Journal of Economic Dynamics & Control 144 (2022) 104539

Contents lists available at ScienceDirect

Journal of Economic Dynamics & Control

journal homepage: www.elsevier.com/locate/jedc

Emigration and fiscal austerity in a depression☆

Guilherme Bandeira[a], Jordi Caballé[b,*], Eugenia Vella[c]

[a] New South Wales Treasury, New South Wales, Australia
[b] Universitat Autònoma de Barcelona, Barcelona School of Economics, Spain
[c] Athens University of Economics and Business and MOVE, Greece

ARTICLE INFO

Article history:
Received 22 October 2021
Revised 8 August 2022
Accepted 21 September 2022
Available online 24 September 2022

JEL classification:
E32
F41

Keywords:
Fiscal austerity
Emigration
On-the-job search
Matching frictions
Greek crisis
Fiscal multipliers

ABSTRACT

What is the role of emigration in a deep recession when the government implements fiscal consolidation? To answer this question, we build a small open economy New Keynesian model with matching frictions and emigration. In simulations for the Greek Depression, fiscal austerity accounts for almost 1/3 of the GDP decline and 12% of emigration. A no-migration scenario under-predicts the bust in output by 1/6 and the rise in the debt-to-GDP ratio by 8 percentage points. The link between emigration and austerity is bi-directional. Emigration increases the labour tax hike and time required to reduce the debt ratio due to endogenous revenue leakage. In turn, tax hikes intensify emigration, while unproductive government spending cuts have a mild, ambiguous impact as they exhibit opposite demand and wealth effects. However, productive spending cuts display a fiscal multiplier above one, which incentivizes emigration. Emigration then amplifies the productive spending multiplier through internal demand. Similarly, the cumulative labour tax multiplier after five years rises from 0.86 without migration to 1.27 when the unemployed emigrate and 1.47 when both the unemployed and the employed emigrate.

1. Introduction

This paper studies the role of emigration in a deep recession when the government implements fiscal consolidation. Over the period 2010–2015, half a million of working-age (15–64) Greek residents, amounting to 7% of the labour force,

☆ We thank B. Ravikumar (Co-Editor), one Associate Editor and two anonymous referees. We also thank C. Albert, J. Fernández-Blanco, J. Dolado, J. Galí, J. Jimeno, D. Krueger, S. Lazaretou, A. Marcet, B. Moll, R. Rossi, R. Santaeulalia-Llopis and participants in the Spring Meeting of Young Economists 2018, Sheffield Workshop on the Macroeconomics of Migration 2018, Simposio of the Spanish Economic Association 2018, Max Weber fellows conference 2018 at the EUI, Catalan Economic Society Conference 2019, ASSET Conference 2019, Universitat Autònoma de Barcelona, International Labour Organization, Universidad de Zaragoza, Universidad Pablo de Olavide de Sevilla, Bank of Spain and Bank of Greece for helpful comments. J. Caballé acknowledges financial support through the EU Horizon 2020 Program grant 649396 (ADEMU), the MICINN/FEDER grant PID2021-122605NB-100 and the grant 2017 SGR 1765 from Generalitat de Catalunya. E. Vella acknowledges financial support through the EU Horizon 2020 Marie Sklodowska-Curie Grant 798015 (EuroCrisisMove) and research assistance from T. Christou and K. Mavrigiannakis. The views and assertions made in this paper are those of the authors and do not necessarily reflect those of the NSW Treasury. Any errors are of the authors.

* Corresponding author.
E-mail address: jordi.caballe@uab.es (J. Caballé).

https://doi.org/10.1016/j.jedc.2022.104539

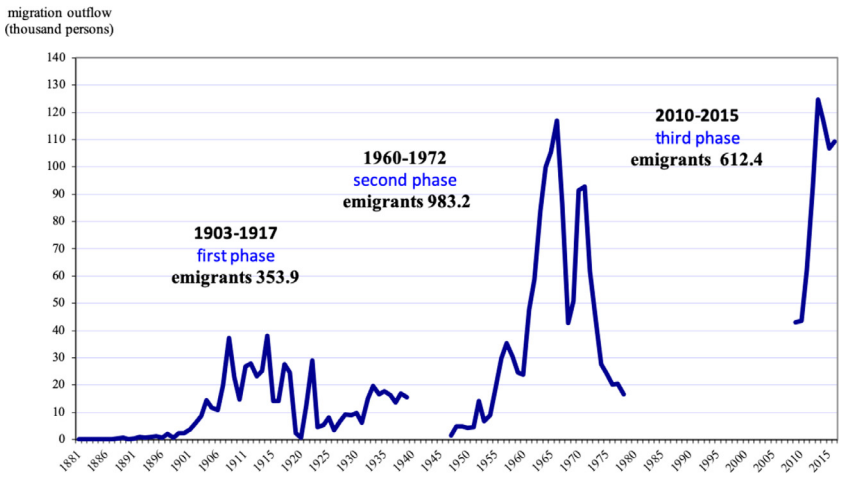


Fig. 1. Emigration phases in Greek history (all age groups) Source: updated graph from Lazaretou et al. (2016).

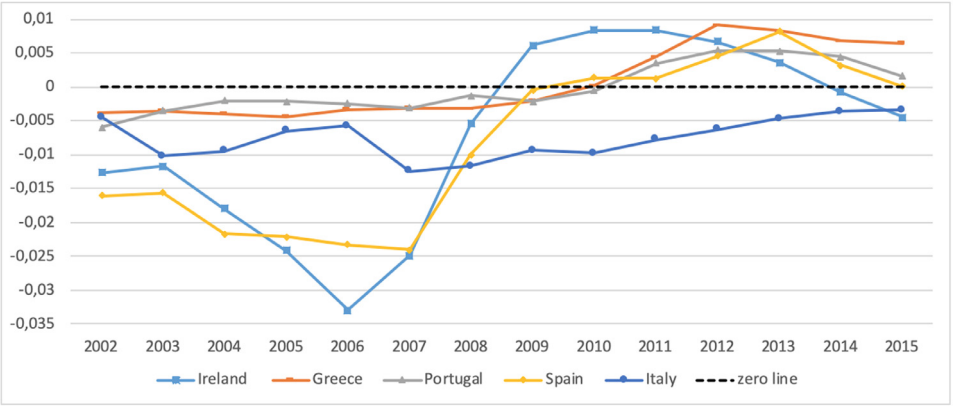


Fig. 2. Net migration flows, defined as outflows minus inflows (% active population) Source: Eurostat.

left the country in search of employment, better pay and better social and economic prospects (see Fig. 1).[1] Interestingly, Labrianidis and Pratsinakis (2016) report that half of those leaving Greece after 2010 were employed before emigrating. Over the same period, the unemployment rate reached 27% and the economy shrank by one quarter. On the fiscal front, Greece experienced the biggest bailout in global financial history with austerity measures as a precondition. The current government has identified the reversal of the emigration wave as a main avenue through which the country can enter a path of sustainable growth and has put in place a set of tax incentives for foreign tax residents who redomicile to Greece.[2]

While a growing number of studies has examined various aspects of the unprecedented Greek crisis, a framework that assesses, firstly, whether the mass exodus from Greece exacerbated the recession and, secondly, whether fiscal austerity contributes more strongly to the depth of recession in the presence of emigration is missing. The key contribution of the paper is to fill this gap. We offer a model-based anatomy of the Greek crisis, studying jointly the impact of the implemented

[1] Adverse labour market conditions and fiscal tightness during the GreatRecession led to net emigration from many European countries that suffered a deep deterioration of their economy (see Fig. 2). In Spain annual outflows exceeded 400K, which was historically the highest level and comparable to the average inflow of 485K during the immigration boom of 2000–2006. Around 40% of these outflows were directed to other EU countries and 30% to South America (Izquierdo et al., 2016). In the case of Greece, Germany and the UK concentrated more than half of the post 2010 emigration (Labrianidis and Pratsinakis, 2016).

[2] The Greek crisis was the deepest and longest ever recorded in an OECD country in the postwar period. Imbalances in the form of persistent current account and fiscal deficits and high levels of external and public debt, an overvalued real exchange rate and weak institutional quality set the crisis stage (Economides et al., 2022). From the late 1990s, Greece experienced an exceptional boom, driven by an increase in private demand and pro-cyclical fiscal policies. This led to the accumulation of large private, public, and external debt, and also to wage (but not productivity) hikes and a decline in competitiveness. Given also that, from the late 1970s, productive resources were directed to non-traded activities protected from competition by natural and political barriers, a fragile economic model took shape.

fiscal austerity mix and the amplification through the emigration channel. We also investigate the effects of different fiscal instruments on emigration as well as the implications of emigration for (a) the success of fiscal consolidations in meeting a given debt target, and (b) the output and unemployment costs of consolidations and the size of fiscal multipliers. Our analysis thus uncovers a novel bi-directional link between emigration and austerity.

Although mobility in response to disparate labour market conditions might result in improvements in aggregate employment, the impact on local adjustments hinges on a number of factors. First, emigration offers an extra outside option for workers in negotiations and therefore sustains higher wages, which may adversely affect firms' job creation ("labour market channel"). Second, migrants take with them not only their labour supply, but also their purchasing power, reinforcing the fall in demand during bad times, especially if remittances do not increase at the same rate as emigration ("private demand channel").[3] In such a case, emigration may reduce the consumption tax base ("fiscal channel"). The impact on aggregate demand depends also on openness and the importance of home bias in the demand for tradable goods. With low trade integration, the increase in external demand might not compensate for the fall in internal demand. Moreover, emigration dilutes the per capita variables, ceteris paribus, through a reduction in population ("population channel").

In addition, there are two implications when the employed can also move abroad. The first one concerns the labour market. If employed workers quit their jobs to emigrate, they free up jobs for the stayers, potentially mitigating the emigration of the unemployed. The second one is related to public finances. While the outflow of unemployed workers acts as an automatic fiscal stabilizer, the outflow of employed workers (net payers) shrinks the labour income tax base posing a challenge to the public treasury (Borjas et al., 2019a).

On the flip side, fiscal policy affects migration decisions in the current period and also through emigrants' expectations regarding the domestic fiscal stance and the perception of future austerity. In their review of the empirical literature on the effects of personal taxation, Kleven et al. (2020) stress that professions with little location-specific human capital may be quite responsive to taxes in their location decisions, even though systematic evidence on migration elasticities of income taxation of a broader population and across a larger group of countries is still scant.

Taking instead a quantitative theoretical approach, we build a Dynamic Stochastic General Equilibrium (DGSE) model of a small open economy (SOE) with sticky prices, fiscal details and search and matching frictions (see Section 3 in the Online Appendix for a graph of the joint evolution of emigration and unemployment in Greece).[4] Both the employed (through on-the-job search) and the unemployed have an incentive to migrate abroad where better wage and employment opportunities exist. We thus focus on the composition of emigrants in terms of their labour market status before departure, while abstracting from different skill types to keep the model tractable.[5] Apart from supplying labour, migrants pay taxes, buy the foreign consumption good and send remittances to the source country. The government engages in three types of spending: wasteful, utility-enhancing, and production-enhancing, financed via public debt and taxation.

Results. In our simulations for the Greek Depression, fiscal austerity accounts for almost one-third of the output decline and 12% of emigration, with the rest attributed to the macroeconomic environment, proxied by negative demand shocks. A counterfactual without emigration underpredicts the bust in output by one-sixth and the rise in the debt-to-GDP ratio by 8 percentage points. Rather than stabilizing the Greek business cycle, the mass exodus of workers exacerbated the recession by amplifying the drag in consumption, investment, vacancies and employment. Moreover, tax hikes and spending cuts have very different effects on emigration. Overall, the effects are more attenuated for cuts in wasteful government spending, as agents expect lower taxes in the future (positive wealth effect) and this not only curbs emigration but also sustains aggregate demand and, therefore, GDP and government revenues.

We then consider simple feedback rules for fiscal policy, which allow us to study the opposite direction of the emigration-austerity link. Through a positive analysis, we compare labour income taxes hikes and cuts in government spending when they are both designed to achieve the same reduction in the debt-to-GDP ratio. We find that tax hikes induce significant and persistent emigration. In turn, emigration implies an increase both in the tax hike and time required to meet a given debt target ("fiscal channel"). Intuitively, when people can "vote with their feet", austerity policies face a more elastic tax base and can potentially lead to higher public debt as the tax base erodes. The endogenous revenue leakage from the loss of taxpayers is translated into a reduction in consumption-tax receipts ("private demand channel") and the labour-income tax base. The higher tax hike required to reach the debt target depresses further both economic activity and the tax base. Despite the higher tax hikes, our model implies a smaller fall in the debt-to-GDP ratio, relative to a no migration scenario, even when only the unemployed emigrate. Our findings suggest that there is a "Detroit effect" when consolidation occurs through taxes: migration erodes the tax base and flattens the Laffer curve. Therefore, it becomes more difficult to raise revenue and reduce debt.

[3] World Bank data on remittances over GDP for 2013 are as follows: Ireland: 0.33%, Greece: 0.34%, Spain: 0.75%, and Portugal: 1.95%. A Hellenic Observatory survey reveals that only 19% of migrants send remittances, suggesting that h"emigration contributes mainly to the subsistence and/or the socioeconomic progress of the emigrants themselves and not of the household" (Labrianidis and Pratsinakis, 2016).

[4] The Online Appendix is available at the journal's webpage (https://ars.els-cdn.com/content/image/1-s2.0-S0165188922002433-mmc1.pdf).

[5] Around two-thirds of Greek emigrants were high-skilled (see, e.g, Triandafyllidou and Gropas, 2014, Labrianidis and Pratsinakis, 2016). In addition to this positive selection in terms of education, emigrants may also be more productive in other ways. For instance, Borjas et al. (2019b) find evidence of positive self-selection for Danish emigrants in terms of pre-emigration earnings and residual earnings. Decomposing the self-selection in total earnings reveals that unobserved abilities play the dominant role. Solely focusing on the years of schooling may thus underestimate the lost amount of human capital.

By amplifying the changes in internal demand (private consumption and investment), emigration increases the labour tax multiplier. For example, the cumulative labour tax multiplier after five years rises from 0.86 without migration to 1.27 with migration of the unemployed and 1.47 with migration of both the unemployed and the employed. Similarly, migration increases the multiplier for productive government spending, which is larger than one. Consistently, among the three types of public expenditure, cuts in productive spending exert the strongest impact on labour market variables and emigration, and they also induce the deepest contraction in per capita GDP, consumption and investment.

Cuts in wasteful and utility-enhancing spending seem to avoid the "Detroit effect". In these two cases, the model generates multipliers smaller than one, providing little migration incentive. The migration response along the time horizon depends on the opposite forces of a negative demand, Keynesian effect and a positive wealth effect. Indeed, we see a very small increase in emigration in the first five periods after the shock, while the response subsequently becomes negative but still small in magnitude. Driven by the positive wealth effect, which boosts consumption, return migration then amplifies the increase in consumption and mitigates the crowding-out of investment. As a result, migration lowers the value of these multipliers, but only after the eighth period.

Finally, as a shock absorber, emigration temporarily mitigates the per capita output costs of fiscal consolidation due to population loss ("population channel"). Yet, the unemployment gains from emigration may be reversed over time given the upward pressure on wages, which hampers job creation ("labour market channel"), and the distortionary effects of the higher tax hikes required to achieve the debt reduction ("fiscal channel"). Both for tax hikes and spending cuts, the emigration of the employed reduces further the short-run unemployment gains and reinforces the costs over time.

Related Literature.

Our paper brings together four strands of macroeconomics literature. First, we contribute to the vast research on fiscal multipliers. For instance, using U.S. data, Leeper et al. (2010) and Zubairy (2014) estimate multipliers for tax and aggregate government spending shocks in RBC and New Keynesian models, respectively. House et al. (2020) provide evidence that aggregate spending multipliers in Europe might have been larger than one in the Great Recession and this might have led to self-defeating austerity. Focusing on Spain, Anzoategui (2022) finds that the likelihood of self-defeating austerities depends on the magnitude of fiscal multipliers. Through the lens of our model, we show that emigration amplifies the labour tax multiplier and the productive government spending multiplier, which is a new finding in the literature.

Second, we extend the theoretical fiscal consolidation literature (see, e.g., Erceg and Lindé, 2012; Erceg and Lindé, 2013; Pappa et al., 2015; Philippopoulos et al., 2017; Bandeira et al., 2018; House et al., 2020) by considering an internationally mobile labour force. Our key finding is that a mobile labour force makes it more difficult for austerity policies to reach a certain level of debt reduction. This is in line with Storesletten (2000), where immigration is shown to increase U.S. tax revenues per capita and reduces government debt, serving as a deficit-financing alternative to tax hikes or spending cuts. By highlighting the role of emigration, our results also offer new theoretical underpinnings to the empirical literature on fiscal consolidation, pioneered by Alberto Alesina (see, e.g., Alesina et al., 2015; Alesina et al., 2019). This literature shows that adjustments through spending cuts are less recessionary than through tax increases and, from the point of view of debt sustainability, spending reductions are more potent means for improving the fiscal position and restraining debt growth than tax increases, especially when public debt is high (Fotiou, 2021).

Third, our paper is related to the literature on the Greek debt crisis using micro-founded macroeconomic models (see, e.g., de Córdoba et al., 2017; Gourinchas et al., 2017; Papageorgiou and Tsiaras, 2021; Chodorow-Reich et al., 2021; Economides, Papageorgiou, Philippopoulos). Most of this work has highlighted the significant contribution of fiscal austerity measures to the Greek output loss, a finding that we share. Our paper departs from this research by offering novel evidence on the role of emigration in that context.

Fourth, we extend the macroeconomics literature on migration. While existing work has primarily examined the consequences for the destination economies (see, e.g., Canova and Ravn, 2000; Chassamboulli and Palivos, 2014; Chassamboulli and Peri, 2015; Smith and Thoenissen, 2019; Mandelman and Zlate, 2012; Lozej, 2019), the literature investigating the implications of outward migration has predominantly focused on developing countries, mainly via empirical work or using a neoclassical framework.[6] An exception is the paper by Alessandria et al. (2020), which discusses a feedback loop between emigration and sovereign default with an application to Spain, absent fiscal austerity. Default risk induces emigration, which in turn intensifies default risk by lowering the tax base and investment. Our paper differs in that we focus on fiscal tightening and study the implications of emigration for the tax and spending multipliers. A paper closely related to ours is also Hauser and Seneca (2022), which develops a two-region New Keynesian DSGE model with matching frictions and labour mobility to study optimal monetary policy. Using a multi-country DSGE model with migration, House et al. (2022) show that, while for countries that primarily face demand shocks labour mobility stabilizes inflation and unemployment and improves welfare, for countries that face relatively more supply shocks labour mobility increases the cost of being in a currency union by magnifying inflation volatility. Instead, we focus on the interplay between emigration and fiscal austerity. Introducing labour mobility for the employed in a search and matching framework is a novelty of our model, which turns out to matter for the size of the labour tax multiplier.[7]

[6] See, e.g., Desai et al. (2009); Wilson (2008). For labour market effects of emigration see, e.g., Docquier et al. (2013), Mishra (2007) and the survey in Kapur and McHale (2012). For recent empirical work, see, e.g., Furlanetto and Robstad (2019), d'Albis et al. (2019) and Maffei-Faccioli and Vella (2021).

[7] In a framework without matching frictions, the dynamic trade model in Caliendo et al. (2019) features emigration of unemployed and employed households. For recent migration papers with search and matching frictions, see, e.g., Braun and Weber (2021) and Docquier and Iftikhar (2019).

Since we introduce cross-border on-the-job search in our model, a connection can also be established with the RBC literature featuring domestic on-the-job search (see, e.g., Dolado et al., 2009; Krause and Lubik, 2006; Tüzemen, 2017). Additionally, our analysis distinguishes between RBC supply-side effects (the loss of labour force which leads to a loss of aggregate demand) and New Keynesian demand-side effects (the feedback from this loss to general equilibrium and to government tax revenue).

Structure. Section 2 lays out the DSGE model and Section 3 discusses the calibration strategy. Sections 4 presents our simulations for the Greek Depression and Section 5 studies the role of emigration after fiscal austerity shocks. Section 6 examines the link between migration and fiscal multipliers through the lens of the model. Section 7 presents counterfactual exercises focusing on the debt-to-GDP ratio. Finally, Section 8 concludes.

2. A small open economy with labour force emigration

In this section, we build a small open economy New Keynesian DSGE model to assess the role of emigration in a deep recession when the government implements fiscal consolidation. Most of the model is a standard SOE NK model in the style of Gali and Monacelli (2008), taking foreign demand for goods and labour as given. There are two non-standard features that we consider: (i) labour market frictions and (ii) emigration of the labour force. We delegate the presentation of the formal model, along with a graphical illustration, to the Online Appendix and provide here an informal description as well as the key equations pertaining to unemployment and emigration.

2.1. Informal description of the model

Labour Market.

The labour market is governed by a standard search and matching (SAM) mechanism. SAM frictions allow us to model the emigration of the employed through on-the-job search (see below) and capture its differential impact relative to the emigration of the unemployed on public finances, as discussed in the Introduction. In SAM models, job creation responds to the incentives provided by the market. Firms open more vacancies when labour costs are low and potential gains from new jobs are large. Within such a framework, we can also account explicitly for the effect of emigration on job-creation incentives. We thus effectively capture a trade-off arising from the emigration of the employed members: on the one hand, it shrinks the tax base, which leads to the need for higher tax hikes to reduce the debt-to-GDP ratio; on the other hand, it frees up positions for the stayers. In addition, SAM frictions allow us to capture the wage effect of the on-the-job search through the Nash bargaining process. As we will see, the higher the intensity of the on-the-job search, the higher is the probability that workers resign, pushing down wages.

Goods.

The economy contains firms that operate at different stages of production. In the first stage, we have competitive firms that combine resident worker hours with effective capital and productive government expenditure to produce intermediate goods. The intensive margin of labour supply matters for the positive wealth effect of spending cuts, according to which the household increases consumption and reduces labour supply in expectation of lower future taxes. The adjustment of hours affects wages, which are important drivers of emigration, especially for the employed segment of the labour force.[8] Firms post vacancies at a cost. Wages and hours for resident workers are then determined by combining the firm's demand for labour, the household's supply of labour, and a simple Nash bargaining protocol that splits match surplus between the two parties. In the second stage, intermediate goods are sold to monopolistic retailers who are subject to price-setting frictions. In the third stage, these retail goods are combined with an imported good to generate final goods.

Price Setting.

All prices are flexible except for the retail goods that are subject to the standard Calvo pricing friction.

Asset Markets.

The household can hold foreign currency bonds that are associated with a risk premium, over the exogenous world interest rate. The risk premium is a function of actual relative to steady-state holdings. Firms are owned by households.

Monetary Policy.

The exchange rate is fixed and we assume lack of monetary policy independence. The nominal interest rate is pinned down endogenously through the Fisher equation.

Public Finances.

The government engages in three types of spending: wasteful, utility-enhancing, and production-enhancing, for which the model generates fiscal multipliers of substantially different size (see Section 6). Additionally, the government pays a fixed unemployment benefit to unemployed workers and lump-sum transfers to the household. Government expenditure can be financed via taxes on consumption, capital income, and labour income and/or public debt.

Households and Emigration.

We assume a continuum of identical households of mass one. In each household, there is a fixed number of nationals who can be residents or emigrate to work abroad. Emigrated workers can return to the source country via exogenous sepa-

[8] Variable capital utilization and hours allow output to react on impact to shocks given that employment is a state variable in our search and matching framework. The evolution of hours worked in Greece over the period under study is shown in Section 3 of the Online Appendix.

ration. Residents can be employed or unemployed.[9] Unemployed residents look for a job at home or abroad. Employed residents can continue working, become unemployed with an exogenous probability, or exert costly effort to find a job abroad with a certain probability. Residents and emigrants belong to a family, or representative household, that (imperfectly) pools income and takes consumption, savings, labour, and job search decisions, in line with evidence about strong family ties in Southern European countries (see, e.g., Alesina and Giuliano, 2014; Giuliano, 2007).[10] Consumption is a CES aggregate of public expenditures, resident consumption, and emigrant consumption. Utility is defined over consumption, an aggregate of hours worked (by residents and emigrants), and a utility penalty of emigration. Emigrants earn labour income abroad, which is split according to an exogenous rule between purchases of the foreign consumption good and remittances. The latter enter directly the representative household's budget constraint. Hours worked and wages abroad are exogenous and this effectively pins down emigrant consumption. The margin of adjustment comes from the number of emigrants, which is controlled by choosing employed's search effort for jobs abroad and the share of unemployed looking for domestic versus foreign jobs, effectively choosing the employment composition.

2.2. Key equations of the model

We use the asterisk $\star$ to denote foreign variables or parameters. Treating foreign variables as exogenous, we omit the time subscript. All quantities are in aggregate terms. Responses of per capita variables are shown in the results of Section 5.

Household Composition.

We assume a continuum of identical households of mass one. The number of nationals of each household is equal to constant $\hat{n}$ and comprises residents, who are employed n_t or unemployed u_t, and the stock of emigrants $n_{e,t}$,

$$\hat{n} = n_t + u_t + n_{e,t}\,. \tag{1}$$

Search and Matching.

An endogenous share $1 - s_t$ of the unemployed u_t search in the domestic labour market, while the remaining s_t look remotely for jobs abroad, facing an individual pecuniary cost given by an increasing function $\varsigma(\tilde{s}_t\tilde{u}_t)$, where $\tilde{s}_t$ and $\tilde{u}_t$ are the average shares of s_t and u_t per household.[11] This cost function (see Section 3 for the specific functional form) links positively the cost of search abroad with the measure of corresponding job seekers, helping to smooth out migration decisions by putting a brake to the search abroad. New matches m_t are given by

$$m_t = \mu_1(\upsilon_t)^{\mu_2}((1-s_t)u_t)^{1-\mu_2}, \tag{2}$$

where υ_t denotes vacancies, μ_1 measures the matching efficiency and μ_2 denotes the elasticity of matches with respect to vacancies. We define the standard probabilities of a job seeker to be hired $\psi_{H,t}$ and of a vacancy to be filled $\psi_{F,t}$,

$$\psi_{H,t} \equiv \frac{m_t}{(1-s_t)u_t} \text{ and } \psi_{F,t} \equiv \frac{m_t}{\upsilon_t}\,.$$

The employed n_t can exert effort z_t searching for a job abroad, where better fiscal and employment conditions exist. We denote by $\varphi(z_t)$ the productivity of on-the-job search effort, measured by the probability of finding a job abroad. Searching while employed is subject to a pecuniary cost $\phi(z_t)$, measured in units of the final good. We assume that $\varphi'(z_t) > 0$ and $\phi'(z_t) > 0$, with $\varphi'(z_t)/\varphi(z_t) < \phi'(z_t)/\phi(z_t)$ such that the on-the-job search effort is effectively costly (see, e.g., Krause and Lubik, 2006; Tüzemen, 2017). Domestic and emigrant employment, n_t and $n_{e,t}$, evolve according to

$$n_{t+1} = (1 - \sigma - \psi_H^\star\varphi(z_t))n_t + \psi_{H,t}(1-s_t)u_t\,, \tag{3}$$

$$n_{e,t+1} = (1-\sigma^\star)n_{e,t} + \psi_H^\star(s_t u_t + \varphi(z_t)n_t)\,. \tag{4}$$

where σ is the exogenous separation rate and $\psi_H^\star\varphi(z_t)$ captures endogenous separation for those who quit to take up a job abroad.[12] For simplicity, we assume equal hiring probabilities abroad for unemployed and employed of the representative

[9] Introducing a labour participation choice does not alter substantially our results (see Section 4 in the Online Appendix). The main impact is that fiscal consolidation leads to a decrease in participation (positive wealth effect) and therefore in the short-run unemployment rate. Keeping this out of the analysis allows us to isolate the effect of emigration on unemployment.

[10] For macro-migration models with a representative agent, see, e.g., Kaplan and Schulhofer-Wohl (2017); Mandelman and Zlate (2012), Binyamini and Razin (2008).

[11] A natural question is whether migration precedes search or search precedes migration. Given the possibility of search online for jobs abroad and the positive relation of available data to OECD migration data (see, e.g., Mamertino and Sinclair, 2019), we assume that emigrants depart with a job in hand. We can obtain similar results if we assume instead that (i) the unemployed relocate before being matched and (ii) there is contemporaneous timing in matching. For remote search and migration, see also Kaplan and Schulhofer-Wohl (2017).

[12] Focusing on cross-country rather than within-country wage differentials, we abstract from domestic on-the-job search, which would require modeling market segmentation. We calibrate the model to Greece where the job-to-job transition probability is low, amounting to 5% (Garda, 2016, Fig. 6A), and was even lower during the Great Recession (see section 4.3 in Casado et al., 2015).

household. Eq. (3) is equivalent to

$$n_{t+1} = (1-\sigma)n_t + \psi_{F,t}\upsilon_t\,, \tag{5}$$

which is convenient to use in the vacancy-posting decision of firms below.

Consumption Bundle.

The representative household derives utility from a consumption bundle Φ_t, composed of private consumption C_t and public consumption g_t^c,

$$\phi_t \equiv \left[(1-\alpha_1)(C_t)^{\alpha_2} + \alpha_1 (g_t^c)^{\alpha_2}\right]^{\frac{1}{\alpha_2}}\,, \tag{6}$$

where the elasticity of substitution is given by $1/(1-\alpha_2)$. In turn, C_t is composed of purchases by residents c_t and emigrants $c_{e,t}$,

$$C_t \equiv c_t + c_{e,t}\,. \tag{7}$$

Migrants' purchases of goods abroad $c_{e,t}$ are equal to their labour income minus remittances Ξ_t,

$$(1+\tau^{c\star})c_{e,t} = (1-\tau^{n\star})w^\star h_e n_{e,t} - \Xi_t\,. \tag{8}$$

We follow Mandelman and Zlate (2012) by assuming that the migrant labour income is part of a unified budget constraint, which allows to model migration as an inter-temporal decision of the household in the source economy. Since the household maximizes utility as a single entity, one cannot treat emigrants and residents as separate agents that choose consumption, labour and remittances independently. To avoid the problem of undetermined consumption allocation between the migrant and non-migrant members of the household, we use an insurance mechanism of remittances, similarly to Mandelman and Zlate (2012)[13],

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

Assuming $\rho_\Xi > 0$, improvements in the net wage premium abroad increase remittances, which represents an altruistic compensation mechanism between migrant and domestic workers. Note that we do not include cross-country differentials in unemployment benefits as we do not intend to study those as drivers of the migration decisions. Evidence from World Bank data suggests that the role of remittances has been very small in the recent emigration wave from Europe's periphery, which is captured in our calibration.

Household Utility, Budget and Assets.

The household suffers disutility from hours worked h_t, exogenous hours worked abroad h_e, and having family members abroad $n_{e,t}$. The latter captures different culture, food, and habits, distance from relatives and friends, less dense networks, and difficult integration.[14] The per period utility function is given by

$$U(C_t, g_t^c, h_t, n_{e,t}) = \frac{\Phi_t^{1-\eta}}{1-\eta} - \chi\frac{\left(h_t^{1+\xi}n_t + h_e^{1+\xi}n_{e,t}\right)}{1+\xi} - \Omega\frac{(n_{e,t})^{1+\mu}}{1+\mu}\,, \tag{10}$$

where η is the inverse of the intertemporal elasticity of substitution and the strictly positive parameters Ω, χ, μ, ξ refer to the disutility from hours worked and living abroad. The budget constraint in units of the final good is given by

$$\begin{aligned}(1+\tau^c)c_t + i_t + \frac{b_{g,t+1}}{r_t} - \frac{e_t b_{f,t+1}}{r_{f,t}} + \varsigma(\tilde{s}_t\tilde{u}_t)s_t u_t + \phi(z_t)n_t \\ \leq (1-\tau_t^n)w_t h_t n_t + \left[r_t^k - \tau^k\left(r_t^k - \delta_t\right)\right]x_t k_t + b_{g,t} - e_t b_{f,t} + e_t\Xi_t + \mathrm{b}u_t + \Pi_t^r + T_t\,,\end{aligned} \tag{11}$$

where $\phi(z_t)n_t$ and $\varsigma(\tilde{s}_t\tilde{u}_t)s_t u_t$ are the total costs of search for jobs abroad incurred by the employed and the unemployed, w_t is the hourly wage, r_t^k is the return on effective capital, b denotes unemployment benefits, T_t is lump-sum transfers, and e_t is the real exchange rate. Government bonds $b_{g,t}$ pay the return r_t, while $b_{f,t}$ denotes liabilities with the rest of the world with return $r_{f,t}$.[15] Profits Π_t^r from monopolistic retailers enter the budget constraint in a lump-sum fashion. Given that the household does not optimize over profits, we abstain from taxes on profits. Also, since our focus is on the labour mobility channel, we consider as fiscal instrument the labour income tax rate τ_t^n and treat the capital and consumption taxes τ^k and

[13] We abstract from endogenizing the allocation of immigrant income between remittances and consumption of the foreign good, which would require to assume that the household in the source country makes this decision or to model migrants as separate optimizing agents. Given that remittances increased much less than migration outflows from Europe's periphery in the aftermath of the Great Recession, such an endogenous choice is outside our scope.

[14] The labour economic migration literature emphasises that migration costs for most people are very high and, hence, long-distance migration is in most cases rare, even if the economic returns to migration would be high. The utility cost of migration is also useful in smoothing out migration decisions without assuming unrealistically high pecuniary costs of job search abroad when we study labour tax hikes.

[15] 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 peripheral countries of Europe (See Fig. 1 in Brutti and Sauré, 2016), supported by the secondary market theory of Broner et al. (2010).

τ^c as constant. The capital depreciation rate is δ_t and the degree of capital utilization is x_t. The household owns the capital stock, which evolves according to

$$k_{t+1} = \epsilon_{i,t}\left[1 - \frac{\omega}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2\right] i_t + (1-\delta_t)k_t\,, \tag{12}$$

where i_t is private investment, $\epsilon_{i,t}$ denotes an investment efficiency shock, and ω dictates the size of investment adjustment costs, which are critical to obtain smooth impulse responses with reasonable degrees of nominal rigidities. The depreciation rate δ_t depends on capital utilization x_t,

$$\delta_t = \bar{\delta} x_t^{\iota}\,, \tag{13}$$

where $\bar{\delta}$ and ι are positive constants. The risk premium depends on the actual relative to steady-state deviation of the net foreign liabilities to GDP ratio,

$$r_{f,t} = r^{\star} exp\left\{\Gamma\left(\frac{e_t b_{f,t+1}}{gdp_t} - \frac{\overline{eb_f}}{\overline{gdp}}\right)\right\}\epsilon_{r,t}\,, \tag{14}$$

where Γ is the elasticity, $\epsilon_{r,t}$ is a risk premium shock, and a bar above variables denotes steady-state values.

Household's Optimality Conditions.

We report the full set of first-order conditions of the household's problem in the Online Appendix and focus here on those that determine the values of employment in the two labour markets as well as the search for jobs abroad for the unemployed and the employed. Denoting by $\lambda_{n,t}$, $\lambda_{e,t}$, and $\lambda_{c,t}$ the Lagrange multipliers on Eqs. (3), (4), and (11), the optimality conditions with respect to s_t and z_t are given by

$$\begin{aligned}\lambda_{n,t} = \beta\Bigg[&E_t\lambda_{c,t+1}((1-\tau_t^n)w_{t+1}h_{t+1} - \mathrm{b} - \phi(z_{t+1})) - \chi\frac{h_{t+1}^{1+\xi}}{1+\xi}\Bigg]\\ &+\beta[E_t\lambda_{n,t+1}(1-\sigma-\psi_{H,t+1}-\psi_H^{\star}\varphi(z_{t+1})) + E_t\lambda_{e,t+1}\psi_H^{\star}\varphi(z_{t+1})]\,,\end{aligned} \tag{15}$$

$$\begin{aligned}\lambda_{e,t} = \beta\Bigg[&E_t\lambda_{c,t+1}((1-\tau^{n^{\star}})e_{t+1}w^{\star}h_e - \mathrm{b} + \varsigma(\tilde{s}_{t+1}\tilde{u}_{t+1})) - \chi\frac{h_e^{1+\xi}}{1+\xi} - \Omega(n_{e,t+1})^{\mu}\Bigg]\\ &+\beta[E_t\lambda_{e,t+1}(1-\sigma^{\star}-\psi_H^{\star})]\,,\end{aligned} \tag{16}$$

where β is the household' s discount factor. According to the two equations, the value of having a member employed in either labour market equates to the utility value of the net wage income, adjusted for the costs of search abroad, minus the disutility from supplying hours and in (16) of having members abroad, plus the continuation value of the match. This includes the expected value of continuing with the job without an exogenous separation, net of the value foregone because workers are not job seeking, captured by $\psi_{H,t+1}$ and $\psi_H^{\star}$ in (15) and (16). Eq. (15) also accounts for the fact that with probability $\psi_H^{\star}\varphi(z_{t+1})$ a current worker will quit to take up a job abroad.[16] Next, the optimality conditions with respect to s_t and z_t are given by

$$\psi_{H,t}\lambda_{n,t} = \psi_H^{\star}\lambda_{e,t} - \lambda_{c,t}\varsigma(\tilde{s}_t\tilde{u}_t)\,, \tag{17}$$

$$\lambda_{c,t}\frac{\phi'(z_t)}{\varphi'(z_t)} = \psi_H^{\star}(\lambda_{e,t} - \lambda_{n,t})\,. \tag{18}$$

Eq. (17) states that the values of job seeking in the domestic and foreign labour markets should be equal, where the latter is expressed net of the utility-adjusted moving cost. Finally, condition (18) states that the marginal costs of on-the-job search intensity, in units of consumption, must be equal to the excess relative value of working abroad subject to the job-finding probability.[17]

In a nutshell, the driving forces behind the migration decisions in our framework are as follows. For the emigration of the unemployed, the household takes into account differences at home and abroad in the net wage income and in the job-finding probabilities as well as the migration costs, which involve a pecuniary moving cost and a utility cost from living abroad. For the emigration of the employed, the household additionally takes into account the cost of the on-the-job search. Therefore, SAM frictions relate migration decisions to a broader set of labour market indicators, consisting not only of current wages, but also of the continuation value of labour-market participation as employed or unemployed.

[16] The Online Appendix includes the full derivation of Eqs. (15) and (16). The value of being employed includes the full foregone value of being unemployed, which in turn consists of the value of the unemployment benefit and the value of being matched to a job.

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

Vacancy Posting.

Intermediate goods are produced with a Cobb-Douglas technology,

$$y_t = (n_t h_t)^{1-\alpha} (x_t k_t)^{\alpha} \left(g_t^y\right)^{\nu}, \tag{19}$$

where g_t^y denotes productive public expenditure. Firms maximize the discounted value of future profits taking as given the number of workers currently employed n_t. They decide the number of vacancies posted υ_t so as to employ in the next period the desired number of workers n_{t+1}. Firms also decide the amount of effective capital $x_t k_t$ to rent at rate r_t^k from the household. The optimization problem can be written as

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

where $p_{y,t}$ is the relative price of intermediate goods with the final good being the numeraire, κ is the vacancy cost, 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 (5), with $\psi_{F,t}$ taken as given. As shown below, the optimality condition with respect to vacancies states that the marginal cost of hiring should equal the expected marginal benefit, given by the marginal productivity of labour minus the wage income plus the continuation value. The termination of the match occurs exogenously with probability σ and also endogenously due to cross-border matches $\psi_H^{\star} \varphi(z_{t+1})$.

$$\frac{\kappa}{\psi_{F,t}} = \mathrm{E}_t \beta_{t+1} \left[(1-\alpha) \frac{p_{y,t+1} y_{t+1}}{n_{t+1}} - w_{t+1} h_{t+1} + (1 - \sigma - \psi_H^{\star} \varphi(z_{t+1})) \frac{\kappa}{\psi_{F,t+1}} \right]. \tag{20}$$

The first-order condition with respect to effective capital is standard (see the Online Appendix).

Wage-Hours Bargaining.

Wages are determined by splitting the surplus of a match between the worker and the firm. Denoting by $\vartheta \in (0,1)$ the firms' bargaining power, the splitting rule is given by $(1-\vartheta)\left(1-\tau_t^n\right) S_t^F = \vartheta S_t^H$, where S_t^H denotes the worker's surplus and S_t^F denotes the firm's surplus. As shown in the Online Appendix, the equilibrium wage income $w_t h_t$ is given by

$$\begin{aligned} w_t h_t = {} & (1-\vartheta) \left\{ (1-\alpha) \frac{p_{y,t} y_t}{n_t} + (1 - \varphi(z_t)) \frac{\psi_{H,t}}{\psi_{F,t}} \kappa \right\} \\ & + \frac{\vartheta}{(1-\tau^n)} \left\{ \mathrm{b} + \frac{\chi}{\lambda_{c,t}} \frac{h_t^{1+\xi}}{1+\xi} + \phi(z_t) - \varphi(z_t) \varsigma(\tilde{s}_t \tilde{u}_t) \right\}. \end{aligned} \tag{21}$$

The term weighted by the workers' bargaining power $(1-\vartheta)$ includes the value of the marginal product of labour and the continuation value to the firm. The higher is on-the-job search effort, the higher is the probability that workers resign $\varphi(z_t)$, pushing down on wages. The term weighted by the firm's bargaining power ϑ includes the outside option of the unemployment benefit, the disutility from hours, and the costs of on-the-job search $\phi(z_t)$, net of the benefit from a match abroad of not incurring the cross-border search cost as unemployed $\varphi(z_t)\varsigma(\tilde{s}_t \tilde{u}_t)$. Finally, the determination of hours in equilibrium is shown in the Online Appendix.

Government.

Total government spending is given by,

$$g_t = g_t^w + g_t^c + g_t^y, \tag{22}$$

where g_t^w is the wasteful component, g_t^c is the utility-enhancing component and g_t^y is the productive component. The government budget constraint is given by

$$b_{g,t} = r_{t-1} b_{g,t-1} + \mathrm{b} u_t + g_t + T_t - \tau_t^n w_t h_t n_t - \tau^k (r_t^k - \delta_t) x_t k_t - \tau^c c_t. \tag{23}$$

For lump-sum transfers T_t, we assume that they evolve endogenously to keep the level of public debt constant in Section 4, while we modify this assumption in Section 5 by postulating that lump-sum transfers are held constant at their steady-state level since alternative fiscal instruments react to public debt.

Exports.

Exports depend on the domestic price divided by the real exchange rate,

$$y_{m,t}^{\star} = \left(\frac{p_{r,t}}{e_t} \right)^{-\gamma_x} \overline{y_m^{\star}} \, \epsilon_{y_m^{\star},t}, \tag{24}$$

where γ_x is the price elasticity, $\epsilon_{y_m^{\star},t}$ is a shock to the foreign demand for the exports of our small open economy, and $\overline{y_m^{\star}}$ is the steady-state level of exports, pinned down by the calibrated value of steady-state net foreign assets.

3. Calibration and model solution

In line with the annual frequency of the available data for the migration flows and the implemented fiscal austerity measures, which are relevant for our model-based simulations in Section 4, we calibrate the model annually with Greece at

Table 1
Calibration.

Description	Symbol	Value	Rationale
National accounts			
per capita GDP	gdp	1.00	normalization
private consumption / GDP	C/gdp	0.62	Eq. (29)
private investment / GDP	i/gdp	0.18	Eurostat data
imports / GDP	y_m/gdp	0.25	Eurostat data
public debt / GDP	$\bar{b}$	1.27	Eurostat data
net foreign assets / GDP	b_f/gdp	0.10	Eurostat data
remittances / GDP	Ξ/gdp	0.003	World Bank data
Preferences			
discount factor	β	0.96	4% interest rate
intertemporal elasticity	η	1.01	Hansen and Singleton (1983)
home bias in consumption	ϖ	0.75	imports / GDP
elasticity of hours worked	ξ	1.00	normalization
weight of hours worked	χ	0.5626	Eq. (17) in the Online Appendix
Production			
capital share in production	α	0.33	standard value
capital depreciation rate	$\bar{\delta}$	0.088	investment / GDP
elasticity home/imported goods	γ	1.65	Chodorow-Reich et al., 2021
elasticity of exports	γ_x	1.65	Chodorow-Reich et al., 2021
price monopolistic elasticity	ϵ	11	10% price markup
price Calvo lottery	λ_p	0.25	standard value
Labour market			
unemployment rate	$u/(u+n)$	0.12	Eurostat data
stock of migrants	$m_e/\bar{n}$	0.10	UN data
vacancy-filling probability	ψ_F	0.70	share of searchers abroad
job-finding probability	ψ_H	0.60	share of quitters
job-finding probability abroad	$\psi_H^\star/\psi_H$	1.60	7% foreign unemployment rate
firm's bargaining power	ϑ	0.383	Beqiraj and Tancioni (2014)
elasticity of matches to vacancies	μ_2	ϑ	Hosios condition
vacancy posting cost	κ	0.16	1% GDP total vacancy costs
net replacement rate	$b/[(1-\tau^n)w]$	0.41	OECD data
termination rates	σ, $\sigma^\star$	0.072	Pappa et al. (2015)
Migration			
on-the-job search effort	$\bar{z}$	1.00	normalization
on-the-job search productivity	φ_{z1}	0.0047	workers matched abroad
on-the-job search productivity	φ_{z2}	8.25	simulation targets
on-the-job search cost	ϕ_{z2}	9.0	simulation targets
unemployed's search cost	ς_{s2}	1.105	simulation targets
unemployed's search cost	ς_{s1}	0.7995	equations (13)-(16)
on-the-job search cost	ϕ_{z1}	0.0024	equations (13)-(16)
weight of migration in utility	Ω	0.8394	equations (13)-(16)
elasticity of migrants stock	μ	1.00	normalization
Policy			
elasticity risk premium	Γ	0.001	Schmitt-Grohé and Uribe (2003)
wasteful gov. spending / GDP	g^w/gdp	0.0533	Eurostat data
utility gov. spending / GDP	g^c/gdp	0.1048	Eurostat data
productive gov. spending / GDP	g^y/gdp	0.0512	Eurostat data
labour income tax	τ^n	0.289	Papageorgiou et al. (2012)
capital income tax	τ^k	0.172	Papageorgiou et al. (2012)
consumption tax (VAT)	τ^c	0.139	Papageorgiou et al. (2012)

Note: Simulation targets refer to the quantitative analysis in Section 4 where (a) migration outflows match the total magnitude of Greek emigration (equal to half a million people), (b) the average share along the simulation horizon of emigrants that were previously employed matches the survey evidence in Labrianidis and Pratsinakis (2016) reporting a share of 50 percent, and (c) on-the-job effort fluctuates within reasonable values.

the onset of the crisis (2008–2009) as our target economy. Table 1 shows the key parameters and steady-state values we target.

National Accounts.

The annual depreciation rate is calibrated to 8.8% to match the ratio of capital investment to GDP, which is 18% according to Eurostat data. Setting net foreign assets to 10% of GDP and remittances to 0.3% of GDP, in line with Greek data, pins down the net exports to GDP ratio. To match the ratio of imports to GDP, which is 25%, we assume a degree of home bias equal to 0.75. Together with the net exports to GDP ratio, this pins down the ratio of exports to GDP. In the policy paragraph below, we refer to the calibration of government spending (% GDP). The share of private consumption in GDP is then obtained as a residual. We also set public debt to 127% of GDP, in line with Greek data.

Preferences.

Following the DSGE literature, we set the discount factor β to 0.96, implying an annual real interest rate of 4%. For the inverse elasticity of intertemporal substitution η, much of the literature uses econometric estimates which place it between 0 and 2 (Hansen and Singleton, 1983). We fix it to unity, so that utility from consumption takes the logarithmic form. The elasticity of hours worked is fixed to 1, while the relative weight in utility χ is implicitly determined through the bargaining expression for hours (see Eq. (17) the Online Appendix). Hours are normalized in the steady state to unity. In the Online Appendix, we also explore a version of the model without the intensive margin. Following the literature on Edgeworth complementarity between private and public consumption (see, e.g., Bouakez and Rebei, 2007; Fève et al., 2013), we set $\alpha_2 = -0.75$. Using the household's first order conditions with respect to $g_{c,t}$ and c_t, allows us to pin down, $\alpha_1 = \left(1 + (1+\tau^c)(C(1-\zeta)/g_c)^{1-\alpha_2}\right)^{-1} = 0.2925$. [18]

Production.

The capital share takes the standard value of one-third and the steady-state price markup over marginal costs is set to 10%. Using the firm's first order condition with respect to $g_{y,t}$ in the steady state allows us to pin down, $\nu = g_y/y. = 0.05$. Using the estimate provided by Chodorow-Reich et al., 2021, we set the elasticity of substitution between domestically produced and imported goods γ as well as the export elasticity (i.e., the counterpart for the foreign elasticity of substitution) γ_x equal to 1.65. For the degree of investment adjustment costs ω, we assume that it is equal to 4. In addition to ω, the model's steady state is independent of the degree of price rigidities, which takes a standard annual value ($\lambda_p = 0.25$).[19]

Labour Market.

We normalize the measure of nationals $\hat{n}$ to unity, of which 10% reside abroad.[20] The unemployment rate is set equal to 12% according to the Greek figure during 2009–2010. We target an unemployment rate abroad which is lower almost by half (7%) by calibrating the job-finding probability abroad to be 60% higher. Assuming a relatively mild wage premium abroad, i.e., $w^\star/w = 1.2$, helps us to moderate migration costs. Specifically, our calibration implies that per job match abroad, search costs as a share of the wage amount to 55% and 47% for the unemployed and the employed respectively, or total costs of search abroad correspond to 0.4% of GDP. For simplicity, we assume that the termination rates in the two labour markets are equal amounting to 7% (see also Pappa et al., 2015). The efficiency of the matching technology μ_1 is pinned down by setting the vacancy-filling and job-finding probabilities equal to 0.7 and 0.6 respectively, which, using the laws of motion of employment the two labour markets, implies a reasonable steady-state share of unemployed looking for jobs abroad of 6.5%. Our calibration also implies that 34.5% of migration outflows (household members newly matched to a job abroad) are current workers. This number will be the starting point in Section 4, where the model matches over the simulation horizon an average share of 51% previously employed Greek emigrants, in line with the survey evidence in Labrianidis and Pratsinakis (2016). We calibrate the net replacement rate $b/[(1-\tau_n)w] = 0.41$ in line with data from the OECD Benefits and Wages Statistics. The vacancy cost parameter κ is set such that total vacancy posting costs represent just under 1% of GDP. We enforce the Hosios condition by setting the elasticity of matches to vacancies equal to the bargaining power of firms, $\mu_2 = \vartheta = 0.38$. The implied value for workers' bargaining power is therefore $1 - \vartheta = 0.62$, which is close to the 0.72 estimate for unions' bargaining power in Greece over the period 1980–2012 in Beqiraj and Tancioni (2014). For firms' bargaining power, we also investigate results for a higher value (equal to 0.7) in Section 4 of the Online Appendix.

Search Abroad and Migration.

In the steady state, net migration flows are zero. For the costs of job search abroad and the productivity of on-the-job search effort, we adopt the following functional forms, $\varsigma(\tilde{s}_t\tilde{u}_t) = \varsigma_{s1}(\tilde{s}_t\tilde{u}_t)^{\varsigma_{s2}}$, $\phi(z_t) = \phi_{z1}(z_t)^{\phi_{z2}}$, $\varphi(z_t) = \varphi_{z1}(z_t)^{\varphi_{z2}}$. We normalize z to 1 and use φ_{z1} to determine the steady-state number of workers that are matched to a job abroad. The scale parameters ς_{s1} and ϕ_{z1}, and the weight on the utility cost of migration Ω, are implicitly determined by conditions (15)–(18) in the steady state. We set φ_{z2}, ϕ_{z2}, ς_{s2} such that in our simulations (a) migration outflows match the total magnitude of Greek emigration (equal to half a million people), (b) the average share along the simulation horizon of emigrants that were previously employed matches the survey evidence in Labrianidis and Pratsinakis (2016) reporting a share of 50%, and (c) on-the-job effort fluctuates within reasonable values.[21] The elasticity of the utility cost of living abroad μ is then normalized to 1. In the absence of this utility cost, the ratio of pecuniary searching costs to GDP would have to be unrealistically high to reproduce the magnitude of Greek emigration. For the elasticity parameter ρ_Ξ in the rule for remittances, we assume an arbitrarily low value, equal to 0.05, to virtually mute this channel in our simulations, given the evidence suggesting that remittances did not play a meaningful role during the Greek depression.

Policy.

[18] The productive and utility-enhancing public goods are provided for free. However, to find their optimal levels, we equate the marginal productivity of each of the public goods to its price, which is equal to that of the private consumption good (our numeraire).

[19] We abstract from wage rigidities as we found very little impact annually.

[20] Data from the UN Population Division at the Department of Economic and Social Affairs shows that the share of nationals living abroad in 2015 was above 8% for Greece, 19% for Ireland, 22% for Portugal, and close to 5% for Spain and Italy. All numbers were higher compared to the previous data points for 2010.

[21] For instance, with $\varphi_{z2} = 1$, z_t could more than triple in our simulations to generate the same number of workers moving abroad. Krause and Lubik (2006) look at on-the-job search in the domestic market and set $\varphi_{z1} = \varphi_{z2} = 1$, while letting the steady-state value of search effort $\bar{z}$ determine the number of low paid workers moving to a better job. They calibrate the job-to-job transition rate to be 6%, whereas here the comparative measure would be below 0.45%. This difference in magnitudes explains why we opt for $\varphi_{z2} > 1$.

The elasticity of the spread between domestic and foreign interest rates Γ is set equal to 0.001 (Schmitt-Grohé and Uribe, 2003). For the steady-state output shares of the government spending components, we use annual Greek data from Eurostat. Specifically, for g^w we use *Government's Final Consumption Expenditure*, taking out the compensation of employees (which we do not model) and consumption expenditure in the health and education sectors; for g^y we use *Government's Gross Capital Formation* and for g^c we use *Government's Expenditure in Health and Education*, taking out the amount used in these sectors for *Gross Capital Formation* to avoid double counting with the previous item. The consumption, capital and labour tax rates are set to 13.9%, 17.2% and 28.9% respectively, corresponding to the values of the effective tax rates in Greece for 2009 in Table 1 of Papageorgiou et al. (2012).

Next, we work as follows. In Section 4, we feed in the model negative demand shocks that try to mimic the experience of Greece in the aftermath of the Great Recession, along with the paths of the fiscal instruments from the data (2010–2015). We use Dynare to solve a first-order approximation of the model and then use the reduced form solution of the approximated model to simulate the model with the sequence of unexpected shocks. In Section 5, we feed in a shock that leads gradually to a 5% reduction in the debt-to-GDP target, use feedback fiscal policy rules and solve the model by linearizing the equilibrium conditions around a non-stochastic steady state. The parameterization of the fiscal rules is such that, in the absence of emigration, the debt-to-GDP ratio meets the new lower debt target after 10 years.

4. Quantitative analysis

In this section, we offer a model-based anatomy of the Greek Depression, which stands out as an example of public debt crisis and implementation of fiscal austerity policies. We study jointly the impact of thefiscal mix implemented and the amplification through the emigration channel.

4.1. Methodology

Our calibration targets the magnitude and composition of the emigration wave in Greece by aiming to match (a) a total outflow of half a million during the period 2010–2015 and (b) a share of around 50% of emigrants that had a job before departure (Labrianidis and Pratsinakis, 2016). As shown in Section 3 of the Online Appendix, annual migration inflows throughout this period remained constant at around 60K, below their pre-crisis level, and started to pick up again after 2015.

Starting the economy at its steady state, we feed in the model the actual annual values of the four fiscal consolidation instruments for the period 2009–2015 (see Fig. 3a). All public expenditure paths are inputted as shares of 2009 GDP. Note that the Eurostat does not supply: (a) quarterly statistics on government spending by function, such as government spending or compensation of employees in health and education, which we need to split final government expenditure into wasteful and utility-enhancing spending; (b) quarterly sectoral data on "Households; non-profit institutions serving households" or on "Taxes on individual or household income including holding gains", which we need to calculate the labour tax rate.

Under the informational assumption of random walk, the household expects the current fiscal policy stance to remain the same in the next period, so any change is entirely unanticipated. This assumption is justified given that many ex post unanticipated changes in the fiscal packages were implemented due to failure of previous plans and mid-course revisions, and is in line with the annual frequency of the emigration data. For lump-sum transfers, we assume that they evolve endogenously to keep the level of public debt constant. In other words, lump-sum transfers are calculated as the exact mirror image of the government deficit (including interest payments) each year. We allow for public debt to evolve endogenously in Sections 5 and 7.

We use Dynare to solve a first-order approximation of the model and then use the reduced form solution of the approximated model to simulate the model with a sequence of unexpected shocks. We proxy the macroeconomic environment through a combination of a risk premium shock, a negative investment-efficiency shock, and a negative foreign demand shock (see Eqs. (14), (12) and (24)), which follow an auto-regressive form with one lag and coefficient $\rho = 0.75$. Specifically, we use risk premium shocks to match the response of consumption to the data from 2010 to 2015, investment efficiency shocks to match the response of investment over the same period, and external demand shocks (shocks to Greek exports) to adjust the response of GDP so that it too matches the data. The shocks are calibrated jointly.[22] Fig. 3a plots the simulated shocks for the period under study. Note that we have also tried negative supply side (TFP) shocks as an alternative to risk premium shocks. The results (available upon request) are very similar except mainly for the fact that negative TFP shocks are inflationary, which is not a desirable outcome for the context of our exercise.

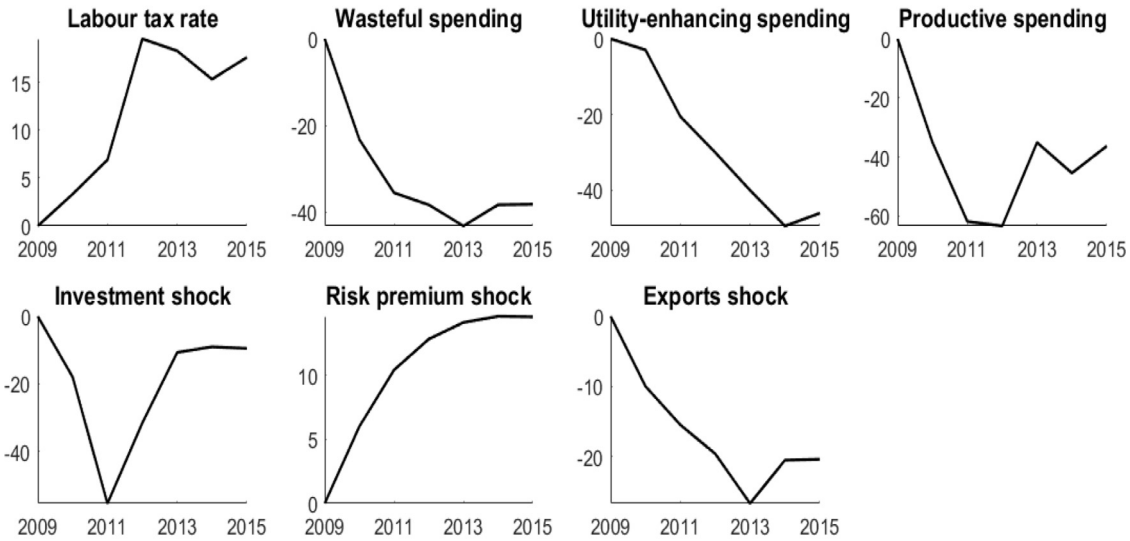
4.2. Results

We now turn to our findings, followed by a set of counterfactual exercises. We compare results for three variants, with: (i) no emigration, (ii) emigration of the unemployed, (iii) emigration of the unemployed and employed.[23]

[22] We target the paths of GDP, consumption, and investment in units of the final good, consistently with our model (see, e.g., Eq. (28) in the Online Appendix). To this end, we divide nominal quantities with the harmonized index of consumer prices (HICP) using data from Eurostat.

[23] We eliminate potential steady-state differences by working with the full model (iii), setting all variables related to migration and on-the-job search abroad to their steady-state values for models (i) and (ii), i.e., shutting down the option to emigrate. Calibration remains unchanged.

(a) Paths of the fiscal instruments and of the shocks



(b) Number of emigrants and labour market status prior to emigration

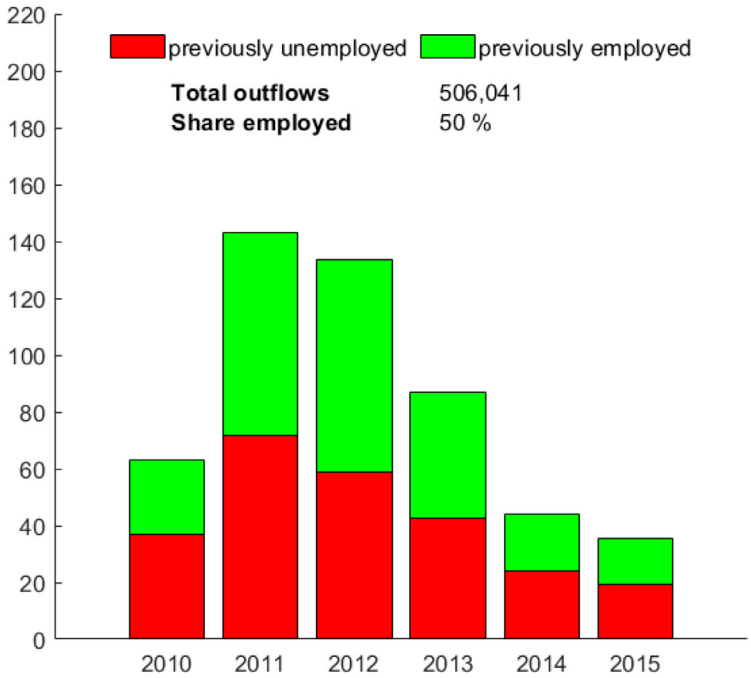


Fig. 3. Quantitative Analysis: Fiscal Instruments and Migration Outflows Note: Data for 2009 is normalized to zero. The figure plots deviations (%).

4.2.1. Baseline calibration

Fig. 3b shows the predicted number of emigrants by employment status before departure and calculates the total emigration wave in Greece until 2015. As targeted, the model generates total migration outflows of 506,041 persons, which matches closely the data from the Hellenic Statistic Authority for emigrants aged 15–64 during the period 2010–2015. The share of employed emigrants from our simulations is 50%, again very close to the survey evidence in Labrianidis and Pratsinakis (2016).

(a) Baseline calibration

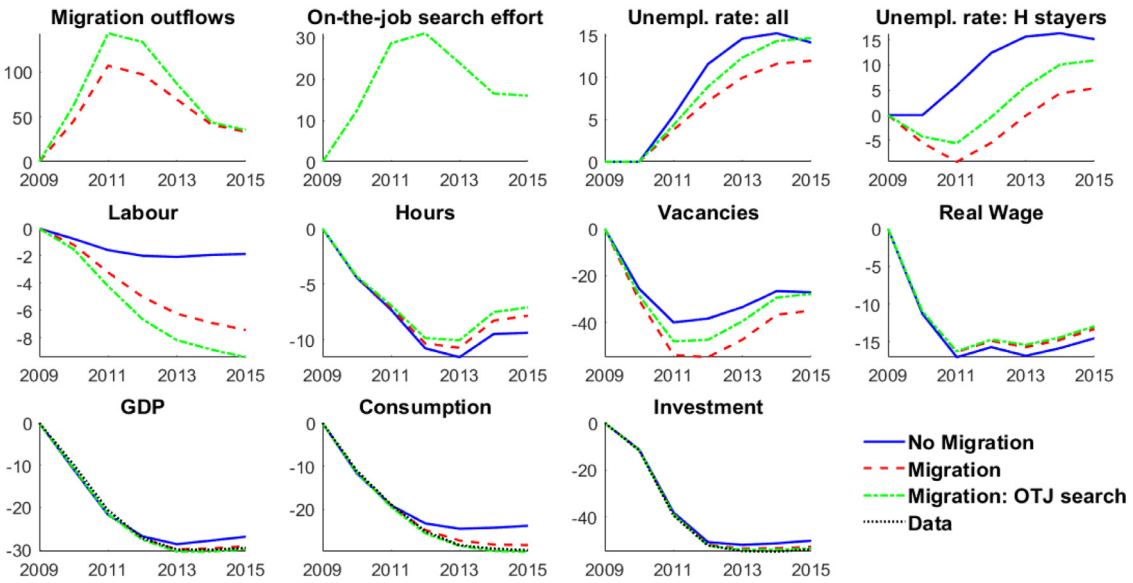


Fig. 4. Quantitative Analysis: Results Notes: Responses for migration outflows are in level deviations from steady state (thousand persons). All other responses are in percent deviations from steady state. Consumption refers to the domestic good. Unempl. rate: H stayers excludes the unemployed targeting a job abroad. OTJ denotes on the job.

Fig. 4 a shows the simulation results for migration, unemployment, vacancies, employment, the real wage, hours, consumption, investment and GDP, using solid lines for model (i), dashed lines for model (ii), and dash-dotted lines for the full model (iii). The model generates a significant increase (close to 30% at peak) in the intensity with which current workers look for employment abroad. Consumption, investment, and GDP decline following closely the actual path of the data depicted by the dotted lines for comparison. Both consumption and investment, and as a result labour demand (vacancies) and employment, fall by more in the presence of emigration.

The model without migration underestimates the actual output contraction in 2013 by around 15%. Although we block the on-the-job search channel used by half of the emigrants in the full model (by not allowing the employed to migrate), total emigration is reduced by less than half. This is because the emigration of the employed frees up positions for the stayers. When the employed cannot leave the country, the unemployed face a lower job finding probability in Greece, with lower vacancies being posted by firms, which leads more unemployed to look for a job abroad.

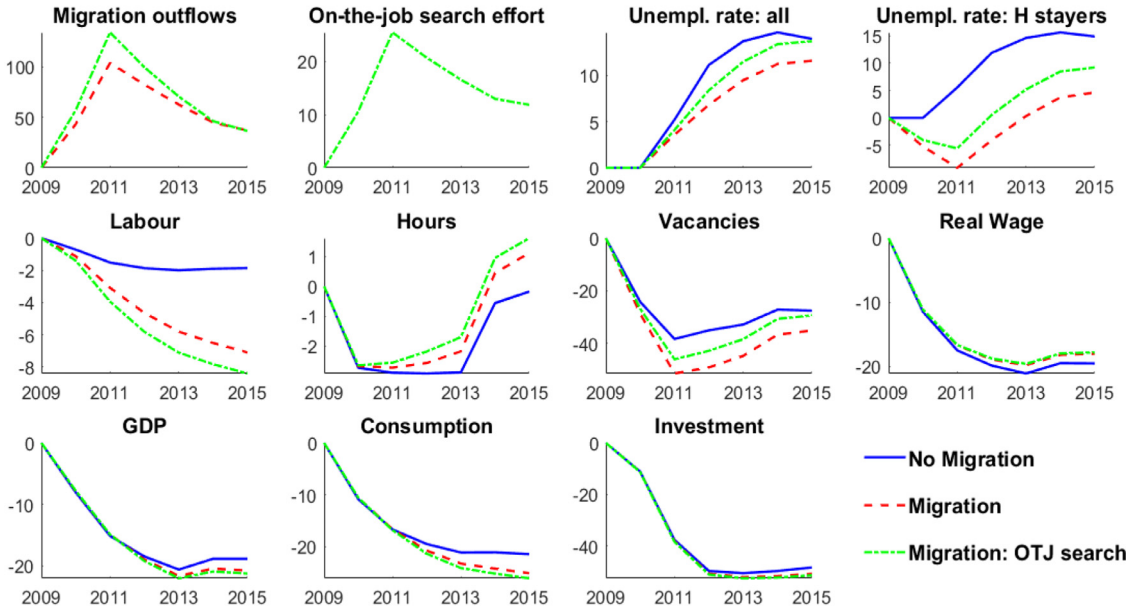
The model predicts a steady increase in unemployment after 2010, even though the magnitude falls short of the data, since the unemployment rate in Greece almost doubled between 2010 and 2015. We view this as a manifestation of the "Shimer puzzle" (see also Section 4 of the Online Appendix). Emigration helps to mitigate the increase of all Home nationals' unemployment (*Unempl. rate: all*). Note that the unemployment rate in the first year of fiscal changes (2010) does not move, as employment is a state variable. A second measure including only the unemployed who target domestic jobs (*Unempl. rate: stayers*) is shown to vary from 2010 and, as expected, this measure reveals stronger differentials between the models with and without emigration. Until 2013, unemployment for stayers decreases due to emigration. In addition to this, we also observe differences between the no-migration and migration models from the early period 2009–2011 for employment and vacancies. For output and investment, differences between the two models arise from 2012 onward when labour tax hikes were significantly higher (see Fig. 3a).[24]

4.2.2. Tax hikes and spending cuts: Contribution to the recession and differential migration impact

Next, we present simulation results without the fiscal austerity mix (see Fig. 5a) and without the negative demand shocks (see Fig. 5b). The macroeconomic environment, proxied by the demand shocks, accounts for roughly two-thirds of

[24] Section 4 of the Online Appendix includes a sensitivity analysis for a higher firm's bargaining power, which amplifies the reaction of unemployment and other labour market variables. It also includes a sensitivity analysis for endogenous labour market participation and the absence of the intensive margin from the model, as well as a discussion on the potential implications of skills heterogeneity. The qualitative results remain essentially the same with the exception of the short-term increase in unemployment brought about by fiscal consolidation when agents can choose participation. However, when we run the simulations without hours, having adjusted the size of the shocks and the calibration of the migration costs to hit our simulation targets (i.e., the paths of GDP, consumption, and investment, as well as the total number of emigrants and the share of the employed in total emigrants), migration costs become lower relative to the baseline model with hours. As a result, when we study labour tax hikes in Section 5 (Fig. 6), migration outflows become too high and the model becomes unstable. Note also that the inclusion of hours matters for the size of the spending multipliers generated by our model (see Section 6). Finally, if we allow for more meaningful role for remittances, emigration no longer magnifies the decrease of consumption and GDP.

(a) The role of the negative demand shocks (to the risk premium, investment efficiency and exports)



(b) The role of the fiscal austerity mix

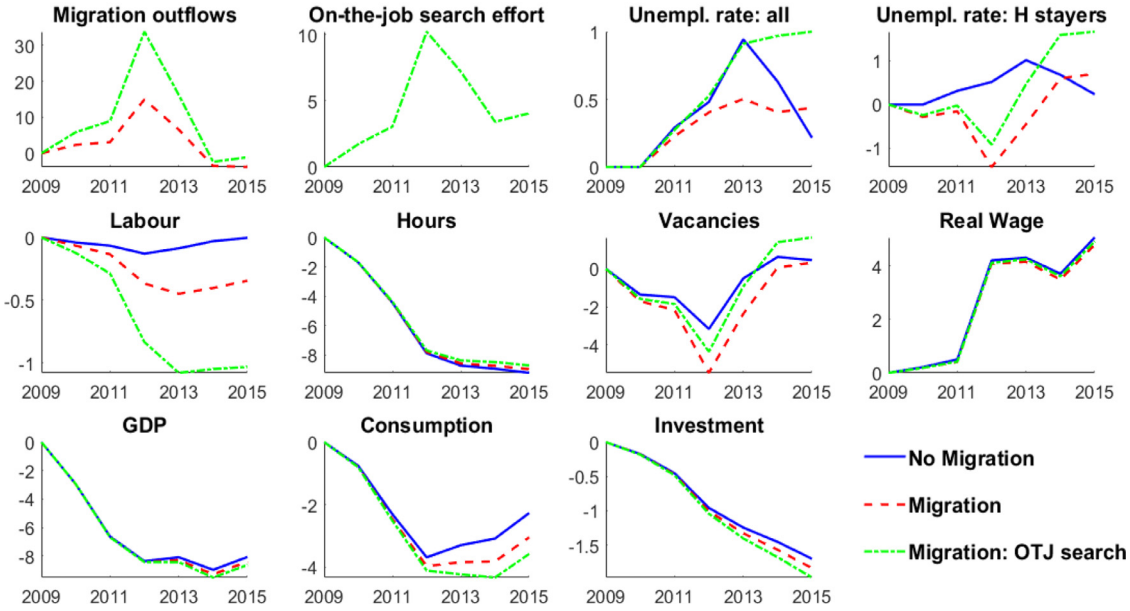


Fig. 5. Quantitative analysis: counterfactual exercises notes: see also Fig. 4.

the output decrease and close to 87% of migration outflows during the Greek Depression. It then follows that fiscal austerity alone accounts roughly for roughly one-third of the output decrease and 13% of migration outflows. Wages, vacancies, and emigration respond more to the recessionary shocks than to the fiscal austerity mix.[25]

[25] Sections 5 and 6 of the Online Appendix present impulse responses to simple AR(1) risk premium and investment efficiency shocks (by linearizing the equilibrium conditions around a non-stochastic steady state). To ensure determinacy of equilibrium and a non-explosive solution for debt, we assume that

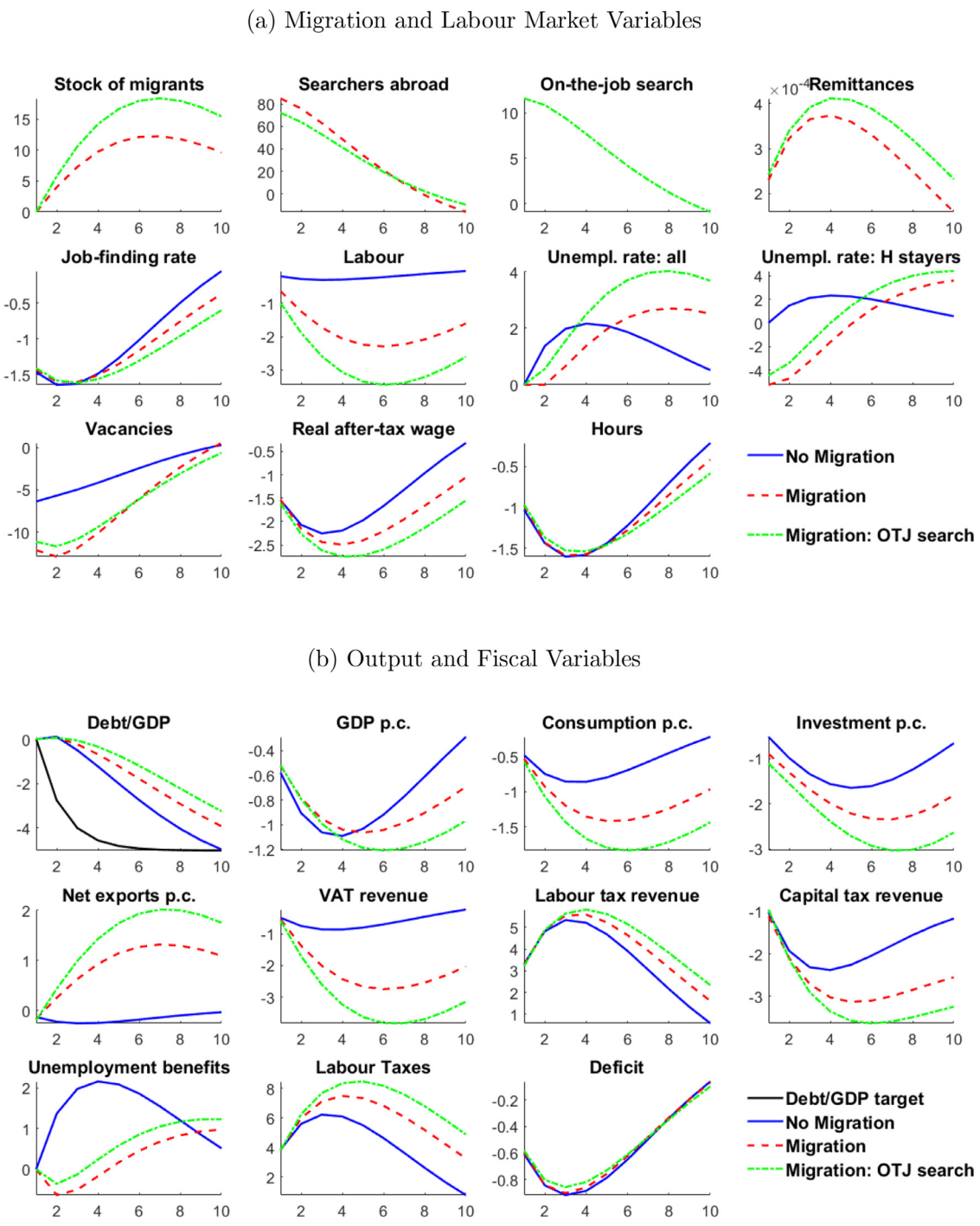


Fig. 6. Labour tax hikes and emigration notes: responses for the job-finding rate and net exports are in levels. All other responses are in percent deviations from steady state. Consumption refers to consumption of the domestic good. Unempl. rate: stayers excludes the unemployed targeting jobs abroad. OTJ denotes on the job and p.c. denotes per capita.

The inclusion of tax hikes or spending cuts alone in the model reveals their differential migration impact (see Section 4.1 in the Online Appendix). Spending cuts generate a very small reduction in migration outflows relative to the steady state of

lump-sum transfers react to the debt-to-GDP ratio $\tilde{b}_{g,t}$ through a standard rule $T_t = \overline{T}\exp(\zeta_b(\tilde{b}_{g,t} - \bar{b}))$, where $\bar{b}$ is the steady-state level of $\tilde{b}_{g,t}$ and $\zeta_b < 0$. All other fiscal instruments are held constant at their steady-state levels. Most of the findings from Fig. 5a continue to hold.

the model, while labour tax hikes increase emigration. The migration path for spending cuts is confirmed also in counterfactual exercises with cuts only in wasteful or utility-enhancing or productive expenditure. For each spending component, the small reduction in outflows follows in shape the path of the instrument (see Fig. 3a). The magnitude is larger for the component with the largest output share, which is utility-enhancing spending (see Table 1). Vacancies and the real wage decrease for productive spending cuts, which imply a fall in firms' productive capacity and the marginal product of labour. After cuts in utility-enhancing expenditure, consumption falls due to the complementarity effect. Finally, after wasteful or utility-enhancing spending cuts, the real wage falls initially, driven by a short-lived negative demand effect, but then rises. In the case of wasteful expenditure cuts, the wage rise is driven by the standard positive wealth effect, which increases consumption.

In Section 6, we further discuss the differential impacts of the three government expenditure types and the associated fiscal multipliers.

5. Fiscal austerity shocks: the role of emigration

What are the implications of labour mobility for the success of fiscal consolidations in meeting a given debt target? In Section 4, using in our model the actual austerity mix implemented in Greece, we found starking differences in the effects of tax hikes and spending cuts on emigration. Since the link between emigration and fiscal austerity is bi-directional, in this section we consider simple feedback rules for fiscal policy, which allow us to study the opposite direction of the relation. Unlike Section 4 where lump-sum transfers adjust to balance the government budget, here we assume that alternative policy instruments adjust to gradually reduce the debt-to-GDP ratio. In this setup, we compare, in the presence of emigration, the output and unemployment effects of the various fiscal consolidation policies when they are all designed to achieve the same reduction in the debt-to-GDP ratio after a given period of time.

5.1. Feedback policy rules and fiscal consolidation

Following Erceg and Lindé (2013) and Pappa et al. (2015), we focus on consolidation through labour income tax hikes and government spending cuts, and study how the economy reacts to shocks to the target debt-to-GDP ratio (so that a consolidation is a reduction in this target ratio), when the relevant instrument follows an autoregressive rule that adjusts at a given speed to ensure that the target ratio is hit in the long-run. Specifically, the active fiscal instrument evolves depending on the discrepancy between the debt-to-GDP ratio $\tilde{b}_{g,t} \equiv \frac{b_{g,t}}{gdp_t}$ and an exogenous target $b^T_{g,t}$, and the discrepancy between their changes, denoted by Δ,

$$\Psi_t = \Psi^{(1-\beta_{\Psi 0})}\ \Psi_{t-1}^{\beta_{\Psi 0}} \left[\left(\frac{\tilde{b}_{g,t}}{b^T_{g,t}} \right)^{\beta_{\Psi 1}} \left(\frac{\Delta \tilde{b}_{g,t+1}}{\Delta b^T_{g,t+1}} \right)^{\beta_{\Psi 2}} \right]^{(1-\beta_{\Psi 0})}, \tag{25}$$

where $\beta_{\Psi 1}, \beta_{\Psi 2} > 0$ for $\Psi = \tau^n$ and $\beta_{\Psi 1}, \beta_{\Psi 2} < 0$ for $\Psi = g^f$, where $f = w, c, y$. We consider each instrument separately, assuming that if one is active, the others are fixed at the steady-state. The target debt-to-GDP ratio is given by the AR(2) process,

$$\log b^T_{g,t} - \log b^T_{g,t-1} = \rho_1 (\log b^T_{g,t-1} - \log b^T_{g,t-2}) + \rho_2 (\log \bar{b} - \log b^T_{g,t-1}) - \varepsilon^b_t, \tag{26}$$

where $\bar{b}$ is the steady-state level of the debt-to-GDP ratio, ε^b_t is a white noise process representing a fiscal consolidation shock, $0 \leq \rho_1 < 1$ and $\rho_2 > 0$. By introducing strong inertia through the AR(2) process, we model a gradual (effectively permanent) reduction in the debt target (see also Erceg and Lindé, 2013, Pappa et al., 2015, Bandeira et al., 2018).[26]

We solve the model by linearizing the equilibrium conditions around a non-stochastic zero-inflation steady state with flexible prices. The price of the final good and the real exchange rate are normalized to unity. We design a theoretical exercise as follows. We assume that the level of each fiscal instrument (labour income tax rate or government spending) is set in each period so as to achieve a reduction in the debt-to-GDP ratio of 5% after ten years in an economy without emigration. The parameterization of the fiscal and debt-target rules, shown in Table 2, implies that the debt-to-GDP ratio converges to the new lower target after 10 years following a fiscal consolidation shock (ε^b_t). Allowing, then, for emigration to take place, we study its role after fiscal austerity shocks.

5.2. Labour tax hikes

We first consider $\Psi = \tau^n$ in the feedback policy rule (25). Fig. 6 depicts the impulse responses to a tax-based consolidation.

No Emigration (solid lines). Given the drop in after-tax income, consumption and investment both fall, which is translated into a reduction in VAT revenue and capital tax revenue. The fall in demand reduces vacancies, the job finding probability

[26] Studying the possibility of sovereign default is beyond the scope of our paper.

Table 2
Parameterization of the fiscal and debt-target rules.

Rules	Parameters	Values	Target(s)
debt target	ρ_1, ρ_2	0.45, 0.000001	5% below SS in 10 yrs, half convergence in 5 yrs
τ^n	$\beta_{n0}, \beta_{n1}, \beta_{n2}$	0.75, 3.3, 6	debt/GDP meets new target in 10 yrs
g^w	$\beta_{gw0}, \beta_{gw1}, \beta_{gw2}$	0.35, -5.5, -7	debt/GDP meets new target in 10 yrs
g^c	$\beta_{gc0}, \beta_{gc1}, \beta_{gc2}$	0.35, -3.35, -5	debt/GDP meets new target in 10 yrs
g^y	$\beta_{gy0}, \beta_{gy1}, \beta_{gy2}$	0.35, -9, -10	debt/GDP meets new target in 10 yrs

Note: SS denotes steady state, yrs denotes years, and g^w, g^c, g^y refer to wasteful, utility-enhancing, productive spending, respectively. For each fiscal consolidation instrument, the actual debt-to-GDP ratio meets the new lower target in 10 years in the baseline model without migration.

and employment, and so unemployment and payments of benefits rise. Tax hikes decrease hours by disincentivizing work. We also see that net exports move very little, while GDP declines.

Emigration of Unemployed (dashed lines).

The household raises the share of foreign-job seekers. Relative to the results of the previous paragraph, there are four main findings. First, emigration offers an extra outside option for workers in negotiations and therefore sustains higher wages, which in turn leads to a more pronounced fall in employment. Second, the unemployment gains from the exodus of job seekers with successful matches abroad are temporary as the unemployment rate rises over time more strongly, due to the more pronounced fall in employment and the shrinking labour force. Third, emigration affects positively the government budget through a reduction in unemployment benefits and negatively through a leakage in VAT revenue and capital tax revenue. The negative impact prevails, which implies that the debt-to-GDP ratio falls more slowly, requiring more time to meet the new target and a higher tax hike. Fourth, the higher tax hike also leads to a higher fall in per capita consumption and investment. Per capita GDP initially falls by less, given that the reduction of resident population implies a reinforced increase of per capita net exports, but after the fourth period the decline is stronger than in the no mobility scenario.

Emigration of Unemployed and Employed (dash-dotted lines).

Tax hikes significantly increase the intensity with which workers look for employment abroad, raising further the stock of migrants, while slightly mitigating the search abroad of the unemployed in the first half of the horizon. The exodus of the employed reduces (increases) the short-run (medium-run) unemployment gains (costs) from emigration due to the deeper demand and output contraction. The increase in per capita net exports is further reinforced. On the fiscal side, the drop in VAT revenue becomes more pronounced. A higher labour income tax hike is required for a longer time (more than two years) to achieve the given debt reduction.

5.3. Spending cuts

Next, we consider $\Psi = g^w$ in the feedback policy rule (25). Fig. 7 depicts the impulse responses to cuts in wasteful government spending.

No Emigration (solid lines).

Due to the negative aggregate demand effect with sticky prices (see the resource constraint in Eq. (24) of the Online Appendix), vacancies, the job finding rate, employment, labour tax revenue and per capita GDP fall, while unemployment rises. The wage initially goes down, given the drop in labour demand, but then increases slightly, given a reduction in labour supply. The latter comes from the standard positive wealth effect (expectation of lower future taxes) for the household, which reduces hours and increases consumption and investment. VAT revenue and capital tax revenue rise aiding the fiscal consolidation effort. The drop in wages and marginal costs increases the competiveness of the economy and net exports rise.

Emigration of Unemployed (dashed lines).

The household initially increases the share of searchers for jobs abroad due to the negative demand, Keynesian effect of spending cuts, but the increase is of significantly lower magnitude and persistence than under tax hikes, which directly distort labour incentives. Emigration mitigates the increase in consumption and reinforces the decline of employment. Relative to the no-migration model, aggregate investment rises by less but the reduction in the resident population drives a higher rise of per capita investment. Unemployment gains from the unemployed's exodus are short-lived and turn later to higher costs due to the reinforced employment decline. After the fourth period when the size of the cuts decreases relative to the impact period, the share of foreign-job searchers falls below its steady-state level while vacancies, the job finding rate and the wage rise above the steady state (after the sixth period). The positive wealth effect therefore becomes dominant. By implying some persistence in spending cuts, the feedback policy rule matters for the turning point of the emigration response. Section 10 of the Online Appendix shows that for a 1% cut in public spending, when the latter follows alternatively a simple autoregressive rule, the emigration response turns negative even earlier. Finally, due to the small emigration response overall, the fall in per capita GDP from the drag in aggregate demand hardly differs from the no-migration scenario. The same holds for the debt-to-GDP ratio: the negative emigration impact on VAT revenue is offset by lower unemployment benefits expenditure. In Section 5.4, we show that a higher degree of price stickiness can

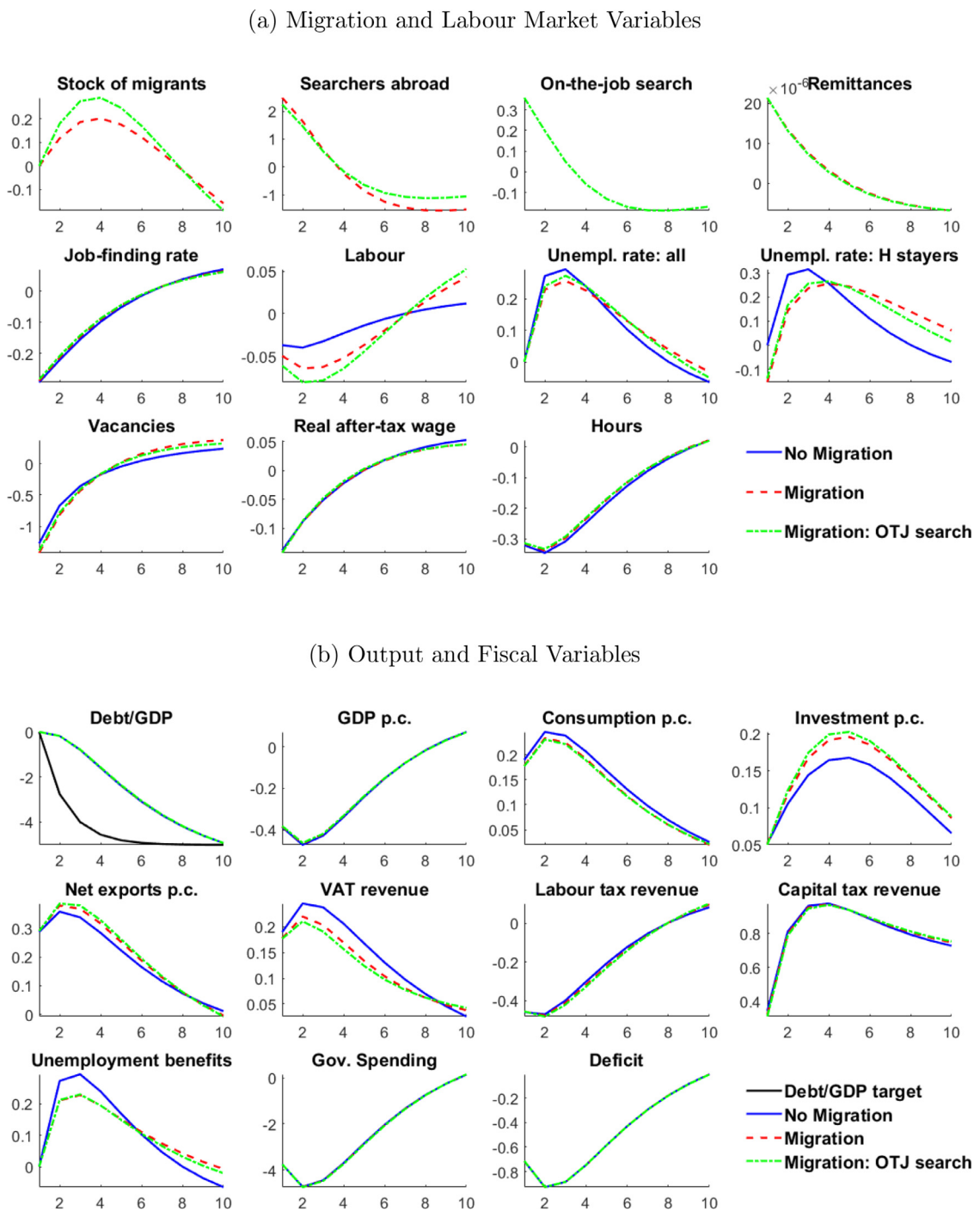


Fig. 7. Wasteful spending cuts and emigration notes: see in Fig. 6.

lead to more pronounced differences between the no-migration and migration models through a stronger response of emigration.

Emigration of Unemployed and Employed (dash-dotted lines).

Spending cuts exert a small and non-monotonic effect on the intensity with which workers look for jobs abroad: on-the-job search effort increases (decreases) until (after) the fourth period, in line with the fall (rise) in the real wage. The emigration of the employed leads to a higher decline in employment from job quits but alters little the response of unemployment and the debt-to-GDP ratio, relative to the model with emigration of the unemployed only.

5.4. Discussion

Our analysis highlights the interplay of various channels. First, emigration puts upward pressure on wages, negatively impacting job creation ("labour market channel"). This effect can be mitigated if employed workers emigrate too, thus freeing up jobs. Second, migrants take with them their purchasing power, reinforcing the fall in demand during fiscal consolidation, especially if remittances do not increase at the same rate as emigration ("private demand channel"). Typically, with low trade integration, the increase in external demand might not compensate for the fall in internal demand. Third, emigration may dilute the per capita variables ceteris paribus, through a reduction in population ("population channel"). Fourth, the outflow of employed workers shrinks the labour income tax base, while the outflow of unemployed acts as a fiscal stabilizer ("fiscal channel"). Below, we briefly summarize the policy implications of our main results.

Effects of Fiscal Austerity on Emigration.

As shown in Fig. 8, labour tax hikes induce significant and prolonged emigration, while the effect of spending cuts is much smaller and depends on the combination of opposite forces arising from a negative demand effect (sticky prices) and a positive wealth effect (expectation of lower taxes).

Effects of Emigration on Fiscal Austerity Success.

Emigration influences the size of fiscal consolidations and time needed to reach a given debt target. Intuitively, when people can "vote with their feet", austerity policies face a more elastic tax base and may lead to higher public debt as the tax base erodes. The endogenous leakage in revenue comes from the loss of taxpayers, generating a reduction both in consumption-tax receipts and the labour-income tax base. A higher tax hike is then required to reach a given debt target, which depresses economic activity and generates a negative effect on the tax base. Despite the higher tax hikes, our model implies a smaller fall in the debt-to-GDP ratio, relative to the no-migration benchmark, even when only the unemployed emigrate. The emigration of the unemployed amplifies the losses in both VAT revenue and capital tax revenue from consolidation via labour tax hikes. This is clearly observed after the second period in Fig. 6, which coincides with the response of the debt-to-GDP ratio becoming differentiated in the models without emigration and with emigration of the unemployed.[27] The emigration of the employed then reinforces the revenue leakage. In a nutshell, our findings suggest that there is a "Detroit effect" if consolidation works through taxes as migration erodes the tax base and flattens the Laffer curve. Therefore, it becomes more difficult to raise revenue and reduce debt.

Effects of Emigration on Fiscal Austerity Costs.

Emigration sustains higher wages by offering an extra outside option for workers. It also implies an increase in the tax hike required for a given debt reduction, hurting demand and employment, which together with the higher wages sustained, offset over time the unemployment gains from the reduction in labour supply. The emigration of the employed reduces the short-run unemployment gains from unemployed emigration and reinforces the unemployment costs over time. Emigration may dilute the short-run costs of tax hikes in terms of per capita GDP, through a reduction of the resident population.

The Role of Price Rigidities.

An annual calibration frequency naturally restricts the role of price rigidities. We now investigate how our results are affected if we raise the degree of price stickiness λ_p from 0.25 to 0.75 (a standard value in quarterly calibration). As shown in Section 7 of the Online Appendix, when more firms cannot reset prices, they react to the negative demand effect of spending cuts by cutting vacancies more. This reinforces the increase in unemployment and emigration, differentiating the responses of per capita GDP and debt-to-GDP ratio between the no migration and migration models. Consequently, the required spending cut does become larger with emigration. These results are reversed in the case of tax hikes: a larger share of firms with fixed prices implies weaker negative effects on inflation and milder consolidation needed (through the debt law of motion and the Fisher equation), with milder effects on labour market variables, emigration and output. Therefore, with stronger price rigidities, the effects of labour income tax hikes and spending cuts become more similar.

6. Fiscal multipliers and different types of government spending

House et al. (2020) provide evidence that aggregate spending multipliers in Europe might have been larger than one in the aftermath of the Great Recession, potentially due to the fixed exchange rate regime, and this might have led to self-defeating austerity. Focusing on Spain, Anzoategui (2022) finds that the likelihood of self-defeating austerities depends on the magnitude of fiscal multipliers and fiscal policy. In our context, a question that naturally arises is the following: How does the presence of migration in a small open economy affect the size of fiscal multipliers? To the best of our knowledge, this question remains unanswered in the literature.

[27] In Section 9 of the Online Appendix, we show that this result continues to hold if we set the consumption tax rate equal to zero. This extreme case can address concerns about potentially overstating, under the assumption of complete markets, the consumption of the unemployed and thus the drop in VAT revenues when they emigrate.

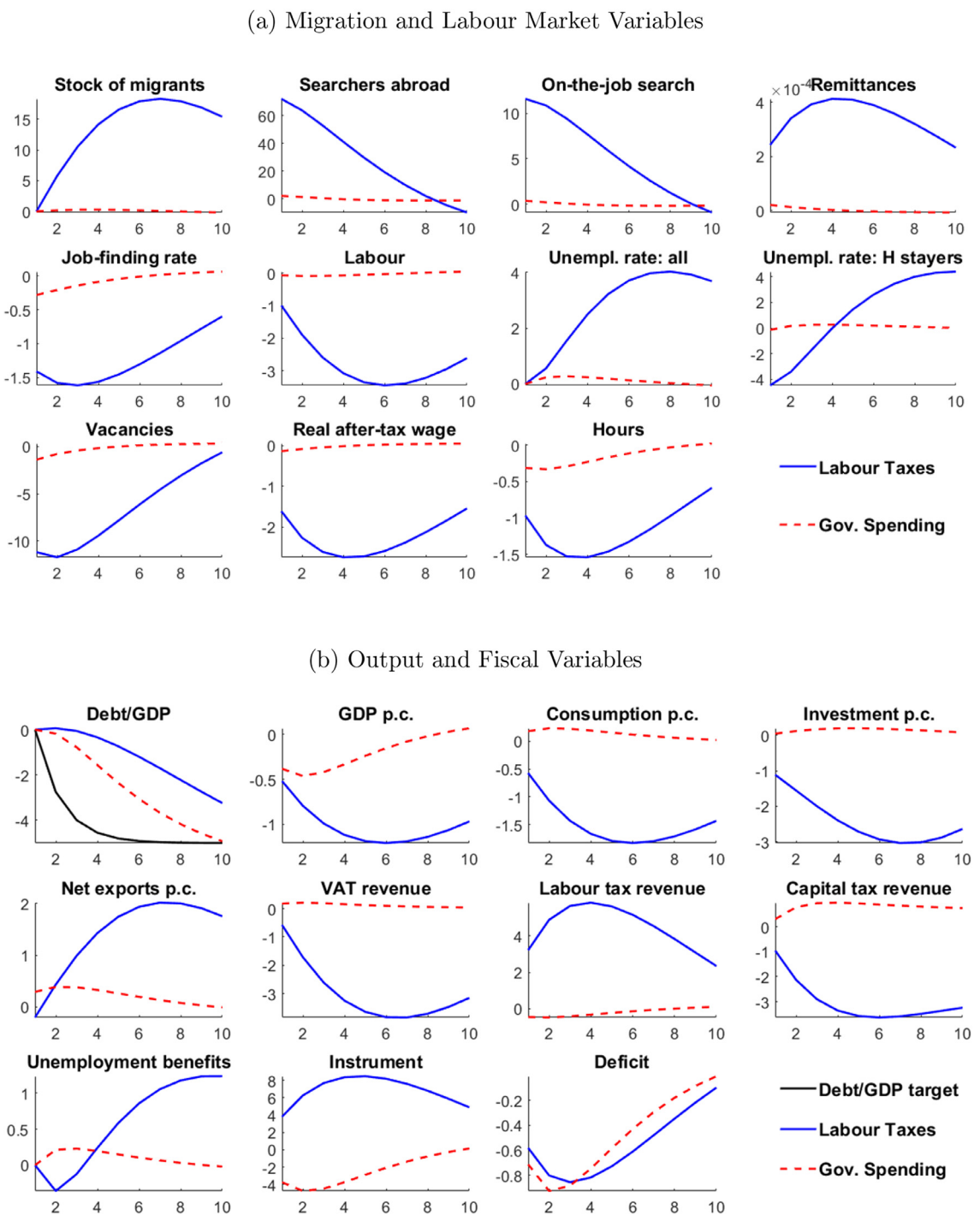


Fig. 8. Tax hikes vs. spending cuts with emigration of the unemployed and employed notes: see in Fig. 6.

In this section, we examine the output multipliers implied by our model and we expand the set of fiscal instruments under consideration. Following common practice in the literature, we assume AR(1) processes for the fiscal instruments,

$$\Psi_t = \overline{\Psi}(\Psi_{t-1})^{\rho^{\psi}} \exp(\varepsilon_t^{\psi}),$$

where ε_t^{ψ} is a zero-mean, white-noise disturbance and ρ^{ψ} determines the persistence of the different processes. Spending multipliers at horizon h are computed by dividing the present-value cumulative response of GDP, IRF_j^{gdp}, by the present-

Table 3
Present-value cumulative multipliers and migration.

	Year after the shock			
Fiscal instrument	0	1	5	10
	No Migration			
Labour Tax	0.60	0.69	0.86	0.94
Productive G	1.18	1.24	1.34	1.39
Utility-enhancing G	0.80	0.77	0.73	0.72
Wasteful G	0.53	0.51	0.48	0.48
	Migration: unemployed			
Labour Tax	0.54	0.73	1.27	1.64
Productive G	1.17	1.25	1.43	1.54
Utility-enhancing G	0.80	0.77	0.73	0.70
Wasteful G	0.53	0.51	0.48	0.46
	Migration: unemployed & employed			
Labour Tax	0.52	0.76	1.47	1.98
Productive G	1.15	1.25	1.46	1.60
Utility-enhancing G	0.79	0.77	0.73	0.69
Wasteful G	0.52	0.51	0.48	0.46

Notes: Year 0 refers to the impact multiplier. G denotes government spending. The labour tax multipliers measure the change in the value of output (in currency units) due to a one currency-unit decrease in labour tax revenues.

value cumulative response of total government spending, IRF_j^g, after the shock to each spending component, and then dividing by the steady-state ratio of total government spending to GDP, $\bar{g}/\overline{gdp}$ (see, e.g., Mountford and Uhlig, 2009):

$$\text{Present-value multiplier (h)} = \frac{\sum_{j=0}^{h}(1+r)^{-j}IRF_j^{gdp}}{\sum_{j=0}^{h}(1+r)^{-j}IRF_j^{g}}\left(\bar{g}/\overline{gdp}\right)^{-1},$$

where total government spending is given by Eq. (22). We assume that lump-sum transfers adjust to balance the government budget. For labour income tax multipliers, we replace government spending with the labour tax revenues, $\tau_t^n w_t h_t n_t$, in the above expression. We normalize the tax shock to generate a change of 1% to the labour tax revenues.

Therefore, the government spending multipliers measure the change in the value of output (in currency units, e.g., euros) due to a one currency-unit increase in government spending. Similarly, the labour tax multipliers measure the change in the value of output (in currency units) due to a one currency-unit *decrease* in labour tax revenues. Table 3 and Fig. 9a–d present the impact and present-value cumulative multipliers with and without migration in our model.[28]

Without migration, the labour tax multipliers build over time reaching a peak value close to one. In other words, a cumulative one euro decrease in tax revenues driven by labour tax cuts results in an almost one euro increase in GDP.[29] Emigration amplifies the decline in internal demand (private consumption and investment) after labour tax hikes (see Section 10 in the Online Appendix). As a result, the labour tax multiplier becomes larger in the presence of migration, roughly doubling in size after ten years when both the unemployed and the employed can emigrate. Notably, the presence of the on-the-job search matters non-trivially for the size of the labour tax multiplier. For example, the cumulative multiplier after five years rises from 0.86 without migration to 1.27 with migration of the unemployed and 1.47 with migration of both the unemployed and the employed.

We obtain similar insights for productive government spending. Multipliers are larger than one at all horizons considered, which strongly incentivizes emigration if the government cuts this budget item. In turn, emigration increases persistently the magnitude of the productive spending multiplier by amplifying the changes in internal demand. Among the three expenditure types, cuts in productive spending exert the strongest impact on labour market variables and emigration, and induce the deepest contraction in per capita GDP, consumption and investment (see Fig. 14 in the Online Appendix). Even though the productive spending multiplier is larger than the labour tax multiplier in the no-migration model, this result is overturned after the fifth year in the model with emigration of the employed and the unemployed.

By contrast, multipliers for wasteful and utility-enhancing spending are smaller than one, generating little incentive to emigrate. It follows that cuts in these two budget items avoid the "Detroit effect". Indeed, we observe a very small increase in emigration in the first five periods after the shocks, while the responses subsequently turn negative but still small in magnitude (see Section 10 in the Online Appendix). Driven by the positive wealth effect, which boosts consumption (after the fifth period for utility-enhancing spending), return migration then amplifies the increase in consumption and mitigates the crowding-out of investment. As a result, the presence of migration lowers the value of these multipliers, but only after

[28] Section 10 of the Online Appendix includes the impulse responses to the AR(1) fiscal shocks and additional results for the multipliers. These are for stronger price rigidities ($\lambda_p = 0.75$), which increases the multipliers' size for wasteful and utility-enhancing spending, and without hours in the model, which leads to lower multipliers for utility-enhancing spending.

[29] Zubairy (2014) estimates a similar value for the U.S. labour tax multipliers at a 5-year horizon.

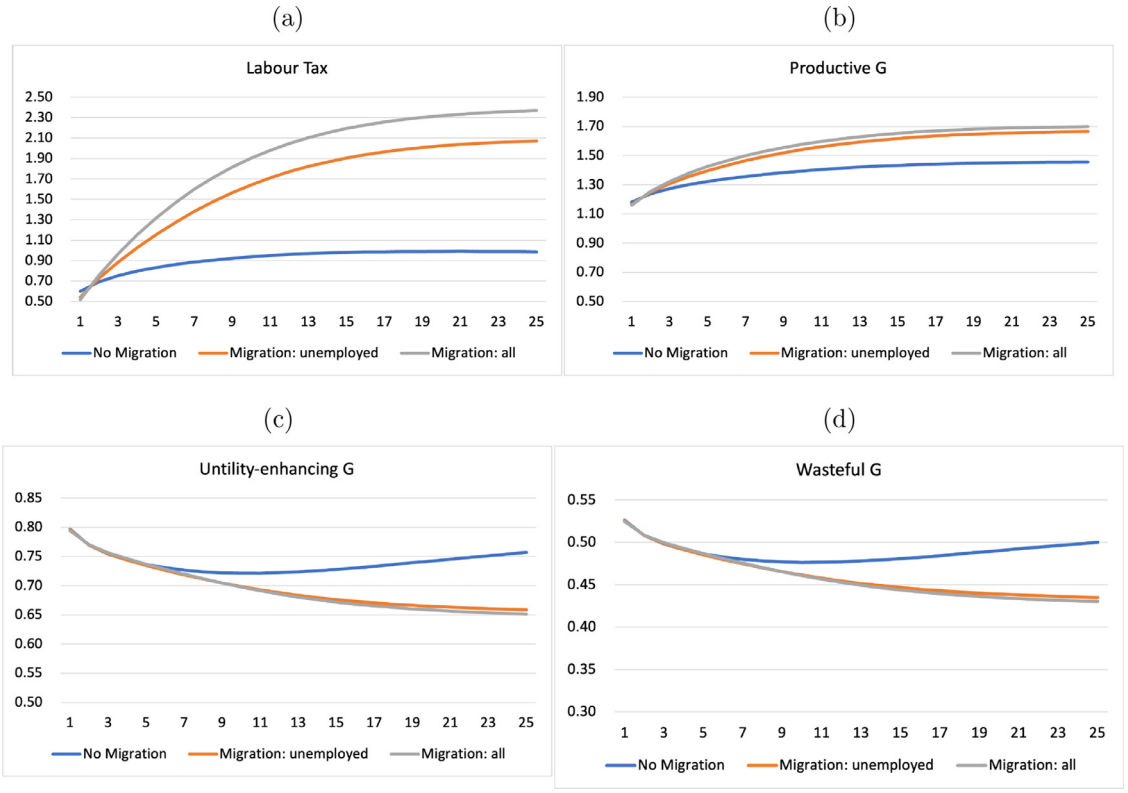


Fig. 9. Present-value cumulative output multipliers and migration notes: the horizontal axis refers to years. G denotes government spending.

the eighth year. Compared to cuts in productive spending, here the smaller response of migration – irrespective of its sign – makes the no-migration model more similar to the migration models.

In a nutshell, our findings indicate that the migration channel matters considerably for the labour tax multipliers and the productive government spending multipliers. By amplifying the changes in internal demand, emigration increases the size of those multipliers and thus the likelihood of self-defeating austerities.

7. Counterfactuals for the debt-to-GDP ratio

The Greek public debt increased from 126.7% of GDP in 2009 to 176.7% of GDP in 2015, i.e., by 50 percentage points. How would it have evolved without emigration and without the fiscal consolidation mix? This section focuses on these questions.

To provide an answer through the lens of our DSGE model, we return to the simulations of Section 4. As discussed there, we used endogenous lump-sum transfers to keep public debt constant. In this section, instead, we construct the path of the debt-to-GDP ratio, consistently with our model simulations, by accumulating those lump-sum transfers over time and dividing by the simulated path of GDP. Further, we normalize the path of the debt-to-GDP ratio to match the Greek data for public debt (% GDP).[30] In this setup, we use the nominal size of consolidation achieved through labour tax hikes and government spending cuts (see Fig. 3a) to run a number of counterfactuals for the debt-to-GDP ratio, the total number of emigrants and real GDP. Results are reported in Table 4 and Fig. 10.

We first compare the benchmark case of Section 4 with fiscal austerity and migration (row 1 of Table 4) with the case of no austerity and migration (row 2 of Table 4). The debt-to-GDP ratio in 2015 rises from almost 177% to 220%, that is an increase of 43 percentage points, while the total number of emigrants falls from 506,041 to 444,705, that is a decline of around 12%. Without fiscal austerity, Fig. 10 shows that the increase in the debt-to-GDP ratio would have been larger than the actual one after 2013, but almost 1/3 of the GDP decline would have been avoided.

[30] In practice, we decompose the path of lump-sum transfers in the model with emigration of the unemployed and the employed of Section 4 into two consolidation components: a) the one captured by labour tax hikes and government spending cuts and b) the one not captured by our model (e.g., cuts in the public wage bill or in pensions and other benefits, and increases in other taxes such as VAT, property taxes, taxes on corporate profits, luxury goods taxes, fuel taxes, etc). Note that the Greek debt level varied also due to other factors external to the model (e.g., revisions because of previously hidden debt). We construct b) as the residual transfers needed so that the model-based path of the debt-to-GDP ratio matches the actual data and we hold it constant across the experiments we run. The size of a) and b) is roughly similar (see the last section in the Online Appendix).

Table 4
The debt-to-GDP ratio and total emigration under different migration and fiscal scenarios.

Simulation Scenario	Debt (% GDP), 2015	Emigrants, 2010–2015
Benchmark	176.7	506,041
Benchmark without fiscal austerity	219.8	444,705
Benchmark without migration	167.3	0
Benchmark without fiscal austerity & migration	212.5	0

Notes: migration concerns both the unemployed and the employed. Each time, the same size of fiscal adjustment is achieved (in terms of nominal value).

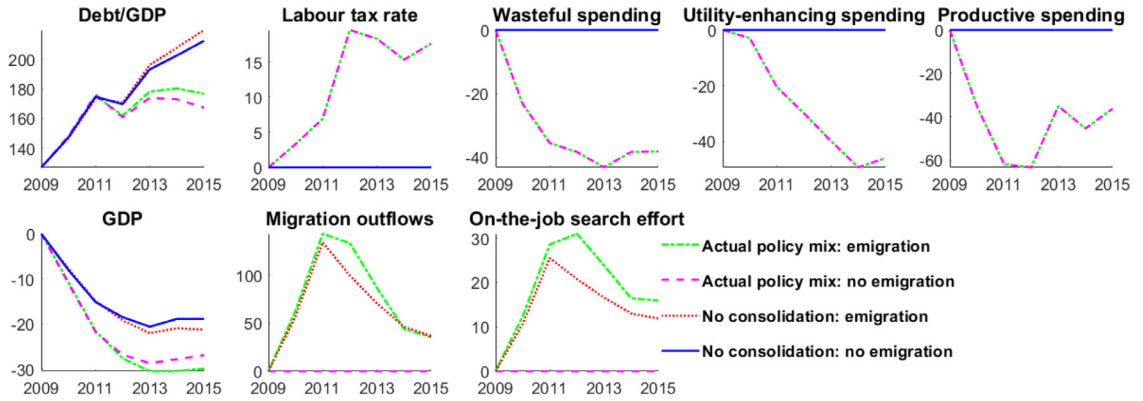


Fig. 10. Simulations for the Greek public debt: counterfactuals note: emigration concerns both the unemployed and the employed.

Next, row 3 displays the results for a no-migration counterfactual which maintains the actual fiscal austerity mix. In this scenario, the implied value for the public debt-to-GDP ratio in 2015 is smaller than the benchmark one by nearly 8 percentage points (approximately 167%). Without emigration, the increase in the debt-to-GDP ratio after 2011 would have been smaller than the actual one, consistently with a smaller decline in GDP over the same period (see Fig. 10).

Last, row 4 reports the findings from a counterfactual without fiscal austerity and migration. In this scenario, in which we isolate the impact of the recessionary shocks only, the debt-to-GDP ratio in 2015 rises to nearly 213%, which is lower than the figure in row 2, as expected. Fig. 10 shows that, even without fiscal austerity, the absence of emigration would still limit the increase in the debt-to-GDP ratio and the decline in GDP after 2013.

To sum up, the experiments of this section illustrate the role of migration in the presence of demand shocks, the role of migration for fiscal consolidation, and the role of fiscal consolidation for the debt-to-GDP ratio. The main finding is that the increase in the Greek debt ratio in the second half of the period under study would have been considerably smaller without emigration.

8. Concluding remarks

Most of the literature has focused on the issues raised by migration in receiving countries. This paper, instead, takes the point of view of the economies that are left behind by investigating the role of emigration in a deep recession when the government implements fiscal consolidation. Through the lens of a small open economy New Keynesian model with labour market frictions and emigration, we show that, rather than stabilizing the Greek business cycle, the mass exodus of workers exacerbated the recession by intensifying the drag in internal demand. Note that especially the amplification of the investment decline hampers the recovery of the economy. Moreover, our counterfactual exercises show that the increase in the debt-to-GDP ratio in the second half of the period under study would have been significantly smaller without emigration. The model has a two-way feedback between fiscal austerity and emigration. Our results highlight the heterogeneous effects of spending cuts and tax hikes on emigration in line with the findings in the literature about the more adverse effects of tax-based consolidations (see, e.g., Alesina et al., 2015 and Alesina et al., 2019). In turn, labour mobility increases the size and time of required consolidations due to an endogenous leakage in revenue.

The model generates multipliers for the various government spending components of substantially different size and reveals how they are impacted over time by emigration. While for wasteful and utility-enhancing spending, multipliers are less than one and the implications of emigration are fairly small, for labour tax hikes and productive spending, multipliers are larger than one and are substantially amplified by emigration. When fiscal austerity induces a strong response of emigration, it can act as an absorber of the austerity shock by diluting the short-run output costs per resident through a population reduction. However, in terms of unemployment, gains are only temporary and are gradually reversed due to the distortionary effects of the higher tax hikes.

Following the Great Recession, restrictions in recruitment of public employees were part of the fiscal adjustment of countries with a sizeable public sector and led graduates, previously absorbed in public sector jobs, to emigrate. Therefore, further work could look into the interaction of public wage bill cuts (see, e.g., Bandeira et al., 2018 and Bermperoglou et al., 2017) with emigration by adding a public sector to our model. Second, another interesting extension could be to incorporate the on-the-job search in a two-country model to study global shocks and the effects of immigration in the foreign economy (see, e.g., Hauser and Seneca, 2022). Possible implications of emigration on long-term productivity is also an interesting topic for future research. Long-term implications may also come in the form of extensive transnational networks and return migration contributing to fostering productivity and institutions in the source country.

The Covid-19 pandemic, the global energy crisis and the rise of inflation have raised new concerns for public finances. The experience from the European debt crisis has offered valuable policy lessons. In this context, our paper has highlighted the possible amplification of the costs of fiscal consolidation through the emigration channel. Based on the study at hand, tax incentives in the form of labour income tax cuts for foreign tax residents to redomicile to the country can contribute to attracting return migration.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.jedc.2022.104539

References

Alesina, A., Favero, C., Giavazzi, F., 2015. The output effect of fiscal consolidation plans. J. Int. Econ. 96, S19–S42.
Alesina, A., Favero, C., Giavazzi, F., 2019. Austerity: When it Works and When it Doesn't. Princeton University Press.
Alesina, A., Giuliano, P., 2014. Family ties. In: Handbook of Economic Growth, Vol. 2. Elsevier, pp. 177–215.
Alessandria, G., Bai, Y., Deng, M., 2020. Migration and sovereign default risk. J. Monet. Econ. 113, 1–22.
Anzoategui, D., 2022. Sovereign spreads and the effects of fiscal austerity. J. Int. Econ. 103658.
Bandeira, G.A., Pappa, E., Sajedi, R., Vella, E., 2018. Fiscal consolidation in a low inflation environment: pay cuts versus lost jobs. Int. J. Cent. Bank. 14, 7–53.
Beqiraj, E., Tancioni, M., 2014. Evaluating labor market targeted fiscal policies in high unemployment EZ countries. Available at SSRN 2409138.
Bermperoglou, D., Pappa, E., Vella, E., 2017. The government wage bill and private activity. J. Econ. Dyn. Control 79, 21–47.
Binyamini, A., Razin, A., 2008. Inflation-output tradeoff as equilibrium outcome of globalization. Technical Report. NBER Working Paper No. 14379.
Borjas, G.J., Kauppinen, I., Poutvaara, P., 2019. Self-selection of emigrants: theory and evidence on stochastic dominance in observable and unobservable characteristics. Econ. J. 129 (617), 143–171.
Borjas, G.J., Kauppinen, I., Poutvaara, P., 2019. Self-selection of emigrants: theory and evidence on stochastic dominance in observable and unobservable characteristics. Econ. J. 129 (617), 143–171.
Bouakez, H., Rebei, N., 2007. Why does private consumption rise after a government spending shock? Can. J. Econ. 40, 954–979.
Braun, S.T., Weber, H., 2021. How do regional labor markets adjust to immigration? a dynamic analysis for post-war Germany. J. Int. Econ. 129, 103416.
Broner, F., Martin, A., Ventura, J., 2010. Sovereign risk and secondary markets. Am. Econ. Rev. 100, 1523–1555.
Brutti, F., Sauré, P., 2016. Repatriation of debt in the euro crisis. J Eur Econ Assoc 14, 145–174.
Caliendo, L., Dvorkin, M., Parro, F., 2019. Trade and labor market dynamics: general equilibrium analysis of the China trade shock. Econometrica 87 (3), 741–835.
Canova, F., Ravn, M.O., 2000. The macroeconomic effects of German unification: real adjustments and the welfare state. Rev. Econ. Dyn. 3, 423–460.
Chassamboulli, A., Palivos, T., 2014. A search-equilibrium approach to the effects of immigration on labor market outcomes. Int. Econ. Rev. 55, 111–129.
Chassamboulli, A., Peri, G., 2015. The labor market effects of reducing the number of illegal immigrants. Rev. Econ. Dyn. 18, 792–821.
Casado, J., Fernández, C., Jimeno, J. F., 2015. Worker flows in the European Union during the Great Rrecession. Technical Report. ECB Working Paper 1862.
de Córdoba, G.F., Pujolas, P.S., Torres, J.L., 2017. Fiscal discipline and defaults. Rev. Econ. Dyn. 24, 1–13.
d'Albis, H., Boubtane, E., Coulibaly, D., 2019. Immigration and fiscal balance: evidence from Western European countries. J. Econ. Dyn. Control 99, 116–151.
Desai, M.A., Kapur, D., McHale, J., Rogers, K., 2009. The fiscal impact of high-skilled emigration: flows of Indians to the US. J. Dev. Econ. 88 (1), 32–44.
Docquier, F., Iftikhar, Z., 2019. Brain drain, informality and inequality: a search-and-matching model for sub-Saharan Africa. J. Int. Econ. 120, 109–125.
Docquier, F., Ozden, Ç., Peri, G., 2013. The labour market effects of immigration and emigration in OECD countries. Econ. J. 124 (579), 1106–1145.
Dolado, J.J., Jansen, M., Jimeno, J.F., 2009. On-the-job search in a matching model with heterogeneous jobs and workers. Econ. J. 119, 200–228.
Chodorow-Reich, G., Karabarbounis, L., Kekre, R., 2021. The macroeconomics of the Greek Depression. Mimeo.
Economides, G., Papageorgiou, D., Philippopoulos, A., 2020. Macroeconomic policy lessons from Greece.
Economides, G., Philippopoulos, A., et al., 2022. What is next? public debt and economic growth in Greece. In: Proceedings of the CESifo Forum, Vol. 23. ifo Institute-Leibniz Institute for Economic Research, pp. 24–29.
Erceg, C.J., Lindé, J., 2012. Fiscal consolidation in an open economy. Am. Econ. Rev. 102, 186–191.
Erceg, C.J., Lindé, J., 2013. Fiscal consolidation in a currency union: spending cuts vs. tax hikes. J. Econ. Dyn. Control 37, 422–445.
Fève, P., Matheron, J., Sahuc, J.-G., 2013. A pitfall with estimated DSGE-based government spending multipliers. Am. Econ. J. Macroecon. 5, 141–178.
Fotiou, A., 2022. Non-linearities in fiscal policy: The role of debt. Eur. Econ. Rev.. forthcoming
Furlanetto, F., Robstad, Ø., 2019. Immigration and the macroeconomy: some new empirical evidence. Rev. Econ. Dyn. 34, 1–19.
Gali, J., Monacelli, T., 2008. Optimal monetary and fiscal policy in a currency union. J. Int. Econ. 76 (1), 116–132.
Garda, P., 2016. The ins and outs of employment in 25 OECD countries. Technical Report. OECD Publishing.
Giuliano, P., 2007. Living arrangements in Eastern Europe: does cultural origin matter? J. Eur. Econ. Assoc. 5 (5), 927–952.
Gourinchas, P.-O., Philippon, T., Vayanos, D., 2017. The analytics of the Greek crisis. NBER Macroecon. Annu. 31 (1), 1–81.
Hansen, L.P., Singleton, K.J., 1983. Stochastic consumption, risk aversion, and the temporal behavior of asset returns. J. Polit. Econ. 91, 249–265.
Hauser, D., Seneca, M., 2022. Labor mobility in a monetary union. J. Int. Econ. 137, 103600.
House, C.L., Proebsting, C., Tesar, L.L., 2020. Austerity in the aftermath of the Great Recession. J. Monet. Econ. 115, 37–63.
House, C. L., Proebsting, C., Tesar, L. L., 2022. Quantifying the benefits of labor mobility in a currency union. Mimeo.
Izquierdo, M., Jimeno, J.F., Lacuesta, A., 2016. Spain: from massive immigration to vast emigration? IZA J. Migr. 5, 10.
Kaplan, G., Schulhofer-Wohl, S., 2017. Understanding the long-run decline in interstate migration. Int. Econ. Rev. 58, 57–94.
Kapur, D., McHale, J., 2012. Economic Effects of Emigration on Sending Countries. Oxford Handbook of the Politics of International Migration.
Kleven, H., Landais, C., Muñoz, M., Stantcheva, S., 2020. Taxation and migration: evidence and policy implications. J. Econ. Perspect. 34 (2), 119–142.
Krause, M.U., Lubik, T.A., 2006. The cyclical upgrading of labor and on-the-job search. Labour Econ. 13, 459–477.
Labrianidis, L., Pratsinakis, M., 2016. Greece's new emigration at times of crisis. Technical Report. Hellenic Observatory, LSE.
Lazaretou, S., et al., 2016. The Greek brain drain: the new pattern of Greek emigration during the recent crisis. Economic Bull. (43) 31–53.
Leeper, E.M., Plante, M., Traum, N., 2010. Dynamics of fiscal financing in the United States. J. Econom. 156 (2), 304–321.

Lozej, M., 2019. Economic migration and business cycles in a small open economy with matching frictions. Econ. Model. 81, 604–620.
Maffei-Faccioli, N., Vella, E., 2021. Does immigration grow the pie? asymmetric evidence from Germany. Eur. Econ. Rev. 138, 103846.
Mamertino, M., Sinclair, T.M., 2019. Migration and online job search: a gravity model approach. Econ. Lett. 181, 51–53.
Mandelman, F.S., Zlate, A., 2012. Immigration, remittances and business cycles. J. Monet. Econ. 59, 196–213.
Mishra, P., 2007. Emigration and wages in source countries: evidence from Mexico. J. Dev. Econ. 82 (1), 180–199.
Mountford, A., Uhlig, H., 2009. What are the effects of fiscal policy shocks? J. Appl. Econom. 24 (6), 960–992.
Papageorgiou, D., Efthimiadis, T., Konstantakopoulou, I., 2012. Effective tax rates in Greece. Centre of planning and economic research, discussion papers 124.
Papageorgiou, D., Tsiaras, S., et al., 2021. The Greek Great Depression from a neoclassical perspective. Technical Report. Bank of Greece.
Pappa, E., Sajedi, R., Vella, E., 2015. Fiscal consolidation with tax evasion and corruption. J. Int. Econ. 96, 56–75.
Philippopoulos, A., Varthalitis, P., Vassilatos, V., 2017. Fiscal consolidation in an open economy with sovereign premia and without monetary policy independence. Int. J. Cent. Bank. 13, 259–306.
Schmitt-Grohé, S., Uribe, M., 2003. Closing small open economy models. J. Int. Econ. 61, 163–185.
Smith, C., Thoenissen, C., 2019. Skilled migration and business cycle dynamics. J. Econ. Dyn. Control 103781.
Storesletten, K., 2000. Sustaining fiscal policy through immigration. J. Polit. Econ. 108, 300–323.
Triandafyllidou, A., Gropas, R., 2014. Voting with their feet: highly skilled emigrants from Southern Europe. Am. Behav. Sci. 58, 1614–1633.
Tüzemen, D., 2017. Labor market dynamics with endogenous labor force participation and on-the-job search. J. Econ. Dyn. Control 75, 28–51.
Wilson, J.D., 2008. A voluntary brain-drain tax. J. Public Econ. 92 (12), 2385–2391.
Zubairy, S., 2014. On fiscal multipliers: estimates from a medium scale DSGE model. Int. Econ. Rev. 55 (1), 169–195.