year of the shock. * denotes statistical significance at the 10% level. The size of migration shock is set to 1 person per 1,000 inhabitants. For per capita, GDP, government purchases and net taxes, the responses are expressed in percentage change; for fiscal balance/GDP, the responses are in percentage points change.

The results presented in Table 3, show evidence of the economic and fiscal benefits of the net flow of migrants. Following an exogenous shock that increases the net flow of migrants by 1 per 1,000 inhabitants, GDP per capita increases significantly by 0.25 percent on impact and by 0.31 percent at the peak (after one years). This finding is consistent with previous empirical studies such as Boubtane *et al.* (2013), Ortega and Peri (2014) and d'Albis *et al.* (2018). Moreover, the migration shock leads to a significant increase in both government purchases and net taxes. Government purchases rise by 0.22 percent on impact and by 0.47 percent at the peak (after two years) while the impact on net taxes per capita is 0.85 percent on impact and 1.11 percent at the peak (after one year). Consequently, in response to the migration shock, the fiscal balance improves significantly by around 0.12 percentage points of GDP on impact (the peak). The improvement remains significant after two years. The responses are similar to those found by d'Albis *et al.* (2018) for European countries over the period 1985-2015.

As expected, the forecast error variance decomposition analysis bears out the importance of economic and fiscal shocks in explaining the fluctuations of their respective variables. Nevertheless, the share of fluctuations in government purchases, net taxes and GDP that is attributable, over ten years, to the net flow of migrants is 6, 7 and 3 percent, respectively[9].

To understand our econometric results, we build an overlapping-generations model that aims at theoretically analyzing the impact of an immigration shock on income per capita and on public finances. Contemporaneous effects and delayed ones are studied successively.

An overlapping generation framework

We consider a demographic structure with three overlapping generations. An agent is successively a child, an adult and an old person, and there is no mortality across these age classes. Migrants enter the population during adulthood and have the same fertility rate as that of the native population. This set of assumptions allows the model to remain analytically tractable. We believe that the results obtained below with this simple structure extend to more general frameworks that would allow for many generations, uncertain survival probabilities and differential fertility rates.

The demographic model distinguishes stock variables, namely the size of each age class at the beginning of the period, and flow variables, given by newborns and migrants that enter the population during the period. The stock of adults at the beginning of period t is denoted by N_{at} while the net flow of migrants is denoted by $I_t = \lambda_t N_{at}$, where $-1 \leq \lambda_t$ is thus the proportion of net flow of migrants within the adult population. The labor force during period t, denoted L_t, is therefore given by:

$$L_t := N_{at} + I_t = (1 + \lambda_t) N_{at}. \tag{5}$$

The fertility rate of adults (both natives and migrants) is given by β_t, which implies that the flow of newborns during period t is $\beta_t (1 + \lambda_t) N_{at}$. Therefore, the difference equations that describe the evolution of the adult population and the elderly population, denoted N_{ot}, are given as follows, respectively:

$$N_{at+1} = \beta_t (1 + \lambda_t) N_{at}, \tag{6}$$

[9]The results of the forecast error variance decomposition are available upon request.

and

$$N_{ot+1} = (1 + \lambda_t)\, N_{at}. \tag{7}$$

Since demographic and economic indicators, including those used here, are expressed in terms of average population in the data, it is worthy of noting that this paper uses as the average population the mean size of the overall population on the 1st of January over two consecutive years. In order to stick to this convention, we therefore define and compute using equations (6) and (7), the average population at time t, denoted P_t, as follows:

$$P_t := \frac{N_{at} + N_{ot} + N_{at+1} + N_{ot+1}}{2} = \frac{[1 + (1 + \beta_t)(1 + \lambda_t)]\, N_{at} + N_{ot}}{2}. \tag{8}$$

Consequently, using equations (5), (6) and (7), the share of the labor force within the average population is obtained by:

$$\frac{N_{at} + I_t}{P_t} = \frac{2\,(1 + \lambda_t)}{1 + (1 + \beta_t)(1 + \lambda_t) + \frac{1}{\beta_{t-1}}}. \tag{9}$$

We observe that migration rate has a positive impact on this share while a shock on the fertility rate in t has a negative impact at time t followed by a positive impact in $t+1$. Similarly, the population growth rate during period t, denoted n_t, is given by:

$$1 + n_t := \frac{N_{at+1} + N_{ot+1}}{N_{at} + N_{ot}} = \beta_t\,(1 + \lambda_t)\,\frac{1 + \frac{1}{\beta_t}}{1 + \frac{1}{\beta_{t-1}}}. \tag{10}$$

We observe that a positive shock on the migration rate at t increases the growth rate in t, while a positive shock in the birth rate at t increases the growth rate both in t and $t+1$. When demographic parameters are constant, the growth rate is given by: $1 + n = \beta\,(1 + \lambda)$.

Contemporaneous impact of immigration on income per capita

We first analyze the impact of a migration shock occurring at date t on income per capita at date t. Table 3 indeed reveals that following a migration shock, GDP per capita significantly increases.

In the literature, a positive impact of international migration on income per capita can be found provided that the production function features some complementarity between migrants and natives (Ottaviano and Peri, 2012) or increasing returns-to-scale (Lundberg and Segerstrom, 2002). Moreover, the economic impact of international migration can also be positive if migrants bring physical or human capital with them (Boubtane *et al.*, 2016). We consider here another channel in a framework that ignores all those factors. We suppose perfect substitutability between migrants and natives, constant returns-to-scale, and migrants that arrive without capital.

The production at time t is given by $F(K_t, L_t)$, where K_t is the stock of capital installed at the beginning of period t, which is not affected by the net flow of migrants, I_t. Function $F(.,.)$ satisfies the usual neoclassical properties: it is homogeneous of degree 1 and is increasing and concave with respect to each argument. As we pointed out above, the convention in empirical studies is to use the average population P_t to calculate income per capita, denoted here y_t. Using (8), we obtain:

$$y_t := \frac{F(K_t, (1+\lambda_t) N_{at})}{P_t} = \frac{2F(k_t, (1+\lambda_t))}{[1+(1+\beta_t)(1+\lambda_t)] + \frac{1}{\beta_{t-1}}}, \tag{11}$$

where $k_t := K_t/N_{at}$ does not depend on the migration rate λ_t. We obtain following result

Proposition 1 *An migration shock in t has a positive impact on income per capita in t if and only if:*

$$\frac{L_t F_L'(K_t, L_t)}{K_t F_K'(K_t, L_t)} \geq 1 + n_t. \tag{12}$$

Proposition 1 states that net flow of migrants has a positive impact on income per capita if the ratio of factor shares in inputs is larger than the population growth factor. We notice that the ratio varies from one country to another but is likely to be larger than one and is equal to 2 when the share of wages in output is 2/3. We also observe that net flow of migrants is more likely to be favorable to the economy when the population growth rate is low, which is a common feature of aging populations.

It should be stressed that the length of a period here is about 30 years, which is approximately the length of a generation. Nevertheless, our result can be easily extended to an overlapping-generations model with periods whose length is one year as in the empirical part of this paper.

The contemporaneous impact of net flow of migrants on factor prices is easier to derive. As wages in t are given by $w_t = F_L'(k_t, (1+\lambda_t))$, the relationship between migration rate and wages is negative due to decreasing marginal returns. For the interest rate, which is linearly related to $F_K'(k_t, (1+\lambda_t))$, the relationship is given by the sign of the cross-derivative of the production function, which implies that the contemporaneous impact of a migration shock is positive.

The government budget

We now turn to the main equation defining the government budget, which is here assumed to be balanced. The budget features two sources of expenses dedicated respectively to youth and old populations , which are financed through taxes on labor income. Let τ_t, π_t and κ_t denote the tax rate, the transfer per elderly and the transfer per child respectively.

The government budget is balanced if:

$$\tau_t w_t (1+\lambda_t) N_{at} = \pi_t N_{ot} + \kappa_t \beta_t (1+\lambda_t) N_{at}. \tag{13}$$

Everything else equal, we see from (13) that an increase in the migration rate at date t increases both fiscal revenues and expenses dedicated to youth population at date t. Let us now suppose that public expenditure per person, in the form of expenses dedicated respectively to old and youth populations, are proportional to the current wages, such that $\pi_t = \pi w_t$ and $\kappa_t = \kappa w_t$, where $\pi \in [0, 1)$ is representing the pension replacement rate and where $\kappa \in [0, 1)$. We also assume that the tax rate is chosen in order to balance the budget. Therefore, using (6) and (7), the tax rate is given by:

$$\tau_t = \frac{\pi}{(1+\lambda_t)\beta_{t-1}} + \kappa\beta_t. \tag{14}$$

This rate positively depends on rates π and κ, and on demographic parameters. We see that a migration shock at t has a negative impact on τ_t while a fertility shock at t has a positive impact on τ_t followed by a negative impact on τ_{t+1}. This difference is explained by the fact that migrants enter the population as adults.

In this framework, net taxes, defined as fiscal revenues minus transfers, can be written in per capita term as:

$$\frac{\kappa w_t \beta_t (1+\lambda_t) N_{at}}{P_t} = \frac{2\kappa w_t \beta_t}{\frac{(1+\beta_{t-1})}{\beta_{t-1}(1+\lambda_t)} + (1+\beta_t)}. \tag{15}$$

Therefore, the impact of a migration shock in t on the net taxes per capita in t is ambiguous: on the one hand, the share of the labor force within the population increases, which tends to raise net taxes per capita, while on the other hand, wages decrease, which tend to decreases net taxes per capita. According to our estimates presented in Table 3, the contemporaneous impact of a migration shock on net taxes per capita is significantly positive, which suggests that the demographic benefit of migration dominates the potentially negative wage effect.

The impact of a migration shock in a dynamic model

We now analyze the consequences of a migration shock on savings and capital accumulation in a model that incorporates the demographic structure and the government budget described above. The saving rate is the solution of the consumer's optimization problem. The agent born in $t-1$ maximizes consumption when adult and old, denoted c_{at} and c_{ot+1} respectively. Without loss of generality, the consumption during childhood is not considered here. During adulthood, the agent distributes her net wages towards consumption and savings, the latter denoted s_t. During old age, the agent consumes her savings income, denoted $R_{t+1}s_t$, where R_{t+1} is the interest on savings or capital accumulation, and her pension. The optimization problem can be written as:

$$\max_{\{c_{at},c_{ot+1}\}} \ln c_{at} + \theta \ln c_{ot+1},$$
$$s.t. \left| \begin{array}{l} c_{at} = (1-\tau_t)\, w_t - s_t, \\ \\ c_{ot+1} = R_{t+1}s_t + \pi_{t+1}, \end{array} \right.$$

where $\theta > 0$. The optimal savings rate is given by:

$$s_t = \frac{1}{1+\theta}\left[\theta\,(1-\tau_t)\,w_t - \frac{\pi_{t+1}}{R_{t+1}}\right]. \tag{16}$$

By replacing the tax rate that balances the budget, given by (14), in the latter expression, optimal savings can be rewritten as:

$$s_t = \frac{1}{1+\theta}\left[\theta\left(1 - \frac{\pi}{(1+\lambda_t)\,\beta_{t-1}} - \kappa\beta_t\right) w_t - \frac{\pi w_{t+1}}{R_{t+1}}\right]. \tag{17}$$

Migration rate influences savings through two opposing channels in our model: migration rate in t decreases wages in t, which tend to reduce savings but also decreases taxes in t, which tend to increase savings. With (17), we also see that future factor prices play a role which require to study the general equilibrium of the model. For consistency purposes, we assume that the tax rate is lower than 1 by imposing an upper bound on the replacement rate π. We assume that:

$$\pi < \pi_t^{\sup} := (1-\kappa\beta_t)\,(1+\lambda_t)\,\beta_{t-1}. \tag{18}$$

This condition is necessary in order to have positive savings. In overlapping-generations models, the capital stock in the next period equals the aggregate savings of the current period such that $K_{t+1} = s_t L_t$. Assuming a Cobb-Douglas production function $K_t^\alpha L_t^{1-\alpha}$, where $\alpha \in (0,1)$, and a capital depreciation rate of 1, we obtain the following difference equation that describe the dynamics of the capital per adult:

$$k_{t+1} = \frac{\theta\left(1 - \frac{\pi}{(1+\lambda_t)\beta_{t-1}} - \kappa\beta_t\right)(1-\alpha)}{\left[\beta_t\,(1+\theta) + \frac{\pi(1-\alpha)}{\alpha(1+\lambda_t)}\right](1+\lambda_t)^\alpha} k_t^\alpha, \tag{19}$$

with k_0 given. Provided that condition (18) is satisfied, there exists a temporary equilibrium. Moreover, once demographic parameters (λ_t, β_t) are constant, k_t monotonously converges to a steady-state. The total impact of a migration shock on capital per adult in the next period is given in the following proposition.

Proposition 2 *There exists* $\bar{\pi}_t \in (0, \pi_t^{\text{sup}})$ *such that a migration shock in* t *has a positive impact on capital per adult in* $t+1$ *if and only if* $\pi \geq \bar{\pi}_t$*. Moreover,* $\bar{\pi}_t$ *decreases with* κ.

Proposition 2 states that there exists a replacement rate above which a migration shock has a positive impact on capital per adult in the following period. This threshold depends on time as long as the demographic parameters (λ_t, β_t) change with time. Moreover, Proposition 2 establishes that the threshold decreases with the public expenditure dedicated to youth population. In a nutshell, net flow of migrants is likely to have a positive impact on capital per adult if public expenses dedicated respectively to youth and old populations are sufficiently large.

Proposition 2 is useful to figure out what would be the effect of a migration shock. For instance, one may want to study the impact of a shock, defined as: $\lambda_0 > \lambda$ and $\lambda_t = \lambda$ for all $t \geq 1$, on the economy at steady-state. According to Proposition 2 and to the stability property of the steady-state defined using (19), the capital per adult would first increase and then converge back to the steady-state if $\pi > \bar{\pi}$. More precisely, the capital per adult will satisfy the dynamics starting at k_0, such that $k_1 > k_0$, $k_2 \in (k_0, k_1)$, $k_3 \in (k_0, k_2)$, etc. Conversely, if $\pi < \bar{\pi}$, the capital per adult will first decrease and then converge back.

Proposition 3 *Consider an economy at steady-state characterized by demographic parameters* (β, λ) *and by* $\pi > \bar{\pi}$*. A migration shock satisfying* $\lambda_0 \in \left(\lambda, \frac{(1-\alpha)}{\alpha\beta} - 1\right)$ *and* $\lambda_t = \lambda$ *for all* $t = 1, 2, ..$ *induces: (i) an increase in income per capita for all* $t = 0, 1, ..;$ *(ii) an increase in net taxes for all* $t = 0, 1, ...$ *Moreover, as of date* $t = 2$*, income per capita and net taxes converge back to their steady-state values.*

Proposition 3 details the dynamic impact of a migration shock on the key variables of the economy. The focus here is made on the positive impacts of net flow of migrants in order to be consistent with our empirical findings, but we obviously get the symmetric dynamics if the conditions are not satisfied. The theoretical responses of income per capita and net taxes per capita are qualitatively similar to those found in Table 3.

Proposition 3 highlights two main transmission channels of the shock on the economy, characterizing the demographic advantage of migration. The first effect is the increase in the *age support ratio*, i.e. the relative size of the adult population, that may cancel out the dilution effect induced by the assumption of constant returns-to-scale in the production function. We see that the impact is positive provided that the migration shock is not too large. As we mentioned with Proposition 1, this first transmission channel impacts the economy at the date of the shock. Thus, income per capita increases while wages decrease. Interestingly, net taxes increase as the increase in the tax base counterbalances the wages reduction.

The second effect is due to a possible increase in the *savings rate.* As we have seen with Proposition 2, this possibility relies on conditions that are assumed in Proposition 3. Through this channel, there is an increase in capital that positively impacts income per capita, wages and net taxes one period after the shock, once savings are transformed into capital. Then, convergence after two periods is due to the fact that we do not assume, to simplify the analysis, any persistence in the shock. The empirical analysis presented above reveals that migration shocks display some persistence, which will shape the response of the economy to the shock.

To keep the theoretical analysis tractable, we have not considered here the possibilities of fiscal deficits as we do in our main regression. Moreover, the impact of a permanent change in the migration rate is not analyzed here, as it is beyond the scope of the paper. It is, nevertheless, relatively simple to study and relies on the same conditions expressed above. Provided that $\pi > \bar{\pi}$, the steady-state value of the capital per adult increases and we observe a monotonic convergence to the new steady-state.

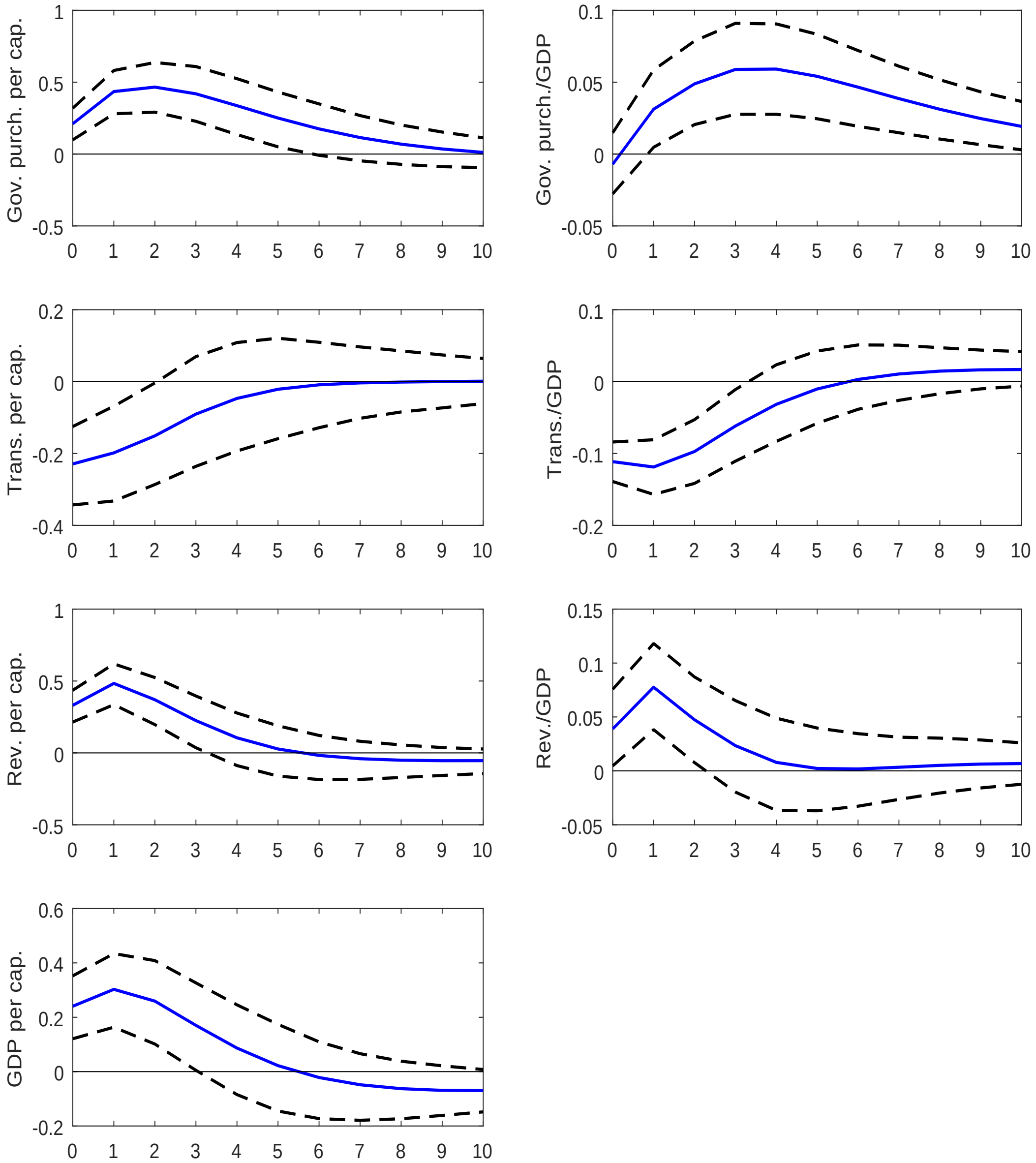
4.2 Immigration and the age structure of public spending

In the previous section, we stressed the importance of the demographic role of the migration shocks. We now develop this idea by proposing various decompositions of our fiscal variables.

We first of all estimated once again our model by breaking up the net taxes to analyze the role of the transfers paid by the general government. We now consider the following system $Z_{it}^2 = [m_{it}, g_{it}, tr_{it}, re_{it}, y_{it}]'$ where tr and re are respectively the logarithms of per capita, transfers paid and revenues received by the general government. The impulse response functions to migration shock are presented in Figure 2 and Table 4-(a). The increases in net taxes reported in Table 3 can now be analyzed more precisely. We see that following a migration shock not only revenues increase (by 0.33% on impact) but also that this positive effect for public finances is magnified by a decreases in transfers. Our estimates reveal that transfers per capita significantly decrease by 0.23% on impact and by 0.20% on year after the shock. Table 4 also report the responses of our fiscal variables computed as a share of the GDP. By doing so, we highlight the effect of migration shock while controlling for its positive impact on GDP. We see that the magnitude of the effects is reduced, which was expected, but that responses remain significant.

One of the main characteristics of migration is that it concerns working-age people, who possibly arrive with children. One thus expects that migration reduces (in per capita term) the public spending dedicated to the elderly people and while increasing (in per capita term) public spending dedicated to children. As indicated in the data Appendix, government purchases and transfers data from OECD Economic Outlook do not provide details on the target population allowing us to identify the public spending on old-age

Figure 2: Responses to migration shock in the model with gov. purchases, transfers and revenues



Notes: The solid line gives the estimated impulse responses. Dashed lines give the 90% confidence intervals generated by Monte Carlo with 5000 repetitions. For per capita variables, the responses are expressed in percentage change; for variables as a share of GDP, the responses are in percentage points change.

population and public spending on youth population. We therefore use SOCX data to identify these expenditure and analyze the effect of migration on the age structure of public spending.

More precisely, we are interested in public spending dedicated to old age population and those dedicated to youth population. These spending can be find both in the transfers paid by the government and the government purchases. Thus, before proposing a decomposition by age structure, we group those two components of government expen-

Table 4: Responses to migration shock and age structure of public spending

(a) Model with gov. purchases, transfers and revenues

	Year 0	Year 1	Year 2	Year 5	Year 10
Gov. purchases per capita	0.21*	0.43*	0.47*	0.25*	0.01
Transfers per capita	-0.23*	-0.20*	-0.15	-0.02	0.00
Revenues per capita	0.33*	0.48*	0.37*	0.03	-0.05
GDP per capita	0.24*	0.30*	0.26*	0.02	-0.07
Gov. purchases/GDP	-0.01	0.02*	0.04*	0.04*	0.01
Transfers/GDP	-0.11*	-0.12*	-0.10*	-0.01	0.02
Revenues/GDP	0.04*	0.08*	0.04*	0.00	0.01

(b) Model with public spending and revenues

	Year 0	Year 1	Year 2	Year 5	Year 10
Spending per capita	-0.01	0.14	0.03	-0.12	-0.02
Revenues per capita	0.28*	0.36*	0.18*	-0.13	-0.05
GDP per capita	0.17*	0.23*	0.01*	-0.20	-0.06
Spending/GDP	-0.12*	-0.06*	0.02	0.05	0.03
Revenues/GDP	0.05*	0.06*	0.07*	0.03	0.00

(c) Model with public spending and revenues, including family spending

	Year 0	Year 1	Year 2	Year 5	Year 10
Public spend. per capita	-0.01	0.14	0.03	-0.12	-0.02
Family spend. per capita	-0.01	0.14	0.03	-0.12	-0.02
Revenues per capita	0.28*	0.36*	0.18*	-0.13	-0.05
GDP per capita	0.17*	0.23*	0.01*	-0.20	-0.06
Public spend./GDP	-0.12*	-0.06*	0.02	0.05	0.03
Family spend./GDP	-0.12*	-0.06*	0.02	0.05	0.03
Revenues/GDP	0.05*	0.06*	0.07*	0.03	0.00

(d) Model with public spending and revenues, including old-age spending

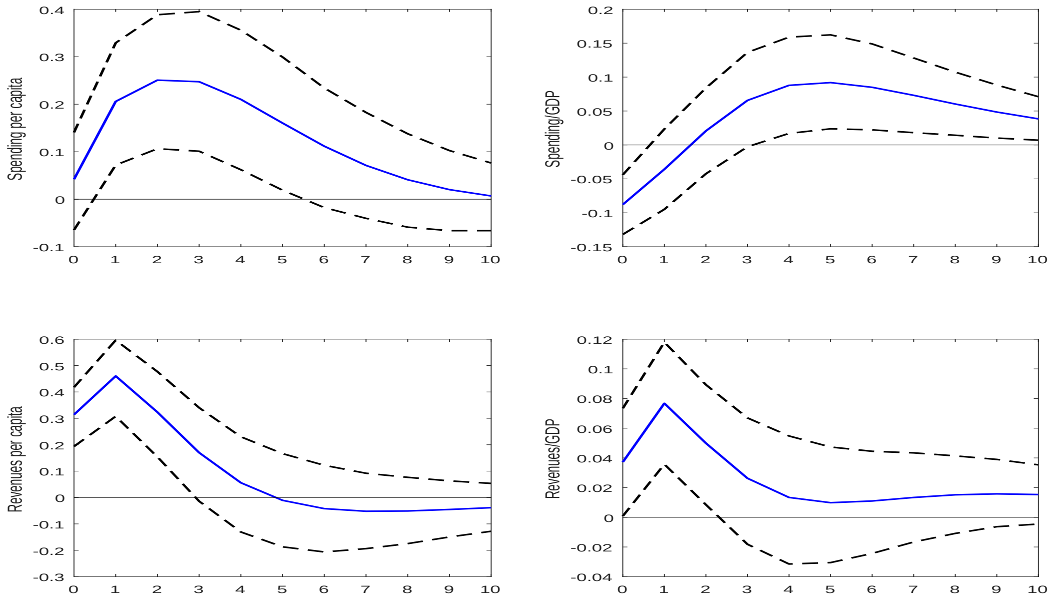
	Year 0	Year 1	Year 2	Year 5	Year 10
Public spend. per capita	-0.01	0.14	0.03	-0.12	-0.02
Old age Spend. per capita	-0.01	0.14	0.03	-0.12*	-0.02
Revenues per capita	0.28*	0.36*	0.18*	-0.13	-0.05
GDP per capita	0.17*	0.23*	0.01*	-0.20	-0.06
Public spend./GDP	-0.12*	-0.06*	0.02	0.05	0.03
Old age Spend/GDP	-0.12*	-0.06*	0.02	0.05	0.03
Revenues/GDP	0.05*	0.06*	0.07*	0.03	0.00

Notes: Year 0 stands for the year of the shock. * denotes statistical significance at the 10% level. The size of the migration shock is set to 1 person per 1,000 inhabitants. For per capita variables, the responses are expressed in percentage change; for variables as a share of GDP, the responses are in percentage points change.

diture in one variable named public spending. The baseline model is thus rewritten as follows: $Z^3_{it} = [m_{it}, s_{it}, re_{it}, y_{it}]'$ where s_{it} stands for public spending including transfers. The impulse response functions to a migration shock are presented in Table 4 -(b) and in Figure 3. We see that our previous results are not modified. Interestingly, public spending, when computed as a share of GDP, significantly decreases the year of the shock.

This is due to a non significant increase in public spending including transfers that is dominated by a significant increase in GDP on impact.

Figure 3: Responses to a migration shock in the model with public spending and revenues



Notes: The solid line gives the estimated impulse responses. For per capita variables, the responses are expressed in percentage change; for variables as a share of GDP, the responses are in percentage points change. Dashed lines give the 90% confidence intervals generated by Monte Carlo with 5000 repetitions.

We now consider in the model including public spending and revenues, the effect of the net flow of migrants on social public expenditure dedicated to old-age population (old-age spending) and those dedicated to youth population (family spending). We estimated two additional models: $Z^4_{it} = [m_{it}, s_{it}, fs_{it}, re_{it}, y_{it}]'$ and $Z^5_{it} = [m_{it}, s_{it}, oas_{it}, re_{it}, y_{it}]'$ where fs_{it} and oas_{it} are respectively the logarithms of per capita, family spending and old age spending. Our estimates are reported in Figure 4 and panels *(c)* and *(d)* of Table 4[10]. We see that family spending significantly increases a few years after a migration shock, whether they are computed in per capita or per GDP terms. Conversely, old-age spending significantly decrease after a migration shock. When computed in per GDP term, the decrease is significant as early as the year of the shock while it is delayed until 3 years after the shock when old age spending are computed in per capita terms.

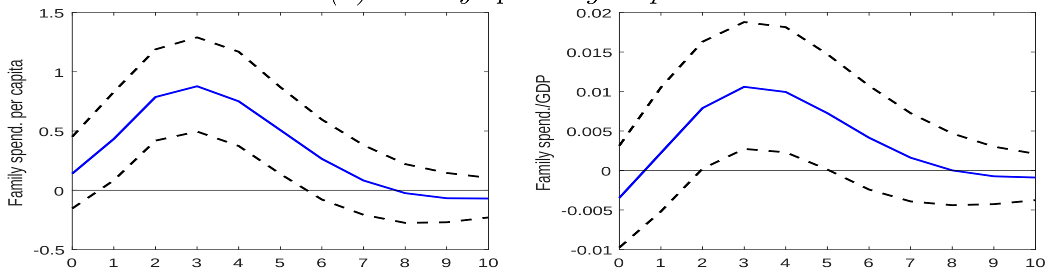
Two mains conclusions can be drawn from these estimates. Firstly, our results are consistent with basic intuition, which constitutes an additional validation of our econometric model. Secondly, our results reinforce the idea that the "demographic dividend" of net flow of migrants goes through public finances. As suggested by the theoretical

[10]Note that due to the shorter data availability of detailed SOCX data, the estimation sample covers the 19 OECD countries over the period 1990-2013 for the models including family spending and old age spending, respectively.

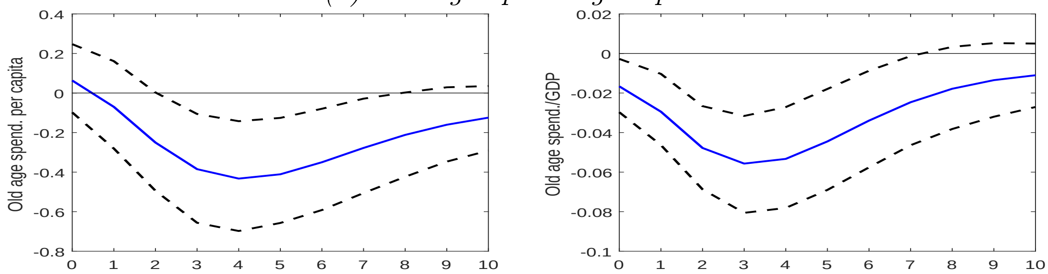
model, the aging economies penalized by important public transfers to retirees strongly benefit from inflows of active-age individuals. Moreover, our results suggest that the cost induced by the increase in family spending is more than compensated by the benefits of international migration, and most notably for the financing of public pension systems.

Figure 4: Age-related public spending responses to migration shock

(a) Family spending responses



(b) Old-age spending responses



Notes: The solid line gives the estimated impulse responses. Dashed lines give the 90% confidence intervals generated by Monte Carlo with 5000 repetitions. For per capita variables, the responses are expressed in percentage change; for variables as a share of GDP, the responses are in percentage points change.

4.3 Immigration and labor market public spending

An important issue in OECD countries is the effect of international migration on labor market conditions. To keep the theoretical model tractable, we have considered that the adjustment of wages ensures the equilibrium in the labor market. This assumption is clearly unrealistic, in particular for European countries, where labor market rigidities may be associated to not only unemployment but also to the fear of a detrimental effect of international migration on labor markets. We thus go beyond our baseline model and consider now the fiscal implications of net flow of migrants while explicitly taking into account the labor market.

We have first estimated our baseline model including the unemployment rate in the system as in d'Albis *et al.* (2018). The corresponding results are presented in Table 5-(a). Second, we estimate an additional model written as follows: $Z_{it}^6 = [m_{it}, s_{it}, re_{it}, y_{it}, u_{it}]'$ where u is the logarithm of the unemployment rate. The corresponding impulse response functions are presented in Table 5-(b). We see that effects on both GDP per capita and fiscal variables are roughly unchanged compared to our baseline model including the unemployment rate. Interestingly, we obtained that a migration shock significantly reduces the unemployment rate by 0.1 percentage points on impact and for two years after the shock. This confirms the previous findings we obtained for France (d'Albis *et al.*, 2016) and Western European countries (d'Albis *et al.*, 2018).

Then, we extended the model with public spending, revenues and unemployment rate by considering public spending on labor market policies. Using SOCX data decomposition of public expenditure, we studied the effect of a migration shock considering the SOCX data social policy areas related to labor market: *unemployement* and *active labor markets policies*[11]. We have estimated two additional models: $Z_{it}^7 = [m_{it}, s_{it}, als_{it}, re_{it}, y_{it}, u_{it}]'$ and $Z_{it}^8 = [m_{it}, s_{it}, us_{it}, re_{it}, y_{it}, u_{it}]'$ where als_{it} and us_{it} represent respectively the logarithms of per capita, active labor market programs spending and unemployment spending. The corresponding impulse response functions are presented in the panels *(c)* and *(d)* of Table 5[12]. We see that following a migration shock, active labor market programs spending increase (by 1.49% on impact) while spending associated to unemployment benefits decrease (by 1.71% on impact). These results interestingly clarify the effects of net flow of migrants on the labor market. As newcomers, migrants are necessarily more likely to benefit from a public accompaniment during their job search, which represents a cost for public finances. However, because of their contribution to the reduction of unemployment rate, migrants do reduce the expenditure associated to unemployment benefits. This suggest that resident population benefit from a migration shock even if public spending dedicated to active labor market policies increase.

5 Conclusion

In this paper, the fiscal impact of net flow of migrants on the government budgets of OECD countries are quantified using a VAR approach consistent with previous studies on the fiscal multipliers and interpreted with an overlapping-generation model. The results show that OECD countries, by virtue of their demographic structures and large public transfers to their non-working cohorts, constitutes a group of countries where international migration probably has positive effects. In particular, net flow of migrants has been shown to increase both GDP per capita and the fiscal balance while decreasing the unemployment rate. Our results are robust to various alternative assumptions. This suggest that the belief that public finance would be deteriorated by international migration was not observed for OECD countries over the period 1980-2015.

[11] See Adema *et al.* (2011) for the methodological aspects of the OECD SOCX data.

[12] Note that due to the shorter data availability of detailed SOCX data, the estimation sample covers the 19 OECD countries over the period 1990-2013 for the model including active labor market programs spending. Denmark are not included in the estimation of the model including unemployment spending. For this model, the estimation sample covers the 18 OECD countries over the period 1990-2013.

Table 5: Responses to migration shock, labor market

(a) Baseline model with unemployment rate

	Year 0	Year 1	Year 2	Year 5	Year 10
Gov. purchases per capita	0.21*	0.42*	0.47*	0.25*	0.02
Net Taxes per capita	0.74*	0.95*	0.81*	0.16	-0.11
GDP per capita	0.23*	0.29*	0.29*	0.05	-0.06
Unemp. rate	-0.10*	-0.14*	-0.13*	-0.03	0.02
Fiscal balance	0.10*	0.09*	0.06*	-0.03	-0.03

(b) Model with public spending, revenues and unemployment rate

	Year 0	Year 1	Year 2	Year 5	Year 10
Public spend. per capita	0.04	0.20*	0.25*	0.16	0.01
Revenues per capita	0.28*	0.41*	0.31*	0.01	-0.04
GDP per capita	0.22*	0.27*	0.24*	0.01	-0.07
Unemployment rate	-0.10*	-0.13*	-0.12*	-0.01	0.02
Public spend./GDP	-0.08*	-0.03	0.00	0.07*	0.04*
Revenues/GDP	0.03	0.06*	0.03	0.00	0.01

(c) Model with public spend., revenues and unemployment rate, including active labor program spend.

	Year 0	Year 1	Year 2	Year 5	Year 10
Public spend. per capita	0.02	0.15*	0.31*	0.23*	-0.03
Active labor prog. spend. per capita	1.49*	1.20*	0.57	-0.16	-0.02
Revenues per capita	0.35*	0.44*	0.41*	0.12	-0.02
GDP per capita	0.27*	0.28*	0.40*	0.20	-0.02
Unemployment per capita	-0.11*	-0.15*	-0.15*	-0.03	0.01
Public spend. /GDP	-0.12*	-0.06	-0.04	0.01	-0.01
Active labor prog. spend./GDP	0.02*	0.01*	0.00	-0.01	0.00
Revenues/GDP	0.04	0.08*	-0.04	-0.03	0.00

(d) Model with public spend., revenues and unemployment rate, including unemployment spend.

	Year 0	Year 1	Year 2	Year 5	Year 10
Public spend. per capita	0.02	0.14*	0.29*	0.21*	-0.03
Unemployment spend. per capita	-1.71*	-2.44*	-2.03*	0.41	0.25
Revenues per capita	0.37*	0.46*	0.41*	0.12	-0.03
GDP per capita	0.28*	0.28*	0.40*	0.20	-0.01
Unemployment per capita	-0.11*	-0.16*	-0.15*	-0.02	0.01
Public spend. /GDP	-0.12	-0.07	-0.05	0.01	-0.01
Unemployment spend./GDP	-0.03*	-0.04*	-0.03*	0.00	0.00
Revenues/GDP	0.04	0.08*	0.00	-0.03	-0.01

Notes: Year 0 stands for the year of the shock. * denotes statistical significance at the 10% level. The size of the migration shock is set to 1 incoming individual per 1,000 inhabitants. For per capita variables, the responses are expressed in percentage change; for variables as a share of GDP, the responses are in percentage points change.

Given the restricted time-frame of our data, the results do not apply to any single country but show the average response of the 19 OECD countries we consider in our sample. Furthermore, the linear structure of the empirical model implies that these results only apply to "small" shocks and cannot be used to anticipate the effect of really massive immigration.

Our research may be extended in various ways. First, the fiscal policy literature has recently discussed the the existence -or, absence- of state dependence in fiscal multipliers (Canzoneri *et al.*, 2016). It could be interesting to see whether the effects of international migration are state-dependent. Second, it would be useful to disaggregate the international migration. A breakdown between nationals and non-nationals would make it possible to more accurately assess the net contribution of migrants as defined in generational accounting studies. Unfortunately this breakdown is not possible from the data currently available. Preliminary work on reconstructing migratory flow statistics is thus necessary.

References

Adema, W., Fron, P., Ladaique, M., 2011. Is the European welfare state really more expensive?: Indicators on social Spending, 1980-2012; and a manual to the OECD Social Expenditure Database (SOCX). OECD Social, Employment and Migration Working Papers No. 124.

Ager, P., Brückner, M., 2013. Cultural diversity and economic growth: Evidence from the US during the age of mass migration. *European Economic Review* 64, 76-97.

d'Albis, H., 2007. Demographic structure and capital accumulation. Journal of Economic Theory 132 (1), 411-434.

d'Albis, H., Boubtane, E., Coulibaly, D., 2016. Immigration policy and macroeconomic performances in France. *Annals of Economics and Statistics* 121-122, 279-308.

d'Albis, H., Boubtane, E., Coulibaly, D., 2017. International migration and regional housing market: Evidence from France. *International Regional Science Review*, forthcoming.

d'Albis, H., Boubtane, E., Coulibaly, D., 2018. Macroeconomic evidence suggests that asylum seekers are not a burden for Western European countries. *Science Advance*,4: eaaq0883.

Alesina, A., Ardagna, S., Perotti, R., Schiantarelli, F., 2002. Fiscal policy, profits, and investment. *American Economic Review* 92, 571-589.

Auerbach, A., Oreopoulos, P., 1999. Analyzing the fiscal impact of US immigration. *American Economic Review* 89, 176-180.

Beaudry, P., Collard, F., 2003. Recent technological and economic change among industrialized countries: Insights from Population Growth. *Scandinavian Journal of Economics*, 105 (3), 441-464.

Beetsma, R., Giuliodori, M., 2011. The effects of government purchases shocks: Review and estimates for the EU. *The Economic Journal*, 121, F4-F32.

Beetsma, R., Giuliodori, M., Klaassen, F., 2006. Trade spill-overs of fiscal policy in the European Union: A panel analysis. *Economic Policy*, 21, 639-687.

Beetsma, R., Giuliodori, M., Klaassen, F., 2008. The effects of public spending shocks on trade balances and budget deficits in the European Union. *Journal of the European Economic Association*, 6(2/3), 414-423.

Blanchard, O. J., Perotti, R., 2002. An empirical characterization of the dynamic effects change in government spending and taxes on output. *Quarterly Journal of Economics*, 117, 1329-1368.

Blau, F. D., 1984. The Use of transfer payments by immigrants. *Industrial and Labor Relations Review*, 37(2), 222-239.

Blau, F. D., Mackie, C., 2016. *The economic and fiscal consequences of immigration.* A Report of the National Academies, Washington DC.

Boeri, T., 2010. Immigration to the land of redistribution. *Economica* 77, 651-687.

Boucekkine, R., de la Croix, D., Licandro, O., 2002. Vintage human capital, demographic trends, and endogenous growth. *Journal of Economic Theory*, 104(2), 340-375.

Boubtane, E., Coulibaly, D., Rault, C., 2013. Immigration, growth and unemployment: Panel VAR evidence from OECD countries. *Labour: Review of Labour Economics and Industrial Relations* 27(4), 399-420.

Boubtane, E., Dumont, J. C., Rault, C., 2016. Immigration and economic growth in the OECD countries 1986-2006. *Oxford Economic Papers* 62, 340-360.

Brücker H., Capuano, S. and Marfouk, A., 2013. Education, gender and international migration: Insights from a panel-dataset 1980-2010, mimeo.

Brückner, M., Pappa, E., 2012. Fiscal expansions, unemployment, and labor force participation: Theory and evidence. *International Economic Review*, 53, 1205-1228.

Canzoneri, M. , Collard, F. , Dellas, H., Diba, B., 2016. Fiscal multipliers in recessions. *Economic Journal*, 126(590), 75-108.

Clemens, M. A., 2011 Economics and emigration: Trillion-dollar bills on the sidewalk? *Journal of Economic Perspectives*, 25, 83-106.

Clemens, M. A., Hunt, J., 2017. The labor market effects of refugee waves: Reconciling conflicting results. NBER No. 23433.

Dustmann, C., Frattini, T. 2014. The fiscal effects of immigration to the UK. *Economic Journal* 124, F593-643.

Eckstein, Z., Schultz, T. P., Wolpin, K. I., 1985. Short run fluctuations in fertility and mortality in pre-industrial Sweden. *European Economic Review*, 26, 295-317.

Faust, J., 1998. The robustness of identified VAR conclusions about money. *Carnegie-Rochester Conf. Ser. Public Policy* 49, 207-244.

Fernihough, A., 2013. Malthusian dynamics in a diverging Europe: Northern Italy, 1650-1881. *Demography* 50, 311-332.

Fry, R. and Pagan, A. 2011. Sign restrictions in structural vector autoregressions: A critical review. *Journal of Economic Literature*, 49 (4), 938-60.

Furlanetto, F., Robstad, Ø, 2016. Immigration and the macroeconomy: Some new empirical evidence. Norges Bank Working Paper 18/2016.

Hahn, J., Kuersteiner, G., 2002. Asymptotically unbiased inference for a dynamic panel model with fixed effects when both n and T are large. *Econometrica* 70, 1639-1657.

Juessen, F., Linnemann, L., 2012. Markups and fiscal transmission in a panel of OECD countries. *Journal of Macroeconomics* 34, 674-686.

Kim, S., Lee, J. W. (2008). Demographic changes, saving, and current account: An analysis based on a panel VAR model. *Japan and the World Economy* 20, 236-256.

Kiviet, J. F., 1995. On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. *Journal of Econometrics* 68, 53-78.

Lee, R., Mason, A., members of the NTA network, 2014. Is low fertility really a problem? Population aging, dependency, and consumption. *Science*, 346, 229-234.

Lee, R., Miller, T., 1997. Immigrants and their descendants. Mimeo, Project on the Economic Demography of Interage Income Reallocation, University of California Berkeley.

Lee, R., Miller, T., 2000. Immigration, social security and broader fiscal impacts. *American Economic Review* 90, 350-354.

Leeper, E. M., Walker, T. B., Yang, S. C. S., 2013. Fiscal foresight and information flows. *Econometrica* 81, 1115-1145.

Liebig, T. and Mo, J., 2013. The fiscal impact of immigration in OECD countries. International Migration Outlook, OECD Publishing.

Lundberg, P., Segerstrom, P., 2002. The growth and welfare effects of international mass migration. *Journal of International Economics* 56, 177-204.

Lütkepohl, H., 2005. *New introduction to multiple time series analysis*. Springer.

Margolis D, Yassine C., 2015. Poverty, Employment and education in Southern Africa, 2020-2100. Mimeo, Labor Markets in Sub-Saharan Africa NJD 2015 SSA Regional Event, November 26-27, 2015; Cape Town, South Africa.

Massey, D. S., Pren, K. A., 2012. Unintended consequences of US immigration policy: Explaining the post â€Ð±965 surge from Latin America. *Population and Development Review* 38, 1-29.

Monacelli, T., Perotti, R., Trigari, A., 2010. Unemployment fiscal multipliers. *Journal of Monetary Economics*, 57, 531-553.

National Research Council, 1997. *The new Americans*. Washington, DC: National Academy Press, 1997.

Nickell, S. J., 1981. Biases in dynamic models with fixed effects. *Econometrica* 49, 1417-1426.

Nicolini, E., 2007. Was Malthus right? A VAR analysis of economic and demographic interactions in pre-industrial England. *European Review of Economic History* 11, 99-121.

OECD, 2018a. *Social Expenditure: Aggregated data* (Edition 2017), OECD Social and Welfare Statistics (database), accessed on 02 Mars 2018.

OECD, 2018b. *Aggregate National Accounts, SNA 2008 (or SNA 1993): Gross domestic product*, OECD National Accounts Statistics (database), accessed on 07 June 2018.

OECD, 2017. *Labour Force Statistics: Population and vital statistics* (Edition 2017) OECD Employment and Labour Market Statistics (database), accessed on 18 May 2018.

OECD, 2016. *OECD Economic Outlook* No. 99 (Edition 2016/1) OECD Economic Outlook: Statistics and Projections (database), accessed on 24 October 2017.

Ortega, J., Peri, G., 2014. Openness and income: The roles of trade and migration. *Journal of International Economics* 92, 231-251.

Ottaviano, G.I.P., Peri, G., 2012. Rethinking the effect of immigration on wages. *Journal of the European economic association*10(1), 152-197.

Perotti, R., 2005. Estimating the effects of fiscal policy in OECD countries. CEPR Discussion.

Preston, I., 2014. The Effect of Immigration on Public Finances. *The Economic Journal* 124, F569-F592.

Price, R.W.R. Dang, T.-T., and Botev, J. 2015. Adjusting fiscal balances for the business cycle: New tax and expenditure elasticity estimates for OECD countries. OECD Economics Department Working Papers, No. 1275.

Sims, C. A., 1992. Interpreting the macroeconomic time series facts: The effects of monetary policy. *European Economic Review* 36, 975-1000.

Stock, J. H., Watson, M. W., 2001. Vector Autoregressions. *Journal of Economic Perspectives* 15, 101-115.

Storesletten, K., 2000. Sustaining fiscal policy through immigration. *Journal of Political Economy* 108, 300-323.

Storesletten, K., 2003. Fiscal implications of immigration - a net present value calculation. *Scandinavian Journal of Economics* 105, 487-506.

Uhlig, H., 2005. What are the effects of monetary policy on output? Results from an agnostic identification procedure. *Journal of Monetary Economics* 52, 381-419.

United Nations, Department of Economic and Social Affairs, Population Division, 2015. International Migration Flows to and from Selected Countries: The 2015 Revision.

United Nations, Department of economic and Social Affairs, Population Division, 2016. International Migration Report 2015: Highlights.

United Nations, Department of Economic and Social Affairs. Population Division, 2017. Trends in International Migrant Stock: The 2017 revision (United Nations database, POP/DB/MIG/Stock/Rev.2017). accessed on 16 July 2018.

Yang, S., 2007. Tentative evidence of tax foresight. *Economics Letters* 96, 30-37.