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Should I Stay or Should I Go? Austerity, Unemployment and Migration

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Abstract

High unemployment and fiscal austerity during the recent crisis have led to significant migration outflows from the periphery of the euro area. This paper introduces endogenous migration both for the unemployed and employed members of the household in a small open economy DSGE model with search and matching frictions. The government can use public spending, unemployment benefits, or labor income taxes as fiscal consolidation instruments. A tax-based consolidation induces the highest migration outflows in the short run, which exacerbates the induced GDP contraction. Cuts in unemployment benefits induce the highest outflows of jobseekers in the medium run, but with more favorable effects on GDP and unemployment as the domestic wage adjusts downwards. The latter also leads to a very persistent increase in the intensity with which current workers look for a job abroad. Government spending cuts, on the other hand, have a small impact on migration. A repatriation policy, modelled as a higher utility cost of migration, generates a return of migrants, leading to a boost in aggregate demand, a fall in real wages and an increase in unemployment.

JEL codes: E32, F41
Keywords: DSGE model, fiscal consolidation, migration, matching frictions, small open economy.

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1 Introduction

Worsening labor market conditions and fiscal tightness in the aftermath of the recent crisis have led to increased migration outflows from peripheral countries of the euro area (see Figure 1).[1] The surge in unemployment rates and the lack of work opportunities, together with fiscal austerity involving tax hikes, cuts in social benefits and restrictions in new recruitment of public employees, have contributed to this notable increase in migration flows.[2] For instance, Greece and Spain exhibited net migration outflows in 2013, representing 2.2% and 1.9% of the workforce, respectively (Lazaretou (2016)). Over the period 2008-2015, 608,000 Greek residents aged 15-64 left the country in search of employment, better pay and better social and economic prospects (see Figure 2).[3] In the case of Spain, migration outflows went from an average of 0.4% of the population over the period 2008-2010 to 1.2% in 2012, when the country started recording net emigration for the first time since the 1970s (Izquierdo et al. (2016)). Since 2010, outflows have totaled more than 400,000 per year, which is, both in absolute and relative terms, the highest level of emigration in Spanish history.[4] The goal of this paper is twofold. First, we study the macroeconomic consequences of migration and its implications for business cycle fluctuations. Second, we shed light on the interactions between fiscal consolidation and endogenous migration decisions.

Although mobility in response to disparate labor market conditions might result in improvements in aggregate employment, the impact on local adjustments hinges on a number of factors. First, as migrants flow abroad, labor market tightness increases in the home country, putting upward pressure on wages and hampering firms' marginal costs. Additionally, and insofar as employed workers also choose to emigrate, firms not only find it more costly to hire new workers but also face a shortage of labor. For instance, Labrianidis and Pratsi-

[1] In general, data on migration has limitations in terms of scope, detail and time span. For instance, data on adjusted net migration from the Eurostat, being a statistical construct, it includes adjustments in population statistics. As Izquierdo et al. (2016) discuss, migration data typically relies on migrants enrolling in voluntary registries, such as municipal registers in the country of arrival or in consulates and embassies. Moreover, because delays in enrollments are likely to occur, and because permanent migrants are more likely to self register, the magnitude and timing of migration data can only be approximate. Other sources used to gauge the dimension and characteristics of the recent migration flows include survey data, like Triandafyllidou and Gropas (2014) and Labrianidis and Pratsinakis (2016) for Greece.

[2] Prior to the crisis, immigration from countries that had recently joined the EU, as well as from countries outside the block contributed the most to migration surpluses in Periphery member-states.

[3] In 2014, the unemployment rate in Greece rose to around 28%, more than double (triple) that of 2010 (2008), with a profound impact on the mobility decisions of the Greek people, previously considered as the least favorable Europeans, after the Cypriots, towards long distance mobility (Commission (2006)). The migration response to the crisis has been considerable in Europe, in contrast to the U.S. where no evidence of greater inter-regional labor mobility is found in reaction to labor market shocks (Jauer et al. (2014)).

[4] This involves high mobility of foreign nationals: in 2012 approximately 5% of foreign residents in Spain left the country, while less than 0.1% of Spaniards born in Spain emigrated. However, since 2007 there is also net emigration of the latter group with outflows tripling between 2006-2012 (Izquierdo et al. (2016)).

nakis (2016) report that half of those leaving Greece after 2010 were employed at the time of emigration.[5] Second, migrants take with them not only their labor supply, but also their purchasing power, inducing a higher fall in internal demand during bad times. Although this impact can be mitigated if emigrants send some of their earnings back home, remittance inflows in the periphery have not increased at the same rate as emigration and amount only to a small portion of total GDP.[6] On the other hand, the impact on aggregate demand depends on the degree of openness and the importance of home bias in the demand for tradable goods. As shown by Farhi and Werning (2014), when a region experiences demand shortfalls in the non-tradable sector, emigration can serve as a rebalancing mechanism by which labor supply is reduced to meet lower demand, leaving workers who do not migrate in an unchanged situation. By contrast, when two regions are highly integrated, an increase in emigration can lead to an increase in external demand, employment and consumption in the country of origin. However, in most typical cases, where trade integration is lower, the increase in external demand might not compensate for the fall in internal demand.

Notably, labor mobility also has fiscal consequences. On the one hand, migration shifts the tax base, both by affecting private demand and, to the extent that employed workers decide to leave, by reducing taxable income. However, migration decisions also depend on migrants' expectations regarding future socioeconomic conditions and the security of their future in the home country. In other words, migrants may leave due to the worsening of the domestic fiscal stance and the perception of future austerity. On the other hand, migration can act as a fiscal stabilizer, mitigating increases in unemployment and therefore lifting fiscal pressure off national governments by reducing the payments of unemployment benefits.[7]

This paper assesses the interplay between migration, the macroeconomy and fiscal consolidation, in comparison to a counterfactual situation of immobility. To this end, endogenous migration decisions are introduced in a Dynamic Stochastic General Equilibrium (DGSE) model of a small open economy with search and matching frictions, endogenous labor force participation, and sticky prices. Labor force participants, including both the employed and the unemployed, have an incentive to migrate abroad where better wage and employment

[5]Several sample surveys investigating the qualitative characteristics of these emigrants have coincided in that the typical migrant is young, single, highly skilled, and having at least two years of work experience (see, e.g, Triandafyllidou and Gropas (2014), Labrianidis and Pratsinakis (2016)).

[6]Remittances over GDP taken from the World Bank for 2013 are as follows: Ireland: 0.33%, Greece: 0.34%, Spain: 0.75%, and Portugal: 1.95%. The *Hellenic Observatory* survey on Greek migration reveals that only 19% of migrants send remittances, suggesting that *"emigration contributes mainly to the subsistence and/or the socioeconomic progress of the emigrants themselves and not of the household"* (see Labrianidis and Pratsinakis (2016)). This and the *Newdiaspora* survey, also on Greek migration, reveal that the vast majority of migrants (68% and 64% respectively) neither sends nor receives money (see Labrianidis and Pratsinakis (2016)).

[7]For instance, Bräuninger (2014) estimates that a scenario of no mobility would have made a difference of nearly 11 pp in the jobless rate for Ireland and 8.2 pp for Spain in 2013.

opportunities exist. The model therefore features cross-border on-the-job search. We assume that employed members of the household will only migrate having secured a job abroad, while the unemployed members migrate to continue their job search abroad. Apart from supplying labor, migrants pay taxes and consume part of their income abroad. Changing country of residence is subject to a moving cost and living abroad entails utility costs.

We first investigate the importance of the migration channel over the business cycle through the dynamic responses of our model to standard TFP, monetary policy and government spending shocks. We find that a TFP shock induces a return of migrant jobseekers, which reinforces the increase in aggregate demand and output, with short-run unemployment costs that are reversed in the medium run. Workers reduce substantially the intensity with which they look for jobs abroad, which reinforces further the decrease in the total stock of migrants and the boost in aggregate demand and output, while mitigating the return of migrant jobseekers relative to a model without cross-border on-the-job search. An increase in the nominal interest rate leads to an increase in migrant jobseekers, which reinforces the decrease in aggregate demand and output, with short-run unemployment gains. In addition, on-the-job-search abroad increases in the short run, driven by the reduction in the real wage.

A government spending shock initially induces a return of migrant jobseekers, given the increase in labor demand. However, this is reversed in the medium run due to a fall in the real wage from the wealth effect of the shock, which increases labor market participation. Yet, the presence of labor mobility mitigates this wealth effect (and so the fall in consumption and investment), reinforcing the output increase, accompanied by short-run (medium-run) unemployment costs (benefits). Interestingly, workers increase persistently the intensity with which they look for jobs abroad because of the fall in the wage, mitigating the migration of the unemployed relative to a model without on-the-job search abroad, since for the household the migration of the employed is translated immediately to a job match abroad. Higher migration costs, capturing the case of anti-immigration and/or repatriation policies, imply an increase in domestic labor supply, which lowers the real wage and increases the unemployment rate. Yet, the boost in aggeregate demand induces a GDP expansion in the economy.

We then investigate the economic consequences of migration during fiscal consolidation episodes. In particular, we consider fiscal consolidations implemented via cuts in public expenditures, cuts in unemployment benefits, or increases in labor income tax rates. Fiscal consolidation is modeled as a negative shock to the debt target, in a fashion similar to Erceg and Lindé (2013), Pappa et al. (2015) and Bandeira et al. (2018). Our findings indicate that a tax-based consolidation induces the highest migration outflows in the short run, which exacerbates significantly the induced GDP contraction. Cuts in unemployment benefits induce the strongest reallocation of jobseekers towards the foreign labor market in the medium

run, but with more favorable effects on GDP and unemployment. This is because the domestic wage adjusts downwards in this case, as the outside option of workers in the wage bargaining is weakened. Both a tax-based consolidation and a consolidation through cuts in unemployment benefits significantly increase the intensity with which current workers look for jobs abroad, which mitigates the migration of the unemployed. A higher stock of migrants abroad has a negative impact on internal demand, deepening the GDP contraction in the case of tax hikes and mitigating the expansion in the case of cuts in unemployment benefits. Cuts in unemployment benefits induce the most persistent increase in the intensity of the on-the-job search because of the downward adjustment in the real wage. Government spending cuts, on the other hand, have a relatively small impact on migration as this instrument impacts directly on aggregate absorption and does not deteriorate labor market conditions as strongly as tax hikes do.

Our paper contributes to the literature on the macroeconomic effects of migration by exploring the business-cycle and fiscal implications of migration outflows in a small open economy that implements debt consolidation. We therefore depart from existing studies that examine the welfare or fiscal implications of migration on the destination economy (see, e.g., Battisti et al. (2017), Dustmann and Frattini (2014), Storesletten (2000), Canova and Ravn (2000)), by disentangling the effects on the origin country. Related papers, without unemployment and fiscal consolidation, are Farhi and Werning (2014), who study labor mobility and macroeconomic adjustment within a currency union, and Mandelman and Zlate (2012), who develop a two-country model with endogenous migration decisions. A related work is Lozej (2017) which develops a small open economy model with unemployment to study the effects of immigration for the host economy. Our paper is differentiated through the (i) focus on the sender economy which implements fiscal consolidation using a rich set of instruments, (ii) modelling of migration for both the employed and the unemployed members of the household, (iii) examination also of TFP, monetary policy, and government spending shocks.[8] A recent paper that builds a two-region model with exogenous migration and unemployment is Braun and Weber (2016), who explore the effects of forced migrants in West Germany after World War II. Finally, Kiguchi and Mountford (2017) study migration effects in a DSGE model with search and matching frictions, but without endogenizing migration decisions.[9] Finally, a link can also be established with previous studies featuring on-the-job search (see,

[8]Other differences are that in Lozej (2017) immigrants become identical to natives and belong to the household in the host country, which does not allow to model the utility cost of migration, and also that labor market participation is exogenous.

[9]Our paper is also related to the theoretical literature that examines the steady-state effects of immigration within search and matching models. Ortega (2000) studies a two-country model, in which unemployed workers decide where to search for a job. Chassamboulli and Palivos (2014) analyze the effects of immigration into the U.S., while Liu (2010) and Chassamboulli and Peri (2015) examine the effect of illegal immigration into the U.S.

e.g., Tüzemen (2017)), but without cross-country labor mobility.

The rest of the paper is organized as follows. Section 2 presents our DSGE model and Section 3 discusses our calibration. Sections 4 and 5 analyze our results, while Section 6 extends the model with on-the-job search abroad and performs sensitivity analysis. Finally, Section 7 concludes the paper.

2 A Small Open Economy Model with Migration

We introduce labor force mobility in a standard small open economy (SOE hereafter) DSGE model with search and matching frictions. The SOE is labeled Home, whereas the rest of the world is denoted by Foreign. We consider a scenario where Foreign tends to have higher wages and more employment opportunities than Home. Hence, when we introduce endogenous migration decisions in the model, unemployed jobseekers from Home will have an incentive to migrate to Foreign. Apart from supplying labor, migrants pay taxes and consume part of their income in Foreign.

Home nationals are part of a representative household. In terms of their labor market status, household members can be employed, unemployed, or labor force non-participants. Home nationals can participate in the domestic and the foreign labor markets. However, changing country of residence is subject to a moving cost. Moreover, living abroad entails utility costs (see, e.g., Hauser (2014)). Together with labor supply decisions, consumption and savings are defined at the household level.[10] On the production side, there are three types of firms in each country: (i) competitive firms that use labor and effective capital to produce a non-tradable intermediate good, (ii) monopolistic retailers that transform the intermediate good into a tradable good, and (iii) competitive final goods producers that use domestic and foreign produced retail goods to produce a final, non-tradable good. The latter is used for private and public consumption, as well as for investment.[11] Price rigidities arise at the retail level, while labor market frictions occur in the intermediate goods sector. The government collects taxes and issues debt to finance public consumption spending, lump-sum transfers, and the provision of unemployment benefits.

In what follows below, the conventional $\star$ denotes foreign variables or parameters. All quantities are in aggregate terms.

[10] See Andolfatto (1996) for an application of the big household assumption in a framework with labor-market search.

[11] Following standard practice in the literature (see e.g. Erceg and Lindé (2013)), we separate the decisions regarding factor demands from price setting to simplify the description of the model.

2.1 Home

2.1.1 Nationals, Residents and Labor Force

The total number of Home *nationals* assumed to be constant and equal to $\bar{n}$. On the contrary, the number of Home *residents* varies depending on changes in the stock of Home *migrants* in Foreign, with the latter varying over time either due to new outflows from Home or due to returns from Foreign. Denoting by $m_{e,t}$ the stock of emigrants originating from Home and by N_t the resident population, total nationals from Home are:

$$\bar{n} = N_t + m_{e,t} \tag{1}$$

At any point in time, Home nationals are either labor force non-participants l_t, employed in Home n_t, employed emigrants $n_{e,t}$, or unemployed jobseekers u_t. Among those looking for a job, a share s_t is searching in Home, while the remaining $1 - s_t$ is job-seeking in Foreign. Hence, the composition of Home residents by labor market status is given by:[12]

$$N_t = l_t + n_t + s_t u_t \tag{2}$$

In turn, migrants can either be employed or job-seeking in Foreign:

$$m_{e,t} = n_{e,t} + (1 - s_t)\, u_t \tag{3}$$

with $(1 - s_t)\, u_t$ representing unemployed immigrants in Foreign at time t. In the domestic labor market, jobs are created through a matching function of the form:

$$m_t = \mu_1 \left(\upsilon_t\right)^{\mu_2} \left(s_t u_t\right)^{1-\mu_2} \tag{4}$$

where m_t denotes matches, υ_t denotes vacancies posted by firms, μ_1 measures the efficiency of the matching process and μ_2 denotes the elasticity of the matching technology with respect to vacancies. We define the probabilities of a jobseeker to be hired, $\psi_{H,t}$, and of a vacancy to be filled, $\psi_{F,t}$, as follows:

$$\psi_{H,t} \equiv \frac{m_t}{s_t u_t} \quad \text{and} \quad \psi_{F,t} \equiv \frac{m_t}{\upsilon_t}$$

[12]Note that we are implicitly assuming that labor force non-participants are all residing in the country of origin. They constitute a pool of members that can be drawn to job-seeking either in Home or in Foreign. Our assumption of risk pooling among household members ensures that the choice of country of residence by non-participants is innocuous.

The law of motion of resident employment in Home, n_t, is thus given by:

$$n_{t+1} = (1 - \sigma)\, n_t + \psi_{H,t} s_t u_t \tag{5}$$

where σ denotes the exogenous separation rate. Similarly, the law of motion for immigrant employment, $n_{e,t}$, is then given by:

$$n_{i,t+1} = (1 - \sigma^\star)\, n_{e,t} + \psi^\star_{H,t}\,(1 - s_t)\, u_t \tag{6}$$

For simplicity, we assume that immigrant workers remain in Foreign when they loose their job through exogenous separations.[13]

2.1.2 Households

The representative household consists of a continuum of infinitely lived agents. The household derives utility from leisure, which corresponds to the fraction of members that are out of the labor force, l_t, and a consumption bundle, C_t. The household also suffers disutility from having members abroad, $m_{e,t}$, and from hours worked at home and abroad, h_t and $h_{e,t}$ respectively. The instantaneous utility function is given by:

$$U(C_t, l_t, h_t) \;=\; \frac{(C_t - \zeta \tilde{C}_{t-1})^{1-\eta}}{1-\eta} + \Phi \frac{(l_t)^{1-\varphi}}{1-\varphi} - \Omega \frac{(m_{e,t})^{1-\mu}}{1-\mu} - \chi \frac{h_t^{1+\xi}}{1+\xi} n_t - \chi \frac{h_{e,t}^{1+\xi}}{1+\xi} n_{e,t}$$

where η is the inverse of the intertemporal elasticity of substitution, ζ is the parameter determining external habits in aggregate consumption, $\tilde{C}_t$, $\Phi > 0$ is the relative preference for leisure, φ is the inverse of the Frisch elasticity of labor supply, and $\Omega, \chi > 0$ and $\mu, \xi > 0$ are parameters associated with the disutility of living abroad and hours worked. In principle, hours worked might differ between resident and migrant workers. The latter are taken as exogenous here as they are equal to the hours for native workers in Foreign. However, to keep with the representative household framework, we assume that all agents pool consumption risk perfectly (see, e.g., Merz (1995), Andolfatto (1996), and Kaplan and Schulhofer-Wohl (2017)). Hence, the consumption bundle is evenly shared by all household members and is composed of goods purchased by Home residents, c_t, and by emigrants, $c_{e,t}$:

$$C_t \;=\; c_t + e_t c_{e,t} \tag{7}$$

[13]This assumption facilitates the derivation of the asset values of job-seeking in the wage determination problem. As we explain below, this is a rather innocuous assumption in the sense that, because the value of job-seeking at home or abroad is equalized in equilibrium, having workers that loose their jobs joining the pool of jobseekers in a particular country does not distort the decision of the household between participation and job-seeking.

where e_t is the real exchange rate.

The budget constraint, in real aggregate terms, is given by:

$$(1+\tau^c)\,c_t + i_t + b_{g,t} + e_t r_{f,t-1} b_{f,t-1} + \tfrac{\phi_u}{2}\left((1-s_t)\,u_t - (1-s)\,u\right)^2 \leq$$

$$(1-\tau^n)\,w_t n_t + \left[r_t^k - \tau^k\left(r_t^k - \delta_t\right)\right] x_t k_t + r_{t-1} b_{g,t-1} + e_t b_{f,t} + e_t \Xi_t + \mathrm{b} s_t u_t + \Pi_t^p + T_t$$

where ϕ_u captures relocation costs when crossing the border, expressed as a function of the number of migrant jobseekers in Foreign relative to their steady-state value $(1-s)\,u$, w_t is the hourly wage, r_t^k is the return on effective capital, b denotes unemployment benefits and Π_t^p are profits from monopolistic retailers. Taxes on private consumption, private capital, labor income and lump-sum transfers are given by τ^c, τ^k, τ^n, and T_t, respectively. Government bonds are denoted by $b_{g,t}$, and pay the return r_t, while $b_{f,t}$ denote liabilities with the Foreign.[14]

Migrants' total income, composed of labor income as well as unemployment benefits, is divided between remittances sent to Home, denoted by $e_t \Xi_t$ (in units of the Home final good), and consumption $c_{e,t}$ of the Foreign final good so that[15]:

$$\Xi_t + (1+\tau^{c\star})\,c_{e,t} \;=\; (1-\tau_t^{n\star})\,w_t^\star h_{e,t} n_{e,t} + (\mathrm{b}/e_t)\,(1-s_t)\,u_t \tag{8}$$

Note that implicitly we assume that natives and immigrants are perfect substitutes and receive the same wage in Foreign (see e.g. Mandelman and Zlate (2012)). This is in line with the educational and skill profile of the recent migrants within Europe. Following Mandelman and Zlate (2012), we use the following remittances rule:

$$\Xi_t = \bar{\Xi}\varrho\left(\frac{(1-\tau_t^{n\star})\,w_t^\star}{(1-\tau_t^n)\,w_t}\right)^{\rho_\Xi} \tag{9}$$

The rationale behind (9) is that remittances represent an altruistic compensation mechanism between migrant and domestic workers. In other words, assuming $\rho_\Xi > 0$, a relative improvement in the wage premium abroad leads to an increase in remittances.[16]

[14] In other words, the household lends the government and borrows from abroad. Assuming government debt is only held by domestic households is in line with the empirical pattern for the "repatriation of public debt" after 2009 in the GIIPS (See Figure 1 in Brutti and Sauré (2016)), supported by the secondary market theory of Broner et al. (2010).

[15] Free movement of workers has long been enshrined in EU law and is considered a cornerstone of its single market architecture. However, although discrimination of job applicants, remuneration and other conditions based on nationality is illegal, jobseekers do not enjoy equal access to social benefits in their host country.

[16] We abstract from endogenizing the allocation of total immigrant income between remittances and consumption of the foreign good, which would require to either assume that the household in Home makes this decision or to model immigrants as separate optimizing agents. Given that remittances have increased much less than migration outflows from Europe's peripheral countries in the recent years, as emphasized in the

The household owns the capital stock, which evolves according to:

$$k_{t+1} = \left[1 - \frac{\omega}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2\right] i_t + (1 - \delta_t)\, k_t \tag{10}$$

where i_t is private investment and ω dictates the size of investment adjustment costs. Following Neiss and Pappa (2005), the depreciation rate δ_t depends on the degree x_t, of capital utilization according to:

$$\delta_t = \bar{\delta}\,(x_t)^{\iota} \tag{11}$$

where $\bar{\delta}$ and ι are positive constants.

The problem of the household is to choose c_t, k_{t+1}, i_t, x_t, $b_{g,t}$, $b_{f,t}$, n_{t+1}, $n_{e,t+1}$, u_t, h_t, and s_t to maximize lifetime utility subject to the budget constraint, the laws of motion of resident and immigrant employment, taking the probability of finding a job in Home and Foreign as given, the law of motion of capital, the definition of capital depreciation, and the composition of the population. We report the full set of first order conditions in the Appendix and focus here on those that determine labor market participation, jobseeking and migration. Denoting by $\lambda_{c,t}$, $\lambda_{n,t}$ and $\lambda_{e,t}$ the Lagrange multipliers on the budget constraint and on the laws of motion of domestic and migrant employment, (5) and (6), the first order conditions with respect to n_{t+1}, $n_{e,t+1}$, u_t, and s_t are given by:

$$\lambda_{n,t} = \beta\left[\lambda_{c,t+1}\,(1-\tau^{n})\, w_{t+1}h_{t+1} - \Phi l_{t+1}^{-\varphi} - \chi\frac{h_{t+1}^{1+\xi}}{1+\xi}\right] + \beta\,(1-\sigma)\,\lambda_{n,t+1} \tag{12}$$

$$\begin{aligned}\lambda_{e,t} = {} & \beta\left[\lambda_{c,t+1}\,(1-\tau^{n\star})\, e_t w_{t+1}^{\star} h_{e,t+1} - \Phi l_{t+1}^{-\varphi} - \chi\frac{h_{e,t+1}^{1+\xi}}{1+\xi} - \Omega\,(m_{e,t+1})^{\mu}\right] \\ & +\beta\,(1-\sigma^{\star})\,\lambda_{e,t+1}\end{aligned} \tag{13}$$

$$\lambda_{c,t}\mathrm{b} + s_t\psi_{H,t}\lambda_{n,t} + (1-s_t)\left(\psi_{H,t}^{\star}\lambda_{e,t} - \lambda_{c,t}\left[\phi_u\left((1-s_t)\,u_t - (1-s)\,u\right)\right]\right) = \Phi l_t^{-\varphi} \tag{14}$$

$$\psi_{H,t}^{\star}\lambda_{e,t} \quad -\lambda_{c,t}\left[\phi_u\left((1-s_t)\,u_t - (1-s)\,u\right)\right] = \quad \lambda_{n,t}\psi_{H,t} \tag{15}$$

The first two expressions, (12) and (13), determine the evolution of the value of being employed in Home and in Foreign, respectively. In both cases, the value for the household of a newly established match equates to the net direct utility gain, which is equal to the utility

Introduction, we leave endogenizing such choice outside the scope of our paper.

value of the net wage minus the disutility from giving up leisure and supplying hours worked, as well as the disutility from having members abroad in the case of (13), plus the continuation value of the match, which depends on the exogenous termination rate.[17] Equation (14) expresses the trade-off between participating or not in the labor market. At the margin, the value of no participation, on the right-hand side of (14), must equal the utility value of jobseeking. This is given in turn by the utility value of the unemployment benefit jobseekers get from the government plus the utility value of finding a job, either in Home or abroad. For the case of searching for a job in Home, its utility value depends on the job-finding probability in Home, $\psi_{H,t}$, which household members take as given, and the share of jobseekers looking for a job domestically, s_t. The same applies with regards to the utility value of searching for a job in Foreign, with an extra term correcting for the utility-adjusted cost of moving abroad in search for a job. Finally, the first order condition with respect to s_t, (15), shows that, at the margin, the value of jobseeking at home and abroad, with the latter including again the utility-adjusted cost of moving abroad, must be equalized. In other words, household members will not search for a job in Home when the value of searching abroad is higher, and vice versa.

2.1.3 Intermediate goods firms

Intermediate goods are produced with a Cobb-Douglas technology:

$$y_t = A_t \left(h_t n_t\right)^{1-\phi} \left(x_t k_t\right)^{\phi} \tag{16}$$

where k_t and n_t are capital and labor inputs, x_t is the degree of capital utilization, and A_t is an exogenous stationary TFP process.

Since current hires give future value to intermediate firms, the optimization problem is dynamic, with firms maximizing the discounted value of future profits. The number of workers currently employed, n_t, is taken as given and the employment decision concerns the number of vacancies posted in the current period, υ_t, so as to employ the desired number of workers next period, n_{t+1}. For firms, the law of motion of employment is given by:

$$n_{t+1} = (1-\sigma)\, n_t + \psi_{F,t} \upsilon_t$$

Firms also decide the amount of the private capital, k_t, to be rented from the household at rate r_t^k. The problem of an intermediate firm with n_t workers currently employed can be

[17] Note that, given our timing assumption, a new match only becomes productive one period ahead.

written as:

$$Q(n_t) = \max_{k_t, v_t} \left\{ p_{x,t} y_t - w_t h_t n_t - r_t^k x_t k_t - \kappa v_t + \mathrm{E}_t \beta_{t+1} Q(n_{t+1}) \right\}$$

where $p_{x,t}$ is the relative price of intermediate goods with the final good being the numeraire, κ is the cost of posting a new vacancy, and $\beta_{t+1} = \beta \lambda_{ct+1} / \lambda_{ct}$ is the household's subjective discount factor. The maximization takes place subject to the law of motion of employment, where the firm takes the probability of the vacancy being filled as given. The first order conditions with respect to capital and vacancies are:

$$r_t^k = \phi \frac{p_{x,t} y_t}{k_t x_t} \tag{17}$$

$$\frac{\kappa}{\psi_{F,t}} = \mathrm{E}_t \beta_{t+1} \left[(1-\phi) \frac{p_{x,t+1} y_{t+1}}{n_{t+1}} - w_{t+1} h_{t+1} + (1-\sigma) \frac{\kappa}{\psi_{F,t+1}} \right] \tag{18}$$

According to (17) and (18), the value of the marginal product of capital equals the real rental rate and the marginal cost of hiring an additional worker is set equal to the expected marginal benefit. The latter includes the marginal productivity of labor minus the wage plus the continuation value, knowing that with probability σ the match can be destroyed.

2.1.4 Wage bargaining

Wages are determined by splitting the surplus of a match between the worker and the firm according to their relative bargaining powers. Denoting by $\vartheta \in (0,1)$ the firms' bargaining power, the splitting rule is given by $(1-\vartheta)(1-\tau^n) S_{f,t} = \vartheta S_{h,t}^H$, where $S_{h,t}^H$ denotes the worker's surplus from a match in Home and $S_{f,t}$ denotes the surplus of the firm. The surplus for workers consists of the asset value of employment net of the outside option given by the value of being unemployed. As shown in the Appendix, the worker's surplus from a match in Home can be written as:

$$S_{h,t}^H = (1-\tau^n) w_t h_t - \mathrm{b} - \frac{\chi}{\lambda_{c,t}} \frac{h_t^{1+\xi}}{1+\xi} + (1-\sigma-\psi_{H,t}) \mathrm{E}_t \beta_{t+1} S_{h,t+1}^H$$

In turn, the firm's surplus, $S_{f,t}$, is given by:

$$S_t^F = (1-\phi) \frac{p_{x,t} y_t}{n_t} - w_t h_t + (1-\sigma) \frac{\kappa}{\psi_{F,t}}$$

Using the above expressions together with the splitting rule and solving for the wage yields:

$$w_t h_t = (1-\vartheta)\left\{p_{x,t}(1-\phi)\frac{y_t}{n_t}+\frac{\psi_{H,t}}{\psi_{F,t}}\kappa\right\}+\frac{\vartheta}{(1-\tau^n)}\left\{\mathrm{b}+\frac{\chi}{\lambda_{c,t}}\frac{h_t^{1+\xi}}{1+\xi}\right\} \quad (19)$$

The equilibrium wage is a weighted average of the two surpluses. The first term, weighted by the worker's bargaining power $(1-\vartheta)$, includes the value of the marginal product of labor and the continuation value of the match to the firm, corrected by the continuation value of the match to the household. The second term consists of the immediate outside option of being unemployed, corrected for the disutility from work hours.

2.1.5 Retailers

There is a continuum of monopolistically competitive retailers indexed by i on the unit interval. Retailers buy domestic intermediate goods and differentiate them with a technology that transforms one unit of intermediate goods into one unit of retail goods, and, thus, the relative price of intermediate goods, $p_{x,t}$, coincides with the real marginal cost faced by the retailers. Let $y_{i,t}$ be the quantity of output produced by retailer i. These goods are aggregated into a tradable good, which is given by:

$$y_{r,t}=\left[\int_0^1 (y_{i,t})^{\frac{\epsilon-1}{\epsilon}}di\right]^{\frac{\epsilon}{\epsilon-1}}$$

where $\epsilon > 1$ is the constant elasticity of demand for each variety of retail goods. The aggregate tradable good is sold at the nominal price $P_{r,t}=\left(\int (P_{i,r,t})^{\epsilon-1}di\right)^{\frac{1}{\epsilon-1}}$, where $P_{i,r,t}$ is the price of each variety i. The demand for each intermediate good depends on its relative price and on aggregate demand:

$$y_{i,t} = \left(\frac{P_{i,r,t}}{P_{r,t}}\right)^{-\epsilon} y_{r,t}$$

We assume that in any given period each retailer can reset its price with a fixed probability $1-\lambda_p$. Firms that are able to reset their nominal price choose $P^*_{i,r,t}$ so as to maximize expected real profits given by:

$$\Pi_{\mathfrak{t}}(i) = \mathrm{E}_t\sum_{s=0}^{\infty}(\beta\lambda_p)^s\frac{\lambda_{ct+s}}{\lambda_{ct}}\left(\left[\frac{P_{i,r,t}}{P_{t+s}}-p_{x,t+s}\right]y_{i,t+s}\right)$$

subject to the respective demand schedule. Since all firms are ex-ante identical, $P^*_{i,r,t} = P^*_{r,t}$ for all i. The resulting expression for the real reset price $p^*_{r,t} \equiv P^*_{r,t}/P_t$ is:

$$\frac{p^*_{r,t}}{p_{r,t}} = \frac{\epsilon}{(\epsilon-1)}\frac{\mathcal{N}_t}{\mathcal{D}_t} \tag{20}$$

where:

$$\mathcal{N}_t = p_{x,t}y_{r,t} + \lambda_p \mathrm{E}_t \beta_{t+1} (\pi_{r,t+1})^{\epsilon} \mathcal{N}_{t+1} \tag{21}$$

$$\mathcal{D}_t = p_{r,t}y_{r,t} + \lambda_p \mathrm{E}_t \beta_{t+1} (\pi_{r,t+1})^{\epsilon-1} \mathcal{D}_{t+1} \tag{22}$$

where $p_{r,t} \equiv P_{r,t}/P_t$ and $\pi_{r,t}$ denotes producer price inflation. Under the assumption of Calvo pricing, the price index, in nominal terms, is given by:

$$(P_{r,t})^{1-\epsilon} = \lambda_p (P_{r,t-1})^{1-\epsilon} + (1-\lambda_p)\left(P^*_{r,t}\right)^{1-\epsilon} \tag{23}$$

The aggregate tradable good is sold domestically and abroad:

$$y_{r,t} = y_{l,t} + y^{\star}_{m,t} \tag{24}$$

where $y_{l,t}$ is the quantity of tradable goods sold locally and $y^{\star}_{m,t}$ the quantity sold abroad.

2.1.6 Final Goods Producer

Finally, perfectly competitive firms produce a non-tradable final good, $y_{f,t}$, by aggregating domestic, $y_{l,t}$, and foreign, $y_{m,t}$, aggregate retail goods using a CES technology:

$$y_{f,t} = \left[(\varpi)^{\frac{1}{\gamma}} (y_{l,t})^{\frac{\gamma-1}{\gamma}} + (1-\varpi)^{\frac{1}{\gamma}} (y_{m,t})^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}}$$

The home bias parameter, ϖ, denotes the fraction of the final good that is produced locally. The elasticity of substitution between home-produced and imported goods is given by γ. Final good producers maximize profits $y_{f,t} - p_{r,t}y_{l,t} - e_t p^{\star}_{r,t} y_{m,t}$ each period, where $p_{r,t}$ and $p^{\star}_{r,t}$ denote the real price of aggregate retail goods produced in Home and in Foreign, respectively, and we have assumed the law of one price holds. Solving for the optimal demand functions gives:

$$y_{l,t} = \varpi (p_{r,t})^{-\gamma} y_{f,t} \tag{25}$$

$$y_{m,t} \quad = \quad (1-\varpi)\left(e_t p^{\star}_{r,t}\right)^{-\gamma} y_{f,t} \tag{26}$$

The nominal consumer price index, P_t, is defined implicitly by substituting out $y_{l,t}$ and $y_{m,t}$ in the CES above by the respective demand curves, which yields:

$$1 \quad = \quad \varpi\left(p_{r,t}\right)^{1-\gamma} + (1-\varpi)\left(e_t p^{\star}_{r,t}\right)^{1-\gamma} \tag{27}$$

where $p_{r,t} = P_{r,t}/P_t$ and $p^{\star}_{r,t} = P^{\star}_{r,t}/P^{\star}_t$ are the retail prices in Home and in Foreign, respectively, denominated in each country's numeraire.

2.1.7 Government

Government expenditure consists of unemployment benefits, consumption expenditure and lump-sum transfers, while revenues come from consumption, capital income and labor income taxes. The primary deficit is, therefore, defined by:

$$DF_t = \mathrm{b}u_t + g_t + T_t - \tau^n w_t h_t n_t - \tau^k (r^k_t - \delta_t) x_t k_t - \tau^c c_t \tag{28}$$

and the government budget constraint is given by:

$$r_{t-1} b_{g,t-1} + DF_t = b_{g,t} \tag{29}$$

The government has three potential fiscal instruments, labor income tax rates, τ^n, unemployment benefits b, and public consumption expenditure, g. The other tax rates, τ^k and τ^c, will be treated as parameters. We consider each instrument separately, assuming that if one is active, the other remains fixed at its steady state value. For $\Psi \in \{\tau^n, b, g\}$, following Erceg and Lindé (2013) and Pappa et al. (2015), we assume fiscal rules of the form:

$$\Psi_t = \Psi^{(1-\beta_{\Psi 0})}\ \Psi_{t-1}^{\beta_{\Psi 0}} \left[\left(\frac{\tilde{b}_{g,t}}{b^T_{g,t}} \right)^{\beta_{\Psi 1}} \left(\frac{\Delta \tilde{b}_{g,t+1}}{\Delta b^T_{g,t+1}} \right)^{\beta_{\Psi 2}} \right]^{(1-\beta_{\Psi 0})} \tag{30}$$

where $\tilde{b}_{g,t} \equiv \frac{b_{g,t}}{gdp_t}$ is the debt-to-GDP ratio, parameters $\beta_{\Psi 1}$ and $\beta_{\Psi 2}$, are positive for $\Psi = \tau^n$, and negative for $\Psi = b, g$, and $b^T_{g,t}$ is the target debt-to-GDP ratio, given by the AR(2) process:

$$\log b^T_{g,t} - \log b^T_{g,t-1} = \rho_2 \log \bar{b} + \rho_1 (\log b^T_{g,t-1} - \log b^T_{g,t-2}) - \rho_2 \log b^T_{g,t-1} - \varepsilon^b_t \tag{31}$$

where $\bar{b}$ is the steady state debt-to-GDP level and ε_t^b is a white noise process representing a fiscal consolidation shock. We therefore consider a gradual (effectively permanent) reduction in the target for the debt-to-GDP ratio (see also Erceg and Lindé (2013), Pappa et al. (2015), Bandeira et al. (2018)). As we explain below, for the fiscal rule (30), we calibrate the set of three parameters for each fiscal instrument in such a way that the actual debt-to-GDP ratio meets the new, lower target at the same time across the different instruments.

2.1.8 Resource constraint

The non-tradable final good is sold for private and public consumption, c_t and g_t, and for investment, i. However, costs related to vacancy posting and moving to/from Foreign reduce the amount of resources available:

$$y_{f,t} = c_t + i_t + g_t + \kappa v_t + \frac{\phi_u}{2}\left(\left(1-s_t\right)u_t - \left(1-s\right)u\right)^2 \tag{32}$$

Aggregating the budget constraint of households using the market clearing conditions, the budget constraint of the government, and aggregate profits, we obtain the law of motion for net foreign assets, which corresponds to the current account and is given by:

$$e_t\left(r_{f,t-1}b_{f,t-1} - b_{f,t}\right) = nx_t + e_t\Xi_t \tag{33}$$

and where nx_t are net exports defined as:

$$nx_t = p_{r,t}y_{m,t}^{\star} - e_t p_{r,t}^{\star} y_{m,t} \tag{34}$$

Real GDP is defined as:

$$gdp_t = y_{f,t} + nx_t \tag{35}$$

Using conditions (24) and (34), together with the fact that in equilibrium $y_{f,t} = p_{r,t}y_{l,t} + e_t p_{r,t}^{\star} y_{m,t}$, real GDP can equally be expressed as $gdp_t = p_{r,t}y_{r,t}$.

2.1.9 Monetary policy

The monetary authority sets the gross nominal interest rate to target zero net inflation:

$$R_t = \rho_R R_{t-1} + \left(1-\rho_R\right)\rho_\pi \pi_t \tag{36}$$

where consumer price inflation, π_t, is defined as:

$$\pi_t = \frac{P_t}{P_{t-1}} \tag{37}$$

while the gross nominal interest rate, R_t, is defined through the Fisher equation:

$$r_t = \frac{R_t}{\mathrm{E}_t \pi_{t+1}} \tag{38}$$

Finally, we introduce a risk premium charged to Home households depending on the relative size of net foreign liabilities to real GDP:

$$r_{f,t} = r_t^{\star} exp\left\{\Gamma e_t \frac{b_{f,t+1}}{gdp_t}\right\} \tag{39}$$

where Γ is the elasticity of the risk premium with respect to liabilities (see also Schmitt-Grohé and Uribe (2003)).

3 Calibration

We solve the model by linearizing the equilibrium conditions around a non-stochastic zero-inflation steady state. Table 1 shows the key parameters and steady state values targeted in our calibration. We calibrate the model at a quarterly frequency and normalize per capita GDP to 1. Net foreign assets and public debt represent 10% and 60% of annual GDP, with private consumption accounting for 63% of GDP, government spending to 20% and capital investment just under 18%. The ratio of remittances over GDP in the steady state (3%) is chosen such that per capita consumption between non-migrant and migrant labor force participants is equalized. Specifically, we set the ratio of Home-purchased consumption over non-migrant labor participants equal to the ratio of Foreign-purchased consumption over migrants.

We set the discount factor, β, to 0.99, implying an annual interest rate of 4%. Utility from consumption takes the log-form and external habits are set equal to 0.4. We assume a degree of home bias equal to 0.85, and an elasticity between domestically produced and imported goods equal to 1.5, following Erceg and Lindé (2013). The inverse of the Frisch elasticity is set to 3 and the elasticities of hours worked and migration are equal to 1. On the production side, we set the capital share equal to 1/3, the depreciation rate to 2.5%, and the degree of investment adjustment costs equal to 8. The steady-state price markup over marginal costs is set to 10%, with the degree of price stickiness, λ_p, set equal to 0.75 (such

that prices last on average 12 months).

Regarding the labor market, we start by normalizing total nationals of Home, $\bar{n}$, to unity, of which 10% reside abroad.[18] Of those residing in Home, we assume that 1/3 are out of the labor force, l. The unemployment rate in Home is assumed to be equal to 12%, while in Foreign is half of that in Home, 6%. This implies that the share of unemployed Home nationals looking for a job abroad is 8%.[19] For simplicity, we assume that the exogenous termination rates in the domestic and foreign labor markets are both equal to 3%. This, together with the unemployment rates in each country, implies that the job-finding probability in Home is lower than in Foreign (0.26 and 0.52, respectively). By setting the vacancy-filling probability in Home equal to 0.50, we pin down the efficiency of the matching technology, μ_1, whereas setting the replacement rate, b/w, to 40% pins down the firm's power in the wage bargaining problem, $\varphi = 0.49$. Likewise, the relative weight of the migration disutility term, Ω, depends on the average wage differential between the two countries, which we calibrate to 5%.[20] Finally, we assume that total vacancy costs represent 1% of GDP and we standardize hours to 1, so that the number of employed is also the number of effective hours worked.

The long-run response of the nominal interest rate to inflation is assumed to be equal to 1.75, while the inertia coefficient in the Taylor rule is set to 0.75. The elasticity of the spread between domestic and foreign interest rates, Γ, is set to 0.001. We calibrate the public debt target rule (31) such that the cut in the debt target is implemented gradually over 10 quarters, remaining below its steady state for an arbitrarily larger number of quarters. For the fiscal rule (30), we calibrate the set of three parameters for each fiscal instrument in such a way that the actual debt-to-GDP ratio meets the new, lower target at the same time across the different instruments and at around 20 quarters after the decision to consolidate is taken. Finally, we set the steady state labor income tax rate at 20%.

Table 1: Calibration

National Accounts:		
real GDP per capita	gdp	1.00
net foreign assets	b_f/gdp	$4 \times (0.10)$
public debt	bg/gdp	$4 \times (0.60)$
public spending	g/gdp	0.20
remittances	Ξ/gdp	0.03

[18] For example, the number of Italians living abroad in 2017 was estimated to be 4.973.942 which represents 8.2% of the country's population (60.656.000 in 2017).

[19] To ensure comparability of the model with the counterfactual scenario without migration, for the latter case we assume that the share of migrants is permanently fixed. In other words, we assume that the pool of labor market participants in Home is the same in both models in the steady state, and that the total number of residents at Home can change only when the number of migrants is not fixed.

[20] See Section 6 for sensitivity analysis.

Table 1: Calibration (continued)

Utility:		
discount factor	β	0.99
intertemporal elasticity	η	1.00
external habits in consumption	ζ	0.40
home bias in consumption	ϖ	0.75
elasticity home/imported goods	γ	1.5
labor supply elasticity	φ	3.00
migration elasticity	μ	1.00
elasticity hours worked	ξ	1.00
Production:		
capital share in production	α	0.33
capital depreciation rate	$\bar{\delta}$	0.025
investment adjustment costs	ω	8.00
price monopolistic elasticity	ϵ	11
price Calvo lottery	λ_p	0.75
Labor market:		
total population	$\bar{n}$	1
non-participants	l	0.33
unemployment rate	$su/(su+n)$	0.12
stock of migrants	$m_e/\bar{n}$	0.10
vacancy-filling probability	ψ_F	0.5
vacancy posting costs	$\kappa v/gdp$	0.01
replacement rate	b/w	0.40
termination rates	σ, $\sigma^\star$	0.03
Foreign unemployment rate	$u^\star$	0.06
Foreign wage premium	$w^\star/w-1$	0.05
Policy:		
Taylor rule: i_{t-1}	ρ_R	0.75
Taylor rule: π_t	ρ_π	1.75
elasticity country premium	Γ	0.001
labor income tax	τ_n	0.20
public debt target	ρ_1, ρ_2	0.6, 0.000001
fiscal rule: labor income tax	$\beta_{n0}, \beta_{n1}, \beta_{n2}$	0.6, -3, -2
fiscal rule: government spending	$\beta_{g0}, \beta_{g1}, \beta_{g2}$	0.6, 1.1, 1
fiscal rule: replacement rate	$\beta_{b0}, \beta_{b1}, \beta_{b2}$	0.6, 3, 2

Table 1: Calibration (continued)

Implied by steady state conditions:		
weight utility from leisure	Φ	0.03
weight disutility from migration	Ω	2.00
weight disutility from hours ($h = 1$)	χ	1.34
elasticity of utilization ($x = 1$)	ι	1.75
job-finding probability	ψ_H	0.26
job-finding probability abroad	$\psi_H^\star$	0.52
matching efficiency	μ_1	0.39
firms' bargaining power	φ	0.49
share of jobseekers abroad	$1 - s$	0.08
pecuniary migration costs	ϕ_u	0.5

4 Migration Over the Business Cycle

We begin our analysis by showing responses to standard shocks in the business cycle literature, namely shocks to technology, monetary policy, and government spending. The goal is, first, to examine the behavior of the migration variables in response to these shocks, and, second, to verify that our model produces plausible results in response to those shocks.

4.1 TFP shock

The solid lines in Figure 3 for the model without migration confirm that a positive TFP shock leads to an increase in consumption, investment and GDP, and to a decrease in the debt-to-GDP ratio in the economy. With the increase in the marginal product of labor, firms post more vacancies and increase real wages. Moreover, and despite the fall in the number of jobseekers due to the positive wealth effect on households, the job finding rate increases and pushes up on employment. Given the positive income effect from the increase in wage, the household decreases hours and labor market participation through an increase in leisure. The latter decreases the unemployment rate in the economy. The real exchange rate depreciates as the economy becomes more competitive.[21] The increase in demand leads to an increase in imports and therefore a decline in net exports.

[21] With search and matching frictions, the cost of an additional worker for firms is not just the wage, but the value of the long-term relationship that the firm and worker enjoy. This depends also on the marginal revenue product of the worker, the ease with which a laid-off worker can be replaced, and the ease with which employees can find other jobs (see Lubik et al. (2014)).

When we allow for cross-border labor mobility, the dashed lines in Figure 3 show that the household reduces the share of unemployed jobseekers abroad, which decreases the stock of employed migrants abroad. The resulting increase of labor supply in the domestic labor market leads to a smaller increase in the real wage and a higher increase in consumption relative to the model without migration. With the return of some migrants, the wage and the job-finding rate increase by less, motivating non-participants to enter the labor force more gradually. On the other hand, the increase in consumption from the returning migrants leads firms to post more vacancies in order to increase production capacity. Employment and GDP rise substantially more than in the case without migration. The unemployment rate rises significantly, given that the foreign labor market now absorbs fewer members of the labor force, but then falls in the medium run, as more jobs are created.

In sum, a positive TFP shock induces a reallocation of jobseekers from Foreign to Home. Moreover, the positive effects of a productivity shock on GDP, consumption and investment are reinforced in the presence of labor mobility, with short-run unemployment costs, which are reversed in the medium run.

4.2 Monetary policy shock

As reported in Figure 4, consumption, investment and real GDP fall after a positive shock to the nominal interest rate in the model without migration (see solid lines). Labor demand (vacancies), hours, wages and employment decrease, while the debt-to-GDP ratio rises. The real exchange rate appreciates due to the increase in the real interest rate. Imports fall as a result of the decline in demand and so net exports go up.

When migration is allowed (see dashed lines in Figure 4), the household decides to increase the fraction of unemployed members searching for a job abroad in response to the fall in domestic wages and the job-finding probability. As a result, employment falls by more relative to the scenario without migration, due to the reduction in labor supply. However, the increase in the unemployment rate is overturned in the short run given the exodus of migrants. The fall in consumption, investment and GDP is more pronounced now. The higher fall in demand is translated into a higher fall in imports relative to the model of no migration, and therefore net exports rise by more now.

In sum, an increase in the nominal interest rate induces a reallocation of jobseekers from Home to Foreign. Labor mobility reinforces the negative effects on GDP, investment, and consumption, with short-run unemployment gains.

4.3 Government spending shock

Turning to an unanticipated increase in government spending, the solid lines in Figure 5 show the crowding out effect on consumption and investment, and the consequent increase in labor supply (through a decrease in leisure and an increase in hours), for the model without migration. The entry of jobseekers in the labor force initially raises the unemployment rate. At the same time, the increase in government spending generates an expansion in aggregate demand, which induces firms to post more vacancies. The increase in vacancies and in the number of jobseekers leads to an increase in employment. The real wage initially goes up given the increase in labor demand, but then falls substantially given the increase in labor supply. The increase in aggregate demand leads to an increase in prices, which increases the nominal and the real interest rate. The fall in wages increases the competitiveness of the economy and induces a real exchange rate depreciation. Nevertheless, the increase in aggregate demand leads to an increase in imports and therefore to a fall in net exports.

When we allow for migration (see dashed lines in Figure 5), the positive demand shock induces the household to initially decrease the share of unemployed jobseekers abroad, which reduces the stock of employed migrants abroad. However, as soon as the real wage falls below its steady state, this pattern is reversed and migration increases. The unemployment rate is determined here by the movements in migration: initially, it increases by more compared to the no-migration model, given the return of migrants, while later on it falls by more, given the increase in migration. The reduction in labor supply due to migration mitigates the fall in wages. Coupled with the effect of the return of migrants in the short run, this implies that consumption and investment fall by less relative to the case without migration. However, these differences are are relatively small, with the main driver of the expansion in GDP being the exogenous increase in government spending. For that reason, the response of real GDP does not differ significantly between the two models.

In sum, a positive shock to public spending leads to a reallocation of jobseekers towards Home in the short run, but this pattern is reversed in the medium run. Labor mobility mitigates the wealth effect of the shock (fall in consumption and investment), reinforcing the output increase, yet the difference is small, and is accompanied by short-run (medium run) unemployment costs (benefits).

5 Migration and Fiscal Consolidation

We consider a shock that drives the debt-to-GDP target 10% below its steady state. We simulate the responses to this shock with government spending, labor income taxes, or unemployment benefits adjusting to achieve fiscal consolidation after 20 quarters. We then

compare the effects of the consolidation under the different instruments with and without migration.

5.1 Labor tax hikes

We begin with the case of fiscal consolidation through labor tax hikes, shown in Figure 6. In the model without migration (solid lines) the labor tax hike increases leisure and decreases hours, by affecting negatively the incentives to work. The exit of jobseekers from the labor force tends to reduce the unemployment rate on impact. Consumption and investment fall, given the drop in after-tax income. The drop in demand leads to a fall in vacancies, employment and real GDP. The job finding probability falls as well. Furthermore, the rise in labor taxes increases unemployment after the impact period and the real wage, and reduces the competitiveness of the economy, leading to a real exchange rate appreciation.[22] The fall in consumption and investment demand leads to a fall in the demand for imports, which is also reflected in the increase of net exports.

When we introduce migration (see dashed lines in Figure 6), the significant fall in the job-finding probability induces the household to increase the share of unemployed members who look for a job abroad, which increases the stock of employed members abroad. Emigration leads to a stronger fall in consumption and investment relative to the model without migration, which explains the bigger contraction in GDP. We also observe a stronger effect on the real exchange rate and imports. Vacancies and employment fall substantially more, given the stonger contraction in demand. The unemployment rate is reduced in the short run given the migration outflow, but rises afterwards given the negative response of employment. Leisure increases by less relative to the case of no cross-border mobility, as the household decides to send jobseekers abroad rather than having them exit the labor force. This affects the response of the real wage, which increases persistently and by more now due to the decrease in labor supply.

Overall, migration leads to stronger adverse effects from fiscal consolidation, with the exception of the real wage and the short-run unemployment rate.

5.2 Cuts in unemployment benefits

When the government cuts the unemployment benefit, the outside option of workers when bargaining wages with firms loses value. As a result, wages are bargained downwards, which allows firms to increase labor demand by posting more vacancies. This increases employ-

[22]Note that the change in taxes matters in the wage bargaining process as workers will demand higher wages to compensate for the higher tax burden.

ment and decreases the unemployment rate. The solid lines in Figure 7 show the responses in the model without migration. We see that, despite the fall in wages and the cut in unemployment benefits, the household experiences a positive wealth effect via the increase in employment and the expectation of lower future taxes, which permits an increase in consumption, investment, and leisure. The economy experiences a GDP expansion and a reduction in unemployment after the impact period. The unemployment rate increases on impact because the household decreases leisure and increases hours on impact, given the drop in the income coming from unemployment benefits. This increases the real wage on impact. However, leisure is increased and hours are decreased after the impact period due to the wealth effect. As the competiveness of the economy improves, the real exchange rate depreciates, while imports increase given the increased demand.

When we allow for migration (see dashed lines in Figure 7), the share of unemployed jobseekers moving abroad increases, despite the positive wealth effect experienced by the household, and pushes up on the total stock of migrant workers, given the fall in the domestic wage. In the presence of migration, the real wage falls by less, given that now part of the domestic labor supply is directed abroad, and so vacancies and employment increase by less. Migration lowers domestic demand, overturning the reponse of consumption, which now decreases, and mitigating the increase in investment. The fall in consumption is translated in a fall in GDP.

Overall, with unemployment benefits as the fiscal consolidation instrument, migration affects significantly the behavior of the macroeconomy by altering the response of consumption and real GDP.

5.3 Public spending cuts

Starting with the case of government spending cuts in a model without migration, the solid lines in Figure 8 confirm the well-known positive wealth effect for the household that increases consumption and investment in expectation of lower taxes in the future. The household also reduces its labor supply, through an increase in leisure and a decrease in hours. At the same time, the fall in government spending has a negative demand effect, which induces vacancies, and consequently the job finding rate, to fall. This leads to a persistent fall in employment. The real wage goes down initially, given the drop in labor demand, but then increases in the medium run, given the reduction in labor supply. The real exchange rate depreciates, given the fall in demand, prices and wages. Real GDP falls persistently since the cut in government spending directly reduces aggregate demand in the economy. Imports fall too given the drop in demand.

When migration is allowed (see dashed lines in Figure 8), the negative demand shock

induces the household to initially increase the share of unemployed jobseekers abroad, which increases the stock of employed members abroad. This mitigates the increase in consumption and tends to increase the fall in real GDP. However, the differences in the response of GDP between the two models are generally small, as the main driver of this response is the reduction of aggregate demand caused by the government spending cut itself. Moreover, the increase in migration is relatively small and rather short-lived: both the share of unemployed jobseekers abroad and the stock of employed migrants fall in the medium run as the real wage increases above its steady-state level.

Overall, with government spending as the fiscal consolidation instrument, migration affects the behavior of the labor market and the macroeconomy to a smaller extent than with labor income taxes or unemployment benefits. The main mechanisms are in line with the results for the government spending shock in section 4.3.

5.4 Comparison of instruments

Figure 9 compares all instruments in the presence of migration in the model. Unemployment benefits, which have been very little explored so far in the fiscal consolidation literature, appear to be the most preferable instrument in terms of GDP, investment, (un)employment, and vacancies, by reducing substantially the real wage. While cuts in government spending and unemployment benefits do not differ very much in terms of consumption and investment effects, the fact that the former impacts directly on aggregate absorption explains the important difference we observe in terms of output effects. The results also confirm that a spending-based consolidation is more favorable than a tax-based consolidation in terms of consumption, investment, GDP and unemployment effects. The fall in GDP is more abrupt and unwinds faster in the case of spending cuts as this instrument impacts directly on aggregate absorption and does not deteriorate labor market conditions as strongly as tax hikes do. A tax-based consolidation affects the incentives to work, reduces output and lowers the tax base. Regarding the real wage, tax hikes lead to a rise after the impact period, while spending cuts leading to a very small fall. The instrument that induces the strongest effects on emigration in the short run is the labor tax hike. This mitigates in the short run the increase in unemployment for the tax-based consolidation. Cuts in the unemployment benefits induce the strongest jobseekers reallocation to Foreign in the medium run. On the other hand, government spending cuts have a small impact on migration.[23]

[23]For a comparison of the instruments in the model without migration, see Figure 14 in the Appendix.

6 Extensions

Below we analyze the role of (i) on-the-job search abroad, (ii) the utility cost of migration, (iii) changes in domestic and foreign wages, and (iv) the assumptions about unemployment benefits to gain a better insight into our results.

6.1 On-the-job search abroad

In extending our baseline model to allow employed workers to search and take jobs abroad, we follow the setup in Krause and Lubik (2006) and Tüzemen (2017) who model on-the-job search in the domestic labor market.[24] Each period, workers decide how much effort z_t to exert in searching for a job abroad. The higher the search intensity, the higher the probability to be matched with a job abroad in the next period. However, on-the-job search is subject to a pecuniary cost $\omega (z_t)^{\xi_1}$, with $\xi_1 > 1$, measured in units of the final good. With on-the-job search, the law of motion of employed workers in Home is given by:

$$n_{t+1} = \left(1 - \sigma - \psi^{\star}_{H,t} z_t\right) n_t + \psi_{H,t} s_t u_t \tag{40}$$

where the term $\psi^{\star}_{H,t} z_t$ accounts for those workers that move abroad to join the measure of employed migrants:

$$n_{e,t+1} = (1 - \sigma^{\star}) n_{e,t} + \psi^{\star}_{H,t} (1 - s_t) u_t + \psi^{\star}_{H,t} z_t n_t \tag{41}$$

The introduction of on-the-job search affects indirectly the household's decisions regarding jobseeking or the allocation of jobseekers between Home and Foreign through the impact on the asset value of being employed in Home. This asset value is negatively affected by the pecuniary costs of on-the-job search and the higher probability of leaving the job in the future, $\psi^{\star}_{H,t+1} z_{t+1}$, and positively affected by the future value of being employed abroad. This trade-off can be clearly seen from the optimality condition for the intensity of on-the-job search, which is given by:

$$\lambda_{c,t} \omega \xi_1 (z_t)^{\xi_1 - 1} \quad = \quad \psi^{\star}_{H,t} (\lambda_{e,t} - \lambda_{n,t}) \tag{42}$$

Condition (42) states that, in equilibrium, the marginal costs of on-the-job search intensity, in units of consumption, must be equal to the excess value of working abroad relative to the value of working in Home, subject to the probability of finding a job in Foreign. The higher

[24] For simplicity, we model on-the-job search only for employment abroad, in line with the recent experience of the euro-area peripheral countries where domestic employment opportunities had dramatically shrunk.

this differential, the higher the optimal level of on-the-job search.[25]

The possibility that workers can resign from their contracts also affects the surplus firms derive from new hires. This occurs because the average tenure of a contract depends on the probability of an early termination by the emigrating worker, which affects the law of motion of employment, (40). These changes in the surpluses affect the real wage, which is now given by:

$$\begin{aligned} w_t h_t &= \frac{\vartheta}{(1-\tau^n)}\left\{ \mathrm{b} + \frac{\chi}{\lambda_{c,t}}\frac{h_t^{1+\xi}}{1+\xi} + \omega\left(z_t\right)^{\xi_1} - z_t\left\{\frac{\Omega\left(m_{e,t}\right)^{\mu}}{\lambda_{c,t}} + \phi_u\left(\left(1-s_t\right)u_t - \left(1-s\right)u\right)\right\}\right\} \\ &\quad + \left(1-\vartheta\right)\left\{\left(1-\phi\right)\frac{p_{x,t}y_t}{n_t} + \left(1-z_t\right)\frac{\psi_{H,t}}{\psi_{F,t}}\kappa\right\} \end{aligned} \tag{43}$$

Comparing to the wage rule in the baseline model, (43) differs in three respects. First, the last term in the second line is now multiplied by $(1-z_t)$, which reflects the fact that the higher on-the-job search is, the lower the average tenure of work contracts in Home. This reduces the continuation value of the contract and, therefore, pushes down on wages. Second, the worker's surplus is affected by the pecuniary costs of on-the-job search. Finally, because in equilibrium the asset value of jobseeking in Home and Foreign must be equal, the surplus for the worker is adjusted to reflect the migration costs associated with the future value of working abroad.

Before we turn to the results, notice that we have assumed that employed members of the household will only migrate having secured a job, which is not the case for the unemployed members who migrate to continue their job search abroad. This implies that when we introduce on-the-job search abroad in the model, the household may decide to substitute migration of the unemployed with migration of the employed, since the latter is directly translated into a job match abroad.

Assuming in our calibration that 2% of workers look for a job abroad at the steady state and that $\xi_1 = 1.4$, Figures 3, 4, and 5 also present the impulse response functions for the three standard shocks examined in Section 4 (see dash-dotted lines). After a positive TFP shock workers reduce substantially the intensity with which they look for jobs abroad, which reinforces further the decrease in the stock of migrants abroad and boosts aggregate demand, employment, and GDP by more than in the baseline model. On the other hand, the reallocation of unemployed jobseekers towards Home is mitigated relative to the baseline model. Next, after a positive shock to the nominal interest rate, on-the-job-search abroad increases in the short run, given the fall in the real wage, but this response is reversed in the medium run, as hours return to their steady-state level, implying that the additional benefit

[25] In the scenarios we analyze below, we only consider cases where $\lambda_e > \lambda_n$ is true in the steady state.

from working abroad is not high enough to compensate for the cost of search. Overall, these effects appear small and do not alter significantly the responses of the other variables. Interestingly, after a positive shock to government spending, the intensity of on-the-job-search abroad increases persistently despite the boost in aggregate demand from higher govenment spending and the subsequent increase in labor demand. This occurs because of the fall in the wage from the increased labor supply (wealth effect). The reallocation of unemployed jobseekers towards Home is reinforced relative to the baseline model.

Figures 6, 7, and 8 also report the responses for the fiscal consolidation shock under the three alternative instruments in the presence of on-the-job search abroad (see dashed-dotted lines). Both a tax-based consolidation and a consolidation through cuts in unemployment benefits significantly increase the intensity with which current workers look for jobs abroad, which mitigates the migration of the unemployed.[26] The latter explains why in the short run the stock of migrants appears smaller relative to a model without on-the-job search abroad, while the former explains why it appears higher afterwards. A higher stock of migrants abroad has a negative impact on internal demand, deepening the GDP contraction in the case of tax hikes and mitigating the expansion in the case of cuts in unemployment benefits. Finally, cuts in public spending also increase (decrease) the intensity of the on-the-job search abroad in the short run (medium run) as a result of the fall (increase) in the real wage. However, this imoact is small and does not affect the rest of the responses in the model. A comparison of the three cases in Figure 10 reveals that cuts in unemployment benefits induce the most persistent increase in the intensity of the on-the-job search abroad because of the downward adjustment in the real wage.

6.2 Cost of migration

In this subsection, we consider a positive shock to the utility cost of migration.[27] An increase in migration costs may well represent the case of anti-immigration policies implemented in the Foreign or repatriation policies implemented in Home. We simulate the shock so that it induces on impact a 1% reduction in the total stock of migrants abroad. As can be seen in Figure 11, the economy experiences a GDP expansion, coming from an increase in consumption and investment demand. The return of migrants leads to a fall in the real wage and an increase in the unemployment rate. The boost in demand and the fall in the real wage lead to an increase in labor demand (vacancies). As a result, employment rises. The increase in the pool of unemployed jobseekers reduces the job-finding rate in the economy.

[26]For a tax-based consolidation, the response of the on-the-job search abroad becomes negative in the medium run, as the instrument (tax rate) starts returning to the steady state.

[27]Notice that the other type of migration costs in the model (pecuniary costs) $\frac{\phi_u}{2}\left(\left(1-s_t\right)u_t-\left(1-s\right)u\right)^2$ are equal to zero at the steady state.

The domestic household initially increases labor force participation and hours, given the increased costs of migration. However, the fall in the real wage and the job finding rate quickly reverses these responses. The real exchange rate depreciates as the economy becomes more competitive with the fall in the real wage. The GDP expansion leads to an increase in the demand for imports, which is reflected also in the fall of net exports.

In sum, a higher utility cost of migration acts as a positive labor supply shock, inducing a boost in aggregate demand that leads to a GDP expansion. At the same time, by reducing migration outflows, the domestic economy experiences a fall in real wages and an increase in the unemployment rate.

6.3 Home and Foreign wages

Real wages in home and abroad play an important role in the migration decisions of the household. For instance, if there is a fall in wages in Home, through (12), the fall in w_t will reduce directly the value of employment in Home. Using (15), we can rewrite (14) as:

$$\lambda_{c,t}\mathrm{b} + \psi_{H,t}\lambda_{n,t} = \Phi l_t^{-\varphi} \tag{44}$$

Hence, we see that a fall in w_t will tend to reduce labor force participation. However, as the value of being unemployed at home and abroad have to be equal from (15), the share of unemployed jobseekers searching in Home will be reduced. This will in turn affect the job-finding probability in Home until the two sides of (15) are again equalized. As $\psi_{H,t}$ increases, the fall in $\lambda_{n,t}$ will not be entirely transmitted to the right hand side of (44). In fact, for a value of φ large enough, participation will barely move. In that case, the number of unemployed migrants, $(1 - s_t)\, u_t$, will unambiguously increase. Finally, from the laws of motion of employment, (5) and (6), we have that the fall in jobseekers in Home, $s_t u_t$, will reduce employment n_t, whereas the increase in migrant jobseekers will lead to an increase in employed migrants $n_{e,t}$. Hence, a fall in the wage in Home w_t will likely increase the stock of Home nationals residing abroad $m_{e,t}$.

In the aftermath of the recent crisis, many peripheral countries of the euro area experienced cuts in wages. For example, in Greece a 22% cut in the standard minimum monthly wage of 751 euros was legislated in 2012. In this subsection, we consider a fall in the home real wage (solid lines) versus an unanticipated increase in the foreign real wage (dashed lines).[28] For comparison, we simulate the two shocks so that they induce on impact a 1% increase in the total stock of migrants abroad.

Starting with the increase in the Foreign real wage, we see that consumption demand

[28]Note that there is no other change in variables of the Foreign.

falls given the departure of migrants. Consequently, real GDP falls and the debt-to-GDP ratio rises. Employment is also reduced. Leisure, hours, vacancies, unemployment, and he job-finding rate move very little. Given the increase in foreign wages, the real exchange rate appreciates and imports fall.

An increase in the stock of migrants abroad coming from a fall in the Home real wage induces very different results. The fall in the real wage induces an increase in vacancy posting and in employment. Given the rule specified for remittances in (9), remittances go up, financing an increase in consumption. Investment and real GDP increase as well, while the unemployment rate is substantially reduced. The real exchange rate now depreciates since labor costs are lower.

6.4 Unemployment benefits

So far, we have analyzed the effects of cuts in unemployment benefits under the assumption that unemployed joseekers abroad receive the Home unemployment benefit. According to EU legislation, this is possible for a period of 3 to 6 months. However, the pool of unemployed jobseekers in Foreign that are Home nationals includes as well those who were previously employed in Foreign and have experienced a termination of their match. In this case, they would be eligible to receive the unemployment benefit of the Foreign. We therefore turn to examine in Figure 13 the sensitivity of our results to an alternative assumption according to which 30% of jobseekers in Foreign, who are Home nationals, receive the unemployment benefits of the Foreign. These benefits are not subject to cuts.

As can be seen by the dashed lines, the results we obtain are very similar to the ones of our benchmark model (solid lines). Given that in this scenario a fraction (here 30%) of the migrant jobseekers do not experience the benefit cut, we observe that the response of migration variables is relatively weaker in the short run, leading to a higher increase in GDP and consumption, relative to the benchmark model. However, the opposite pattern is observed in the medium run. Specifically, we observe a stronger reallocation of jobseekers towards Foreign, and therefore higher fall in demand and GDP, as the foreign labor market becomes more appealing when migrants can receive there the unemployment benefit, which is not subject to cuts.

7 Conclusions

This paper was motivated by the significant migration outflows from the periphery of the euro area in search of employment, better pay and better social and economic prospects in the aftermath of the crisis. We endogenized migration decisions of the household both for

its unemployed and employed members in a small open economy DSGE model with search and matching frictions. Employed members of the household only migrate having secured a job abroad, while the unemployed members migrate to continue their job abroad. The government implements fiscal consolidation through cuts in public spending or unemployment benefits, and through labor income tax hikes.

We showed that migration reinforces business-cycle fluctuations. TFP and government spending shocks induce a return of migrant jobseekers, while an increase in the nominal interest rate leads to an increase in migrant jobseekers abroad. Higher migration costs, which can capture the case of anti-immigration or repatriation policies, implies a higher labor supply domestically, which lowers the real wage and increases the unemployment rate. Yet, the boost in aggeregate demand induces an output expansion in the economy.

Regarding the interplay of migration with fiscal consolidation, our results indicated that a tax-based consolidation induces the highest migration outflows in the short run, which exacerbates the induced GDP contraction. Cuts in unemployment benefits lead to the strongest reallocation of jobseekers towards the foreign labor market in the medium run, but with more favorable effects on output and unemployment due to the downward adjustment of wages. The latter also leads a very persistent increase in the intensity with which current workers look for a job abroad. Government spending cuts, on the other hand, have a small impact on migration and the labor market, affecting directly aggregate demand and output.

This paper has compared the effects of various tax-spending instruments used for debt consolidation in the presence of cross-country labor mobility. However, restrictions in new recruitment of public employees have also been important in the fiscal adjustment of peripheral countries, where the public sector is sizeable (e.g. Greece, Spain, Italy), and have led many graduates, who were previously absorbed in public sector jobs, to emigrate. Further work in this area could therefore look into the effects of public wage bill cuts by adding a public sector to this model (see e.g. Bandeira et al. (2018) and Bermperoglou et al. (2017)) and examining the interplay with migration decisions. We leave this topic for future research.

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Figures

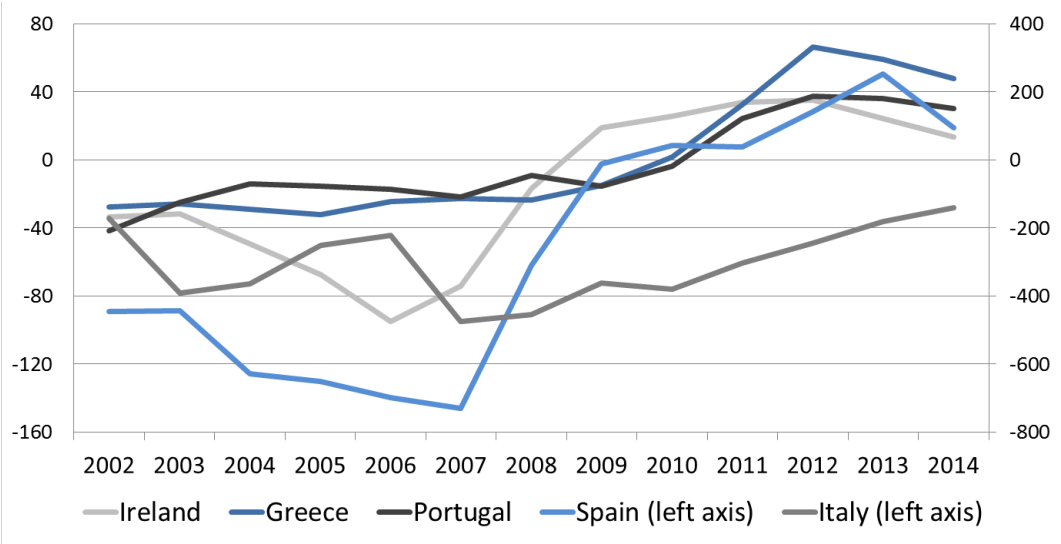

Figure 1: Net migration flows from the periphery of the euro area (in thousand persons)

Source: Eurostat

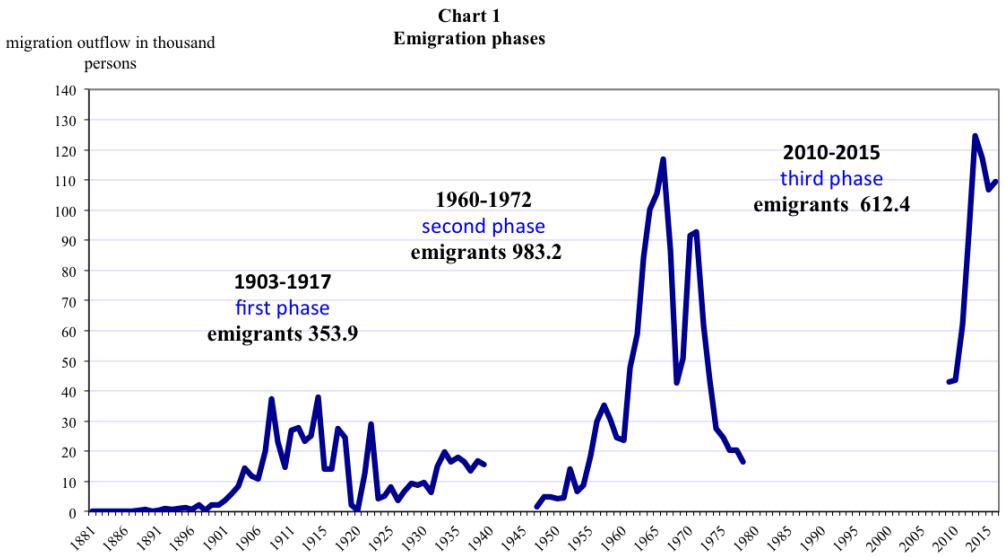

Figure 2: Emigration phases in Greek history (all ages)

Source: updated graph from Lazaretou (2016)

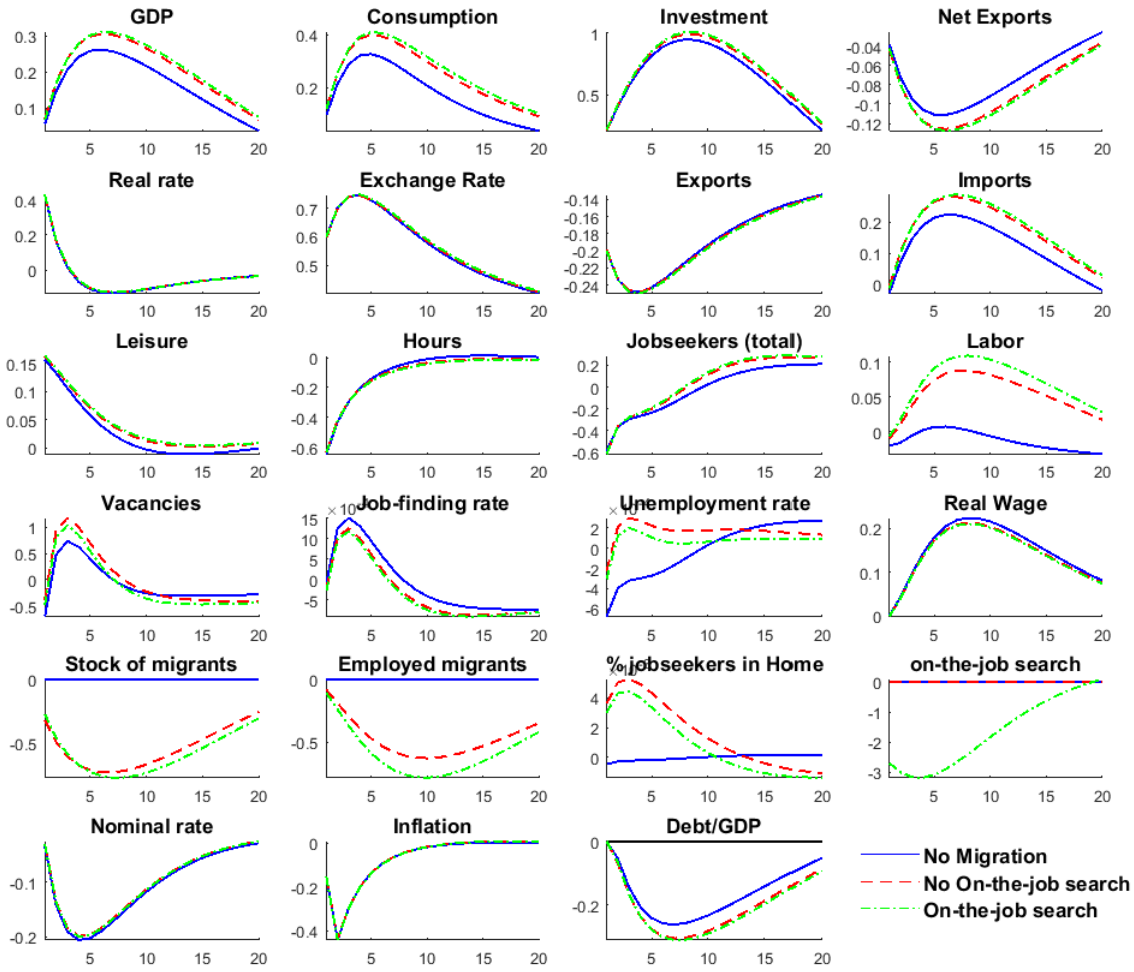

Figure 3: A 1% shock to TFP

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state.

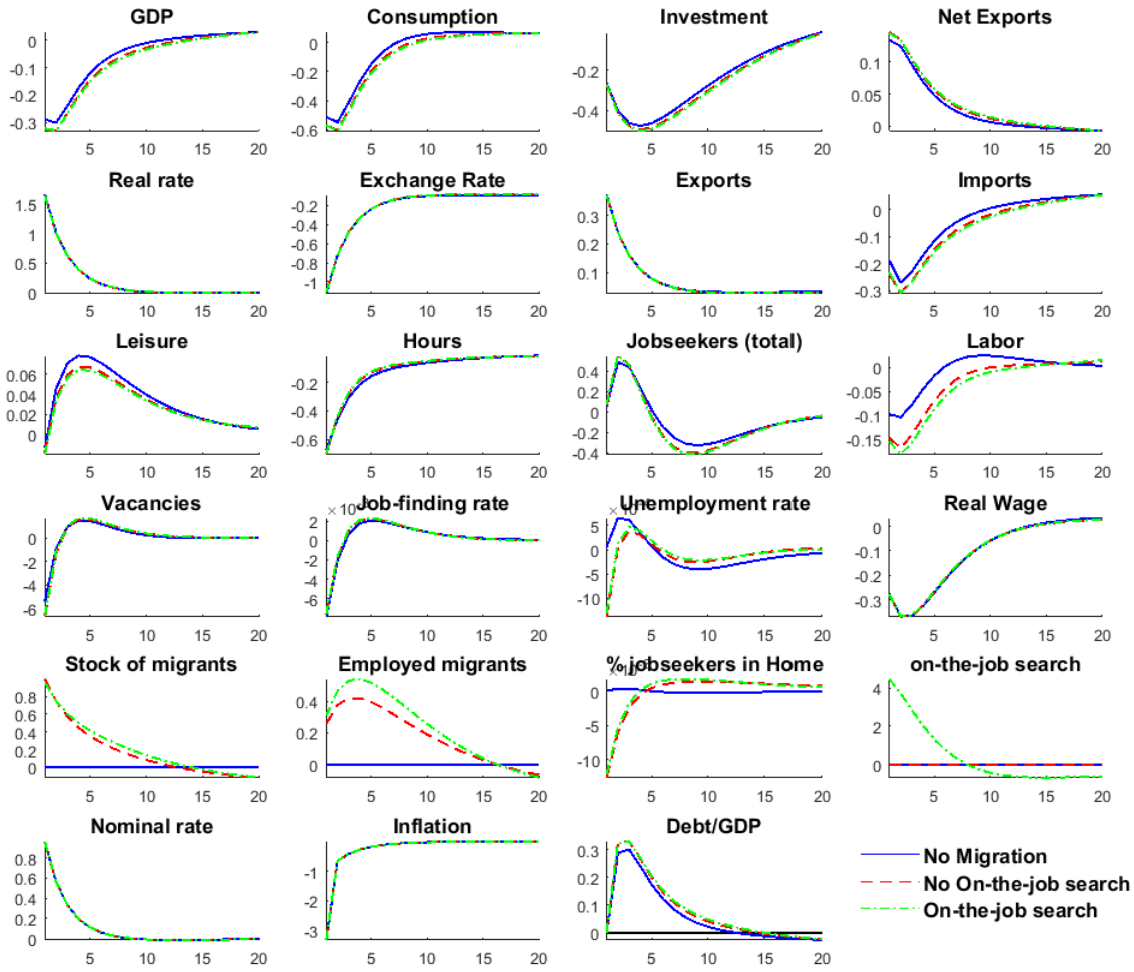

Figure 4: A 1% increase in the nominal interest rate

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state.

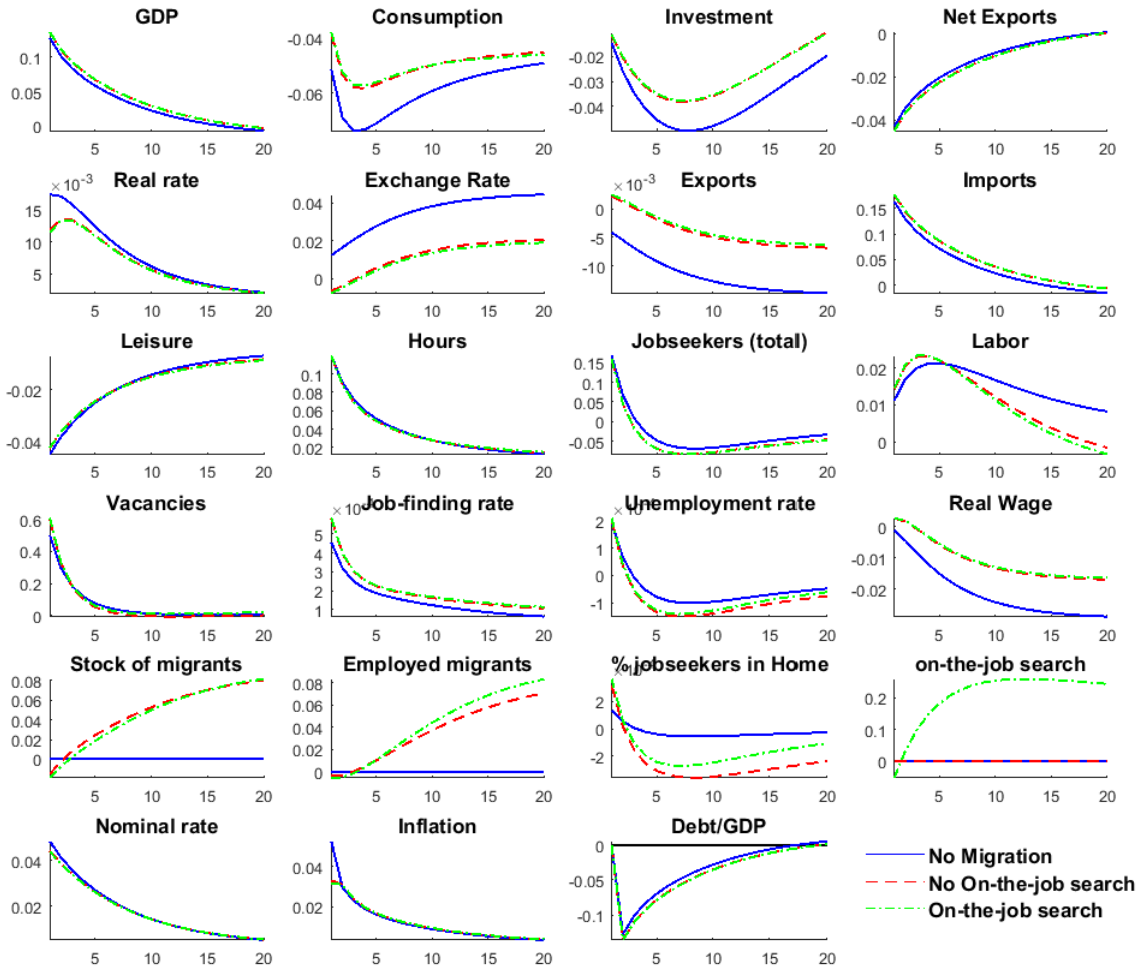

Figure 5: A 1% shock to government spending

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state.

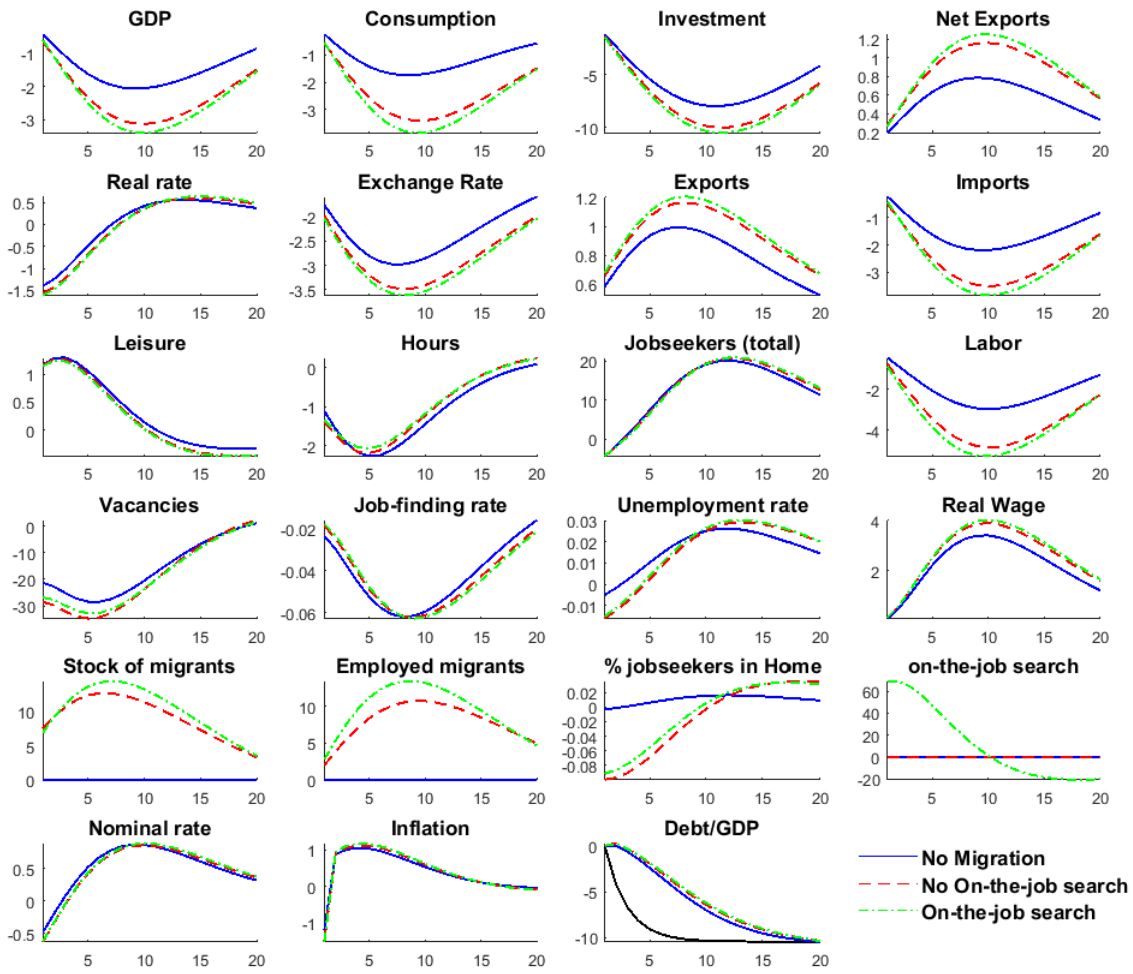

Figure 6: Fiscal consolidation through labor tax hikes

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state. The black line in the bottom-right panel reports the path for the debt-to-GDP target.

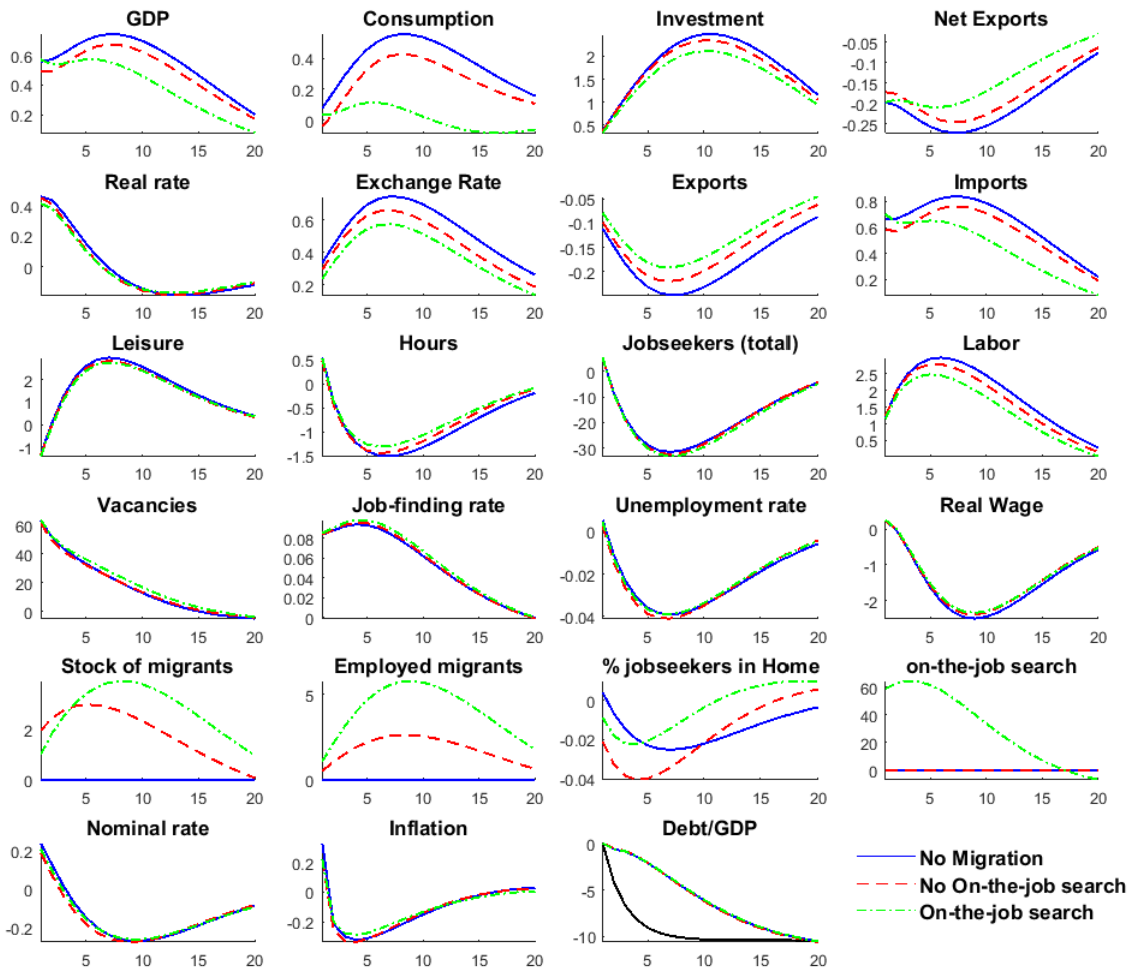

Figure 7: Fiscal consolidation through cuts in unemployment benefits

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state. The black line in the bottom-right panel reports the path for the debt-to-GDP target.

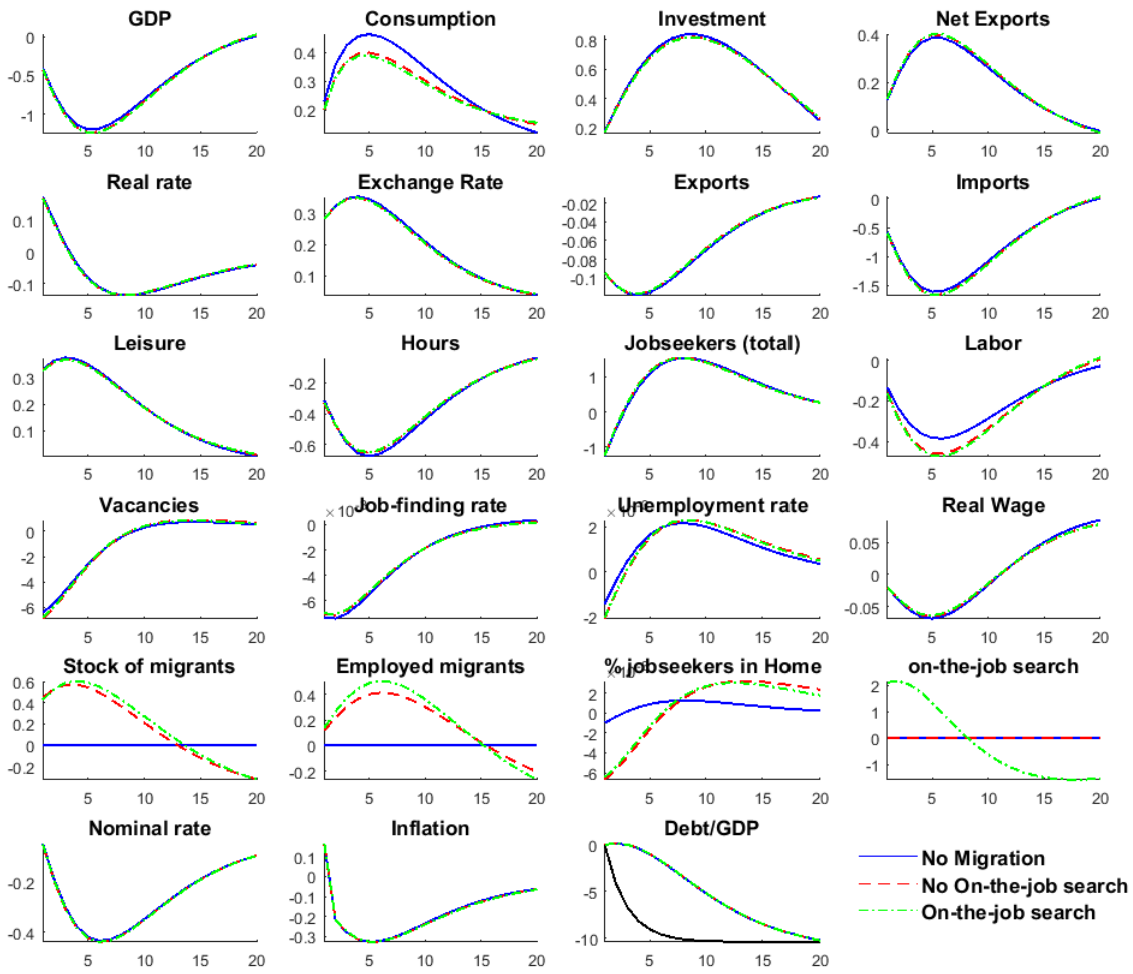

Figure 8: Fiscal consolidation through government spending cuts

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state. The black line in the bottom-right panel reports the path for the debt-to-GDP target.

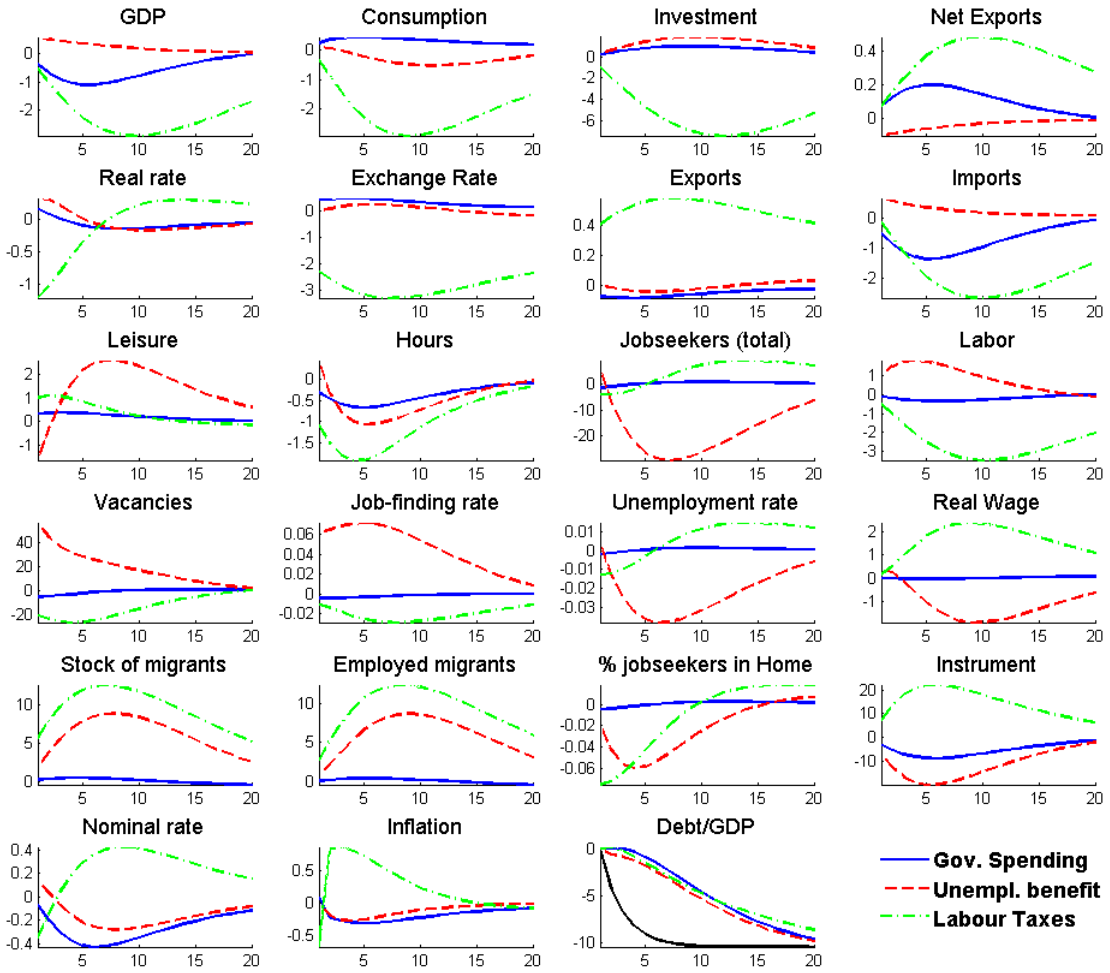

Figure 9: Comparison of instruments with migration

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state. The black line in the bottom-right panel reports the path for the debt-to-GDP target.

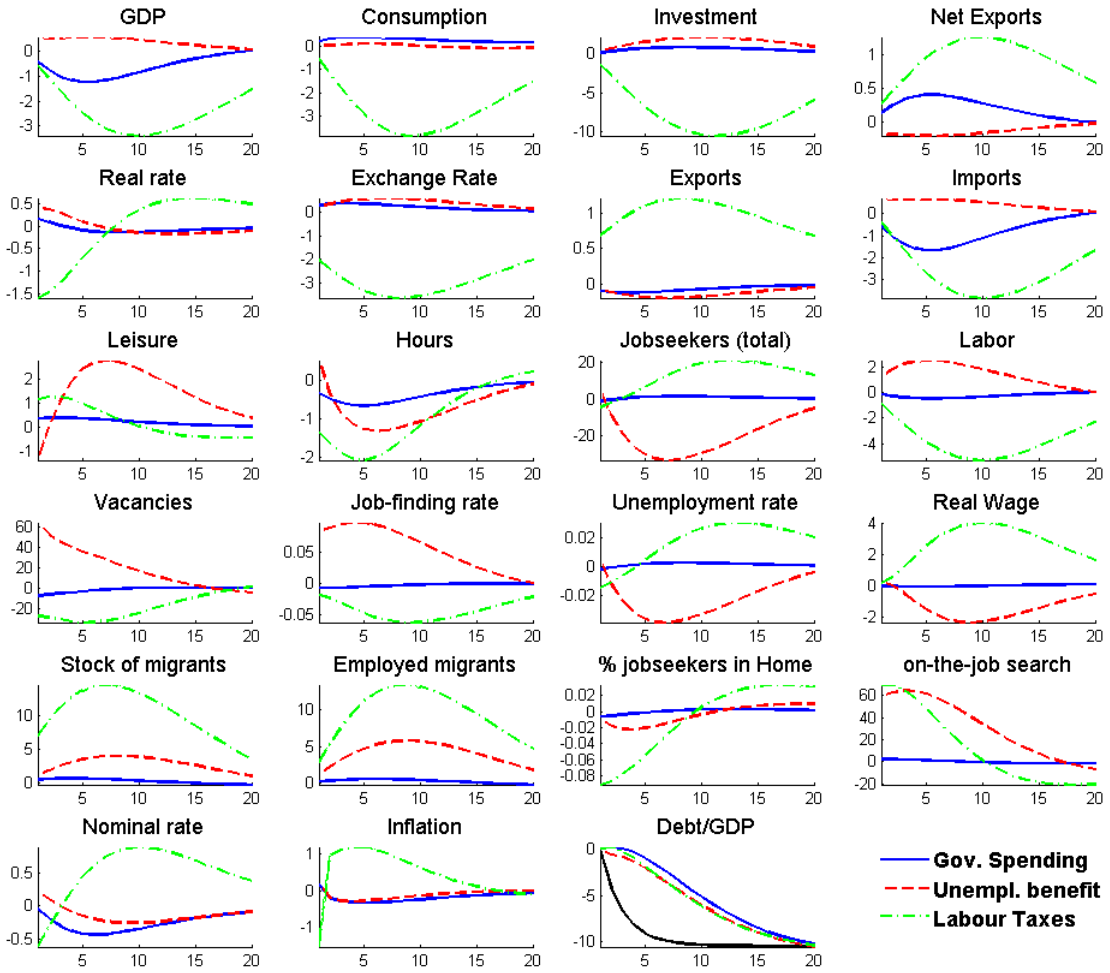

Figure 10: Comparison of instruments with on-the-job search abroad

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state. The black line in the bottom-right panel reports the path for the debt-to-GDP target.

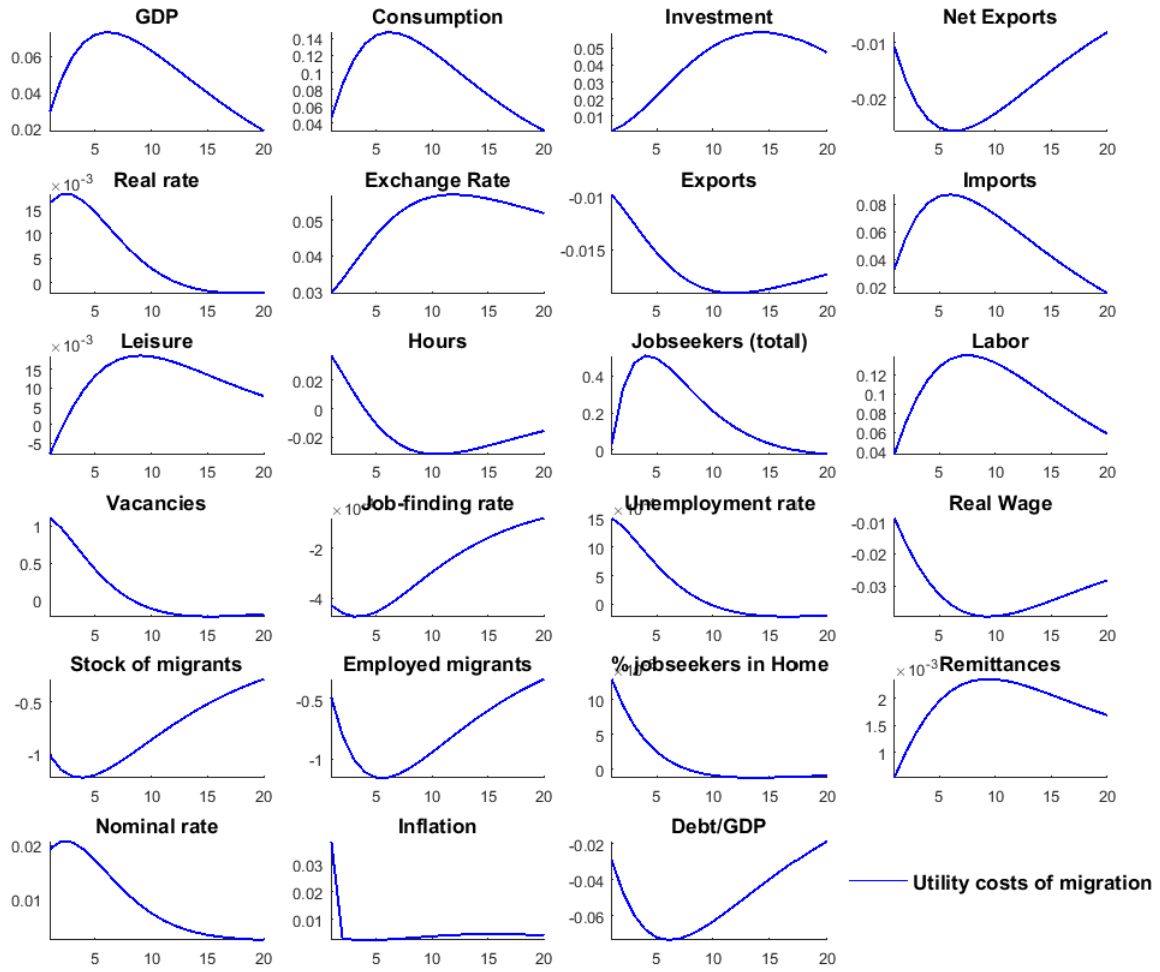

Figure 11: A shock to the utility cost of migration

Responses are in percent deviations from steady state, except for interest rates and inflation, which are in annualized levels, and the unemployment rate and net exports, which are in levels.

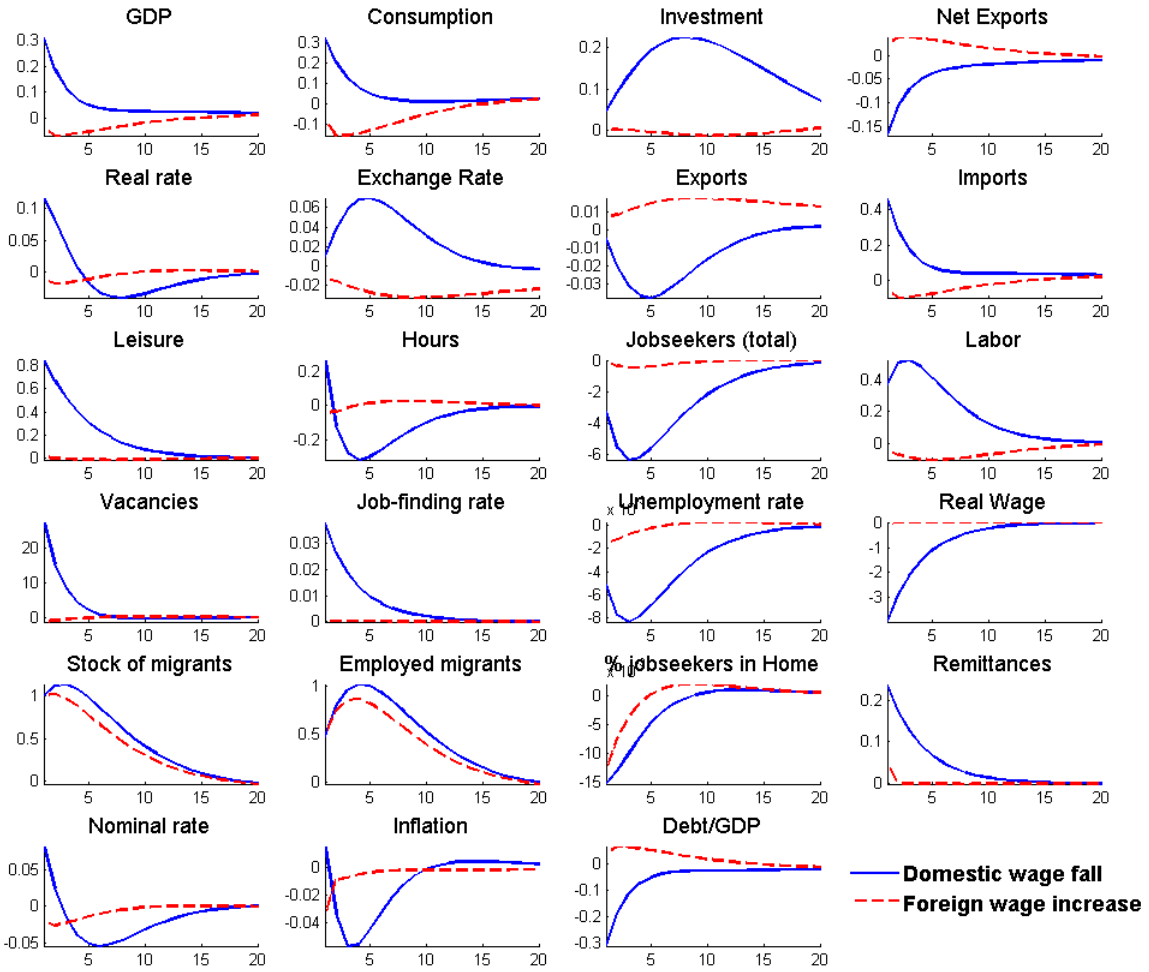

Figure 12: A positive shock to the foreign wage versus a negative shock to the home wage

Responses are in percent deviations from steady state, except for interest rates and inflation, which are in annualized levels, and the unemployment rate and net exports, which are in levels.

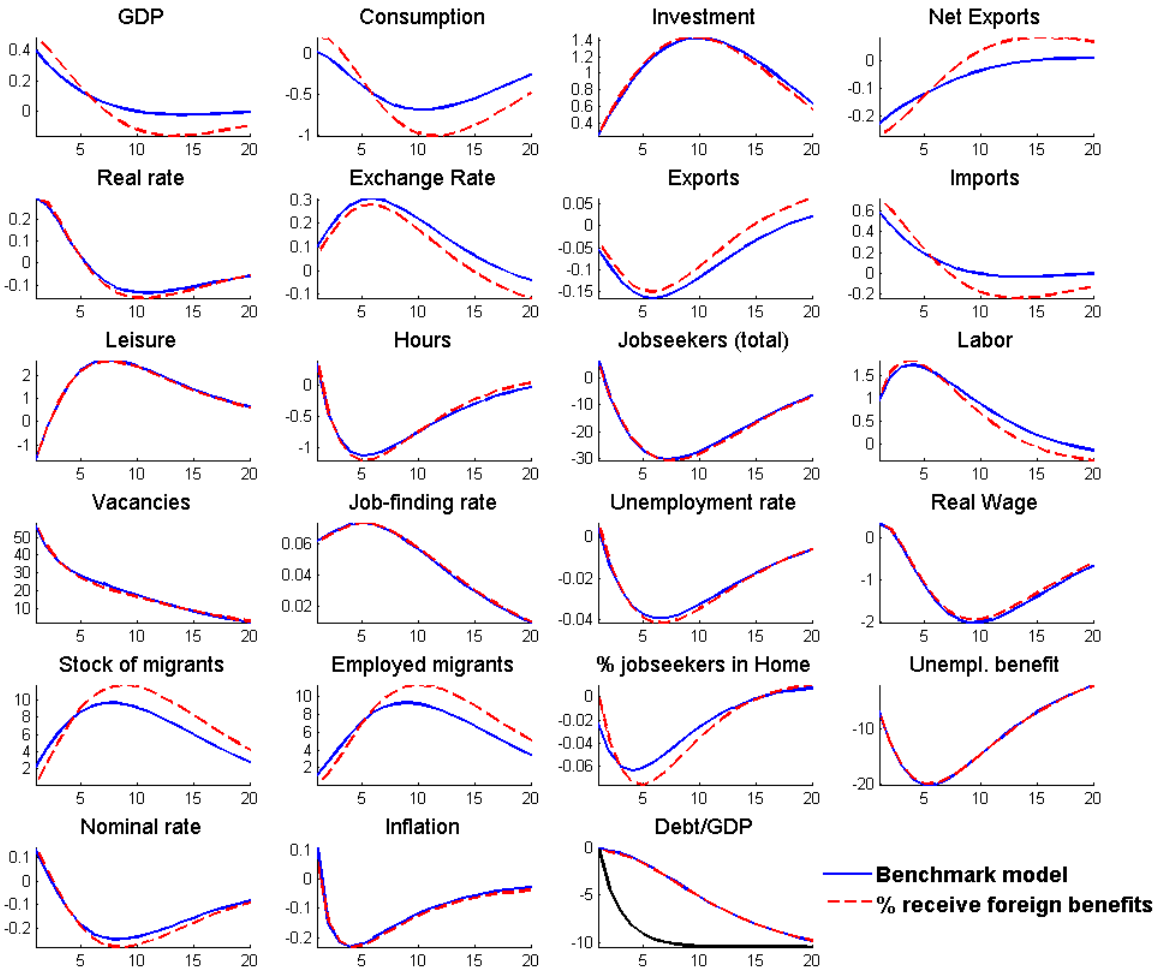

Figure 13: Fiscal consolidation through cuts to unemployment benefits when migrant jobseekers can receive foreign benefits

Responses are in percent deviations from steady state, except for interest rates and inflation, which are in annualized levels, and the unemployment rate and net exports, which are in levels. The black line in the bottom-right panel reports the path for the debt-to-GDP target.

Appendix

1.1 First order conditions of the household problem

The household's Lagrangean can be written as:

$$\begin{aligned}
\mathcal{L} = \sum_{t=0}^{\infty} & \left\{ \frac{(C_t - \zeta C_{t-1})^{1-\eta}}{1-\eta} + \Phi \frac{(l_t)^{1-\varphi}}{1-\varphi} - \Omega \frac{(m_{e,t})^{1-\mu}}{1-\mu} - \chi \frac{h_t^{1+\xi}}{1+\xi} n_t - \chi \frac{h_{e,t}^{1+\xi}}{1+\xi} n_{e,t} \right. \\
& -\lambda_{c,t} \left[(1+\tau^c) c_t + i_t + b_{g,t} + e_t r_{f,t-1} b_{f,t-1} + \frac{\phi_u}{2} \left((1-s_t) u_t - (1-s) u \right)^2 \right. \\
& \quad - (1-\tau^n) w_t h_t n_t - \mathrm{b} u_t - \left[r_t^k - \tau^k \left(r_t^k - \delta_t \right) \right] x_t k_t - r_{t-1} b_{g,t-1} - e_t b_{f,t} - \Pi_t^p - T_t \\
& \quad \left. + e_t \left((1+\tau^{c\star}) c_{e,t} - (1-\tau^{n\star}) w_t^\star h_{e,t} n_{e,t} \right) \right] \\
& -\lambda_{k,t} \left[k_{t+1} - \left[1 - \frac{\omega}{2} \left(\frac{i_t}{i_{t-1}} - 1 \right)^2 \right] i_t - \left(1 - \bar{\delta} \left(x_t \right)^\xi \right) k_t \right] \\
& -\lambda_{n,t} \left[n_{t+1} - (1-\sigma) n_t - \psi_{H,t} s_t u_t \right] \\
& \left. -\lambda_{e,t} \left[n_{e,t+1} - (1-\sigma^\star) n_{e,t} - \psi_{H,t}^\star (1-s_t) u_t \right] \right\}
\end{aligned}$$

We assume external habits in consumption, meaning that C_{t-1} is taken as given in period t. Note that $m_{e,t} = n_{e,t} + (1-s_t) u_t$. The choice variables comprise c_t, k_{t+1}, i_t, x_t, $b_{g,t}$, $b_{f,t}$, n_{t+1}, $n_{e,t+1}$, u_t, h_t, and s_t, and the corresponding first order conditions are the following:

c_t :

$$\lambda_{c,t} (1+\tau^c) = \left(C_t - \zeta \tilde{C}_{t-1} \right)^{-\eta} \tag{45}$$

k_{t+1} :

$$\lambda_{k,t} = \beta \lambda_{c,t+1} \left(\left[r_{t+1}^k - \tau^k \left(r_{t+1}^k - \delta_{t+1} \right) \right] x_{t+1} \right) + \beta \lambda_{k,t+1} (1-\delta_{t+1}) \tag{46}$$

i_t :

$$\lambda_{c,t} - \lambda_{k,t} \left\{ 1 - \frac{\omega}{2} \left(\frac{i_t}{i_{t-1}} - 1 \right)^2 - \omega \left(\frac{i_t}{i_{t-1}} - 1 \right) \frac{i_t}{i_{t-1}} \right\} = \beta \lambda_{k,t+1} \omega \left(\frac{i_{t+1}}{i_t} - 1 \right) \left(\frac{i_{t+1}}{i_t} \right)^2 \tag{47}$$

x_t :

$$\lambda_{k,t} \iota \bar{\delta} \left(x_t \right)^{\iota - 1} = \lambda_{c,t} \left\{ r_t^k - \tau^k \left(r_t^k - (1+\iota) \delta_t \right) \right\} \tag{48}$$

$b_{g,t+1}$:

$$1 = \beta \frac{\lambda_{c,t+1}}{\lambda_{c,t}} r_t \tag{49}$$

$b_{f,t+1}$:

$$1 = \beta \frac{\lambda_{c,t+1}}{\lambda_{c,t}} \frac{e_{t+1}}{e_t} r_{f,t} \tag{50}$$

n_{t+1} :

$$\begin{aligned} \lambda_{n,t}/\beta &= \lambda_{c,t+1}\left(1-\tau^n\right) w_{t+1} h_{t+1} - \Phi l_{t+1}^{-\varphi} - \chi \frac{h_{t+1}^{1+\xi}}{1+\xi} \\ &\quad + \lambda_{n,t+1}\left(1-\sigma\right) \end{aligned} \tag{51}$$

$n_{i,t+1}$:

$$\begin{aligned} \lambda_{e,t}/\beta &= \lambda_{c,t+1}\left(1-\tau^{n\star}\right) e_t w_{t+1}^{\star} h_{e,t+1} - \Phi l_{t+1}^{-\varphi} - \chi \frac{h_{e,t+1}^{1+\xi}}{1+\xi} - \Omega \left(m_{e,t+1}\right)^{\mu} \\ &\quad + \lambda_{e,t+1}\left(1-\sigma^{\star}\right) \end{aligned} \tag{52}$$

u_t :

$$\lambda_{c,t} \mathrm{b} + \lambda_{n,t} \psi_{H,t} = \Phi l_t^{-\varphi} \tag{53}$$

s_t :

$$\lambda_{e,t} \psi_{H,t}^{\star} = \lambda_{n,t} \psi_{H,t} + \lambda_{c,t} \left[\phi_u \left(\left(1-s_t\right) u_t - \left(1-s\right) u\right)\right] \tag{54}$$

h_t :

$$\chi \frac{h_t^{\xi}}{\lambda_{c,t}} = \left(1-\tau^n\right) p_{x,t} \left(1-\phi\right)\left(1-\phi\right) \frac{y_t}{n_t h_t} \tag{55}$$

1.2 Derivation of worker's and firm's surpluses

The surplus for workers consists of the asset value of employment net of the outside option (value of being unemployed). The former is denoted by $V_{e,t}^{H}$ and is given by:

$$V_t^{E_H} = -\frac{\Phi l_t^{-\varphi}}{\lambda_{c,t}} - \frac{\chi}{\lambda_{c,t}} \frac{h_t^{1+\xi}}{1+\xi} + \left(1-\tau^n\right) w_t h_t + \mathrm{E}_t \beta_{t+1} \left\{\left(1-\sigma\right) V_{t+1}^{E_H} + \sigma V_{t+1}^{U_H}\right\}$$

where $V_{u,t}^H$ denotes the value of being unemployed at Home and is given by:

$$V_{u,t}^H = -\frac{\Phi l_t^{-\varphi}}{\lambda_{c,t}} + \mathrm{b} + \mathrm{E}_t \beta_{t+1} \left\{ \psi_{H,t} V_{e,t+1}^H + (1 - \psi_{H,t}) V_{u,t+1}^H \right\}$$

Hence, the worker's surplus, $S_t^H = V_t^{E_H} - V_t^{U_H}$, is given by:

$$S_t^H = (1 - \tau^n) w_t h_t - \mathrm{b} - \frac{\chi}{\lambda_{c,t}} \frac{h_t^{1+\xi}}{1+\xi} + (1 - \sigma - \psi_{H,t}) \mathrm{E}_t \beta_{t+1} S_{t+1}^H$$

The assumption that when an emigrant looses her job she joins the pool of emigrant jobseekers is rather innocuous since in equilibrium, arbitrage implies that $V_{u,t}^H = V_{u,t}^F \equiv V_{u,t}$ for all t. This arbitrage condition is derived from the optimality conditions of the household with respect to s_t.

For the firm, the surplus from a match is given by:

$$S_{f,t} = (1 - \phi) \frac{p_{x,t} y_t}{n_t} - w_t + (1 - \sigma) \mathrm{E}_t \beta_{t+1} S_{f,t+1}$$

which, using (18), can be written as:

$$S_{f,t} = (1 - \phi) \frac{p_{x,t} y_t}{n_t} - w_t + (1 - \sigma) \frac{\kappa}{\psi_{F,t}}$$

Inserting the two surpluses into the splitting rule $(1 - \vartheta)(1 - \tau^n) S_{f,t} = \vartheta S_{h,t}^H$ and solving for the wage yields:

$$w_t h_t = (1 - \vartheta) \left\{ p_{x,t} (1 - \phi) \frac{y_t}{n_t} + \frac{\psi_{H,t}}{\psi_{F,t}} \kappa \right\} + \frac{\vartheta}{(1 - \tau^n)} \left\{ \mathrm{b} + \frac{\chi}{\lambda_{c,t}} \frac{h_t^{1+\xi}}{1+\xi} \right\}$$

1.3 Additional figures

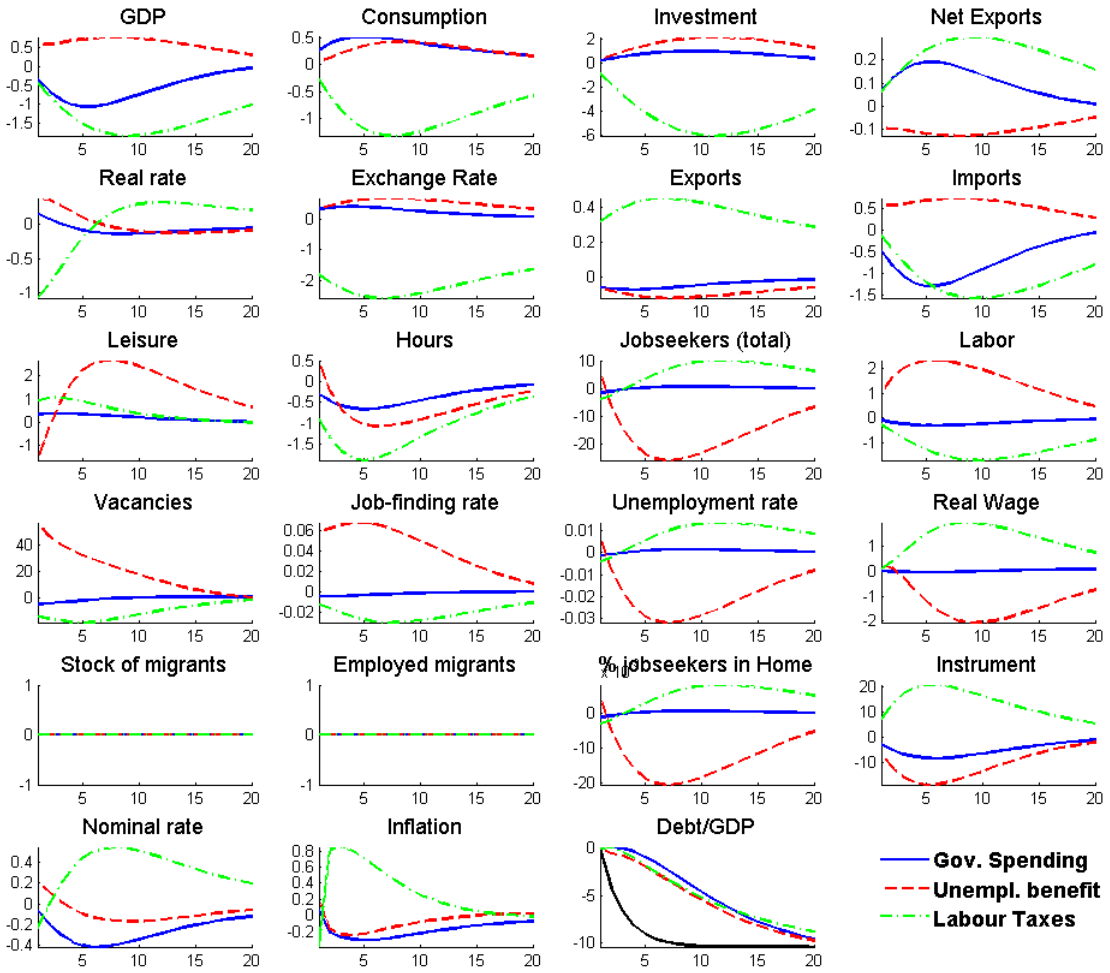

Figure 14: Comparison of instruments without migration

Responses for interest rates and inflation are shown in annualized levels. Responses for the unemployment rate, job-finding rate, share of jobseekers at home and net exports are in levels. All other responses are in percent deviations from steady state. The black line in the bottom-right panel reports the path for the debt-to-GDP target.