Fiscal-Mobility Propagation in Currency Unions*

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Abstract

This paper argues that labour mobility shapes shock propagation in currency unions through its interaction with regional governments' fiscal space, a mechanism beyond the standard Mundellian view. By developing a New Keynesian open-economy model of migration, I show analytically that when governments face binding debt limits, labour mobility exerts two opposing forces on fiscal space: emigration expands fiscal capacity through spillover effects that raise per-capita fiscal contributions, but contracts it through increased per-capita debt burden. The dominant effect dictates whether labour mobility enables a stronger expansionary fiscal response to negative idiosyncratic shocks, reinforcing its stabilising role; or forces governments into pro-cyclical fiscal consolidations, amplifying the original shock – the more probable equilibrium when debt is high. Using LinkedIn data to construct a novel panel of monthly intra-EU migration flows, I estimate an SVAR and local projection model to uncover that the fiscal-mobility amplification mechanism was prevalent during high-debt regimes in the EU between 2000 and 2019.

Keywords: Labour mobility; fiscal space; fiscal policy; currency unions

JEL Classification: E24, E32, E62, F22, F45

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I Introduction

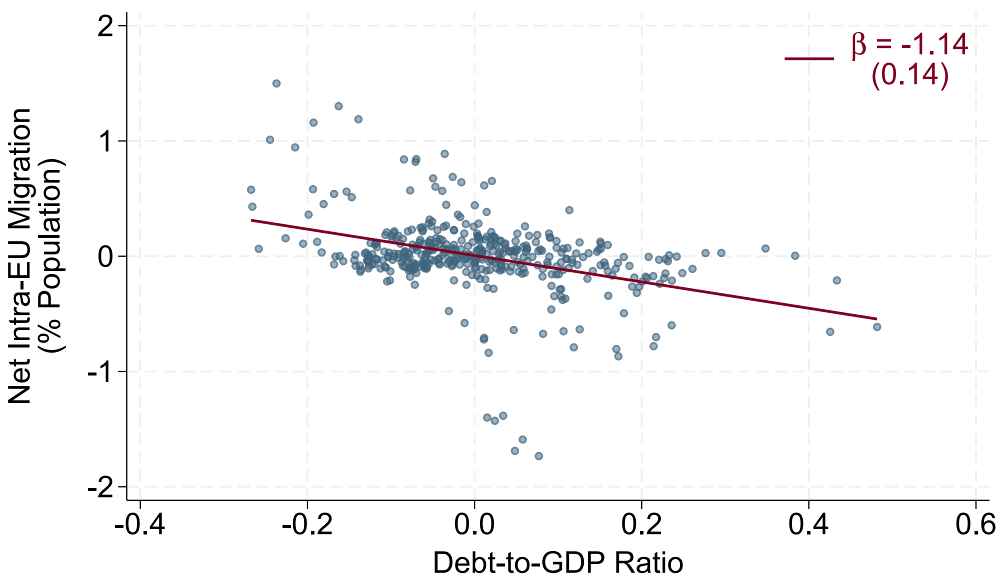
Is labour mobility always a desired stabilising feature in a currency union? The conventional wisdom, going back to the seminal work of Mundell (1961), would respond with an emphatic *yes* – when monetary policy is shared and the possibility of internal exchange rate adjustments is ruled out, labour mobility takes up the stabilising role of attenuating regional imbalances. The subsequent optimal currency area (OCA) literature identified fiscal policy as a second key stabilisation instrument substituting for the lost monetary independence (Kenen, 1969; Gali and Monacelli, 2008). The consensus view is, therefore, that labour mobility and fiscal policy are two separate stabilisation mechanisms aiding members of a currency union facing idiosyncratic shocks.

In this paper, I argue that the fiscal and the labour mobility dimensions are not independent of each other, and in particular that they interact via the fiscal space of regional governments. The result of this interaction affects how idiosyncratic shocks propagate in the currency union, a mechanism I call *fiscal-mobility propagation*. Depending on how migration affects fiscal space, fiscal-mobility propagation can reinforce the stabilising role of labour mobility or amplify the original regional imbalances, making the role of labour mobility in a currency union inseparable from the fiscal conditions of its members.

Fiscal space, defining the capacity for governments to pursue their desired fiscal policy, is the key link connecting labour mobility and fiscal policy. A fiscally constrained government may be forced into consolidations that depress economic activity and wages, raise taxes and deteriorate public services, incentivising the labour force to emigrate. However, depending on how emigration itself feeds back into fiscal space, the extent of such consolidations can be milder or harsher than in the absence of migration, affecting the severity of the recession. Intuitively, the impact of emigration on the government's fiscal capacity can go both ways. Emigration may tighten the constraints faced by the government by eroding the tax base and spreading the burden of government expenditures, as well as that of the existing public debt, over fewer taxpayers. That said, emigration can also provide a welcome fiscal relief if its composition reduces unemployment benefit transfers, or if the reduction in labour supply spills over into higher wages for those who remain, raising per-capita net fiscal contributions in the origin region. The net effect of migration on fiscal space is therefore not obvious, but its importance is central to understanding the role of labour mobility in currency unions, as it determines whether fiscal policy is allowed to be more expansive than otherwise, or whether contractionary consolidations must be reinforced. This paper formalises the opposing forces that migration exerts on fiscal space, characterises the resulting stabilising or amplifying fiscal-mobility propagation mechanisms, and assesses which one holds empirically.

The motivation for this paper is the 21st century European Union (EU), and the sovereign debt crisis of the 2010s in the Euro Area. The introduction of the euro in 1999 established a currency union among a continuously expanding number of European countries, but its setup comprises institutional features that distinguish it from other currency unions such as the US, and make the relevance of fiscal-mobility interactions all the more salient. First, despite its single market, business cycles in the EU are not fully synchronised (Frankel and Rose, 1998), giving rise to regional imbalances. Second, while freedom of labour movement is institutionalised on paper, *de facto* labour mobility remains extremely low. For comparison, less than 5% of working-age EU citizens reside in a different member state than their country of birth, compared to around 30% of Americans living outside their state of birth (Arpaia et al., 2016), implying labour mobility is insufficient to fully stabilise these regional imbalances (Beyer and Smets, 2015). Third, and relatedly, the low level of mobility within the EU increases the importance of fiscal policy to attenuate asymmetric shocks. Yet, despite early warnings for the need of fiscal integration alongside the monetary union (the MacDougall Report, 1977; the Delors Report, 1989), a broad federal budget for the EU was never set up, leaving the required fiscal response of individual member states vulnerable to contractions in their respective fiscal space.

FIGURE 1: Migration and Public Debt in the EU (2000-2019)



Source: Eurostat, author's calculations.
Notes: Each dot corresponds to a country-year pair. Sample includes all EU-28 countries (including the United Kingdom) in 2000-2019, for all available data. Both variables are residualised from country and time fixed effects. Standard error in parentheses.

These institutional fragilities were exposed during the sovereign debt crisis, in which high levels of public debt were coupled with abnormally large levels of intra-EU migration. As evidenced by Figure 1, there is a strong correlation between labour mobility and fiscal space for EU members during this period. The crisis in Euro Area peripheral economies led debt levels to breach Maastricht 60% of GDP limits, and tested the limits of market borrowing, rendering market-implied debt constraints binding for these countries. Some of them (Greece, Portugal, Ireland, Spain, Cyprus) received Troika bailouts or other forms of assistance that conditioned the respective governments to enact austerity programmes. The resulting fiscal consolidations had the effect of further contracting economic activity which was already severely depressed. At the same time, these highly-indebted economies saw an exodus of working-age population to northern European countries – in Greece alone, annual emigration to other European countries more than doubled during the crisis, from 0.26% of its population in 2009 to 0.70% in 2012. Policy makers at the time viewed the austerity programmes as a necessary evil, and the mass emigration as a separate natural economic outcome which aided the stabilisation procedure.

An overlooked question is how mass emigration itself impacted the required extent of the fiscal consolidation programmes. Namely, if emigration from southern to northern EU countries provided a fiscal relief to indebted countries, then labour mobility may have alleviated the required severity of the pro-cyclical fiscal consolidations, and fiscal-mobility propagation had a stabilising effect. By contrast, if emigration from South to North eroded the tax base and shrank fiscal space even further, then southern European governments may have been forced to consolidate their fiscal positions by more than the counterfactual scenario of no migration, and in doing so triggered the fiscal-mobility amplification mechanism that deepened the recession beyond what initial austerity alone would have implied. More broadly, this paper asks whether labour mobility stabilises or amplifies idiosyncratic shocks through its interaction with fiscal space, and which of the two fiscal-mobility propagation mechanisms characterises the European experience during the sovereign debt crisis.

I answer these research questions by first developing a New Keynesian open-economy model of migration. The model is an adaptation of the external demand imbalances model of labour mobility introduced in Farhi and Werning (2014), extended to an infinite horizon to allow for government debt accumulation. The model features two initially symmetric regions in a currency union with independent fiscal authorities. The regions are hit by asymmetric demand shocks, and workers migrate to the region with the highest real wage, subject to a migration cost. Regional governments use fiscal policy to attenuate the effects of their idiosyncratic shocks, but they are subject to an exogenous per-capita real debt limit. Nominal price rigidities imply that fiscal expansions increase real wages, incentivising immigration, while consolidations depress them, and incentivise emigration.

The existence of the debt limit imposes an upper bound as to how much regional governments can spend per-capita in response to idiosyncratic shocks, defining the government's fiscal space. In the model, emigration exerts two opposing forces on fiscal space. On the one hand, it generates a spillover effect that raises per-capita output and increases wages for the remaining workers. This is consistent with the narrative that emigration generally increases average net fiscal contributions. On the other hand, and even if spending needs scale one-to-one with population – meaning the government chooses a *per-capita* level of spending instead of an *aggregate* one – emigration still erodes the tax base as it spreads the existing debt stock over fewer workers. This has the effect of increasing per-capita debt burden in a manner analogous to the $r - g$ condition in the public finance literature (Domar, 1944; Blanchard et al., 1991; Blanchard, 2019; Mehrotra and Sergeyev, 2021), with population (de)growth replacing GDP growth in this analogy.

I show analytically that the model can have two possible equilibria, and in particular the dominant effect of migration on fiscal space pins down whether fiscal-mobility propagation is stabilising or amplifying. If the fiscal contribution channel dominates, emigration expands fiscal space, allowing the government to increase its per-capita spending to attenuate the regional bust, generating a fiscal-mobility stabilisation that complements the labour mobility adjustment envisioned by Mundell. If the debt burden channel dominates, emigration tightens fiscal constraints even more, and forces the government to consolidate its spending, depressing regional demand further and amplifying the original shock, a fiscal-mobility amplification. Crucially, because these fiscal-mobility interactions are only binding when the government is debt-constrained, the fiscal-mobility amplification equilibrium is the most likely outcome, as the high debt required to make fiscal constraints binding is also what makes the debt burden channel stronger.

I then test these predictions on a monthly panel of EU countries between January 2000 and December 2019. I use LinkedIn data from Revelio Labs to construct a novel monthly series of intra-EU migration, based on users' self-reported cross-border movements for new jobs and education. This monthly panel sidesteps data limitations of existing official migration statistics for the EU, which are poorly reported within the Schengen area, yet validates well against available official bilateral flows with a strong log-log correlation of 0.83. The monthly frequency is also used for structural identification of a vector autoregression (SVAR) model using short-run timing restrictions on migration. The SVAR shows that a 1pp migration rate shock reduces unemployment by roughly 4pp at peak and debt-to-GDP by roughly 7pp at peak in receiving countries, and by around 5pp and 6pp respectively in origin countries. However, and most strikingly, falling debt in origin countries is not indicative of fiscal-mobility stabilisation, but rather the result of forced fiscal consolidations – using local projections to estimate the response of quarterly fiscal variables, I show that during high-debt periods emigration forces fiscal consolidations rather than enabling expansions. Government consumption falls by a cumulative 3.4pp of trend GDP over 20 quarters in response to a 1 standard deviation emigration shock for highly indebted countries, while the response is muted when countries have low debt, confirming the theoretical prediction that high-debt regimes trigger the fiscal-mobility amplification mechanism.

Related literature. The paper relates to several strands of the literature. First, it adds to the OCA literature, which has repeatedly emphasised the essential adjustment role of labour mobility (Mundell, 1961; Blanchard and Katz, 1992; Farhi and Werning, 2014), and my model builds upon Farhi and Werning's framework. This literature has also studied the role of integrated and independent fiscal policies as a replacement for monetary policy in currency unions (Kenen, 1969; Gali and Monacelli, 2008; Farhi and Werning, 2017), and more recently, and in close spirit to my framing, Bellifemine et al. (2025) study how heterogeneous fiscal space affects shock propagation across members of a currency union, albeit ignoring shock asymmetry or labour mobility. Wildasin (2000) and Baglioni et al. (2016) study how labour mobility constrains fiscal adjustments in currency unions, but they do so through the lens of tax competition as opposed to fiscal space. To the best of my knowledge, this paper is the first to formalise the interaction between labour mobility and fiscal space as a determinant of shock propagation in currency unions, and to test it empirically.

A separate literature studies fiscal-mobility interactions outside OCA, but these tend to ignore the feedback between migration and fiscal space in equilibrium. Applied micro papers study the migration elasticity to tax changes (see Kleven et al. 2020 for a review). Some macro papers study the short-run interaction between fiscal consolidations and migration (Bandeira et al., 2022), but in small open economy settings that abstract from union-wide general equilibrium effects. In the opposite direction, a vast literature focuses on how migration affects public finances, but this usually takes a demographic analysis of the long-run fiscal sustainability of social programmes (Borjas, 1994; Storesletten, 2000; Dustmann and Frattini, 2014; Fiorio et al., 2024; Bernardino et al., 2025). This paper fills this gap by studying how migration affects short-run fiscal capacity and the conducting of fiscal policy for business cycle management in a currency union.

The paper also relates to the literature on fiscal space and sovereign debt constraints. The notion that governments face binding debt limits, and that these limits have real macroeconomic consequences, is well established (Eaton and Gersovitz, 1981; Reinhart and Rogoff, 2010; Lorenzoni and Werning, 2019). Blanchard et al. (1991) shows that the sustainability of public debt depends critically on the relationship between interest rates and growth, a condition mirrored in this paper by the analogous role of interest rates relative to population growth in determining the debt burden channel. Romer and Romer (2019) provide empirical evidence that fiscal space shapes the severity of post-crisis recessions, consistent with the amplification mechanism documented here. This paper contributes to this literature by showing that labour mobility is itself a determinant of fiscal space, creating a feedback between migration and the government's capacity to conduct stabilising fiscal policy.

Finally, following the austerity programmes applied during the European sovereign debt crisis, a long debate ensued as to the costs of austerity. The literature split into factions, where one camp argued that expenditure-based consolidations are least harmful and can even be expansionary (Alesina and Ardagna, 2010; Alesina et al., 2019); while another deemed them too costly (Blanchard and Leigh, 2013; Guajardo et al., 2014; Jordà and Taylor, 2016), with potentially persistent hysteresis effects (DeLong and Summers, 2012). More broadly, the size of fiscal multipliers has been shown to be state-dependent (Corsetti et al., 2013; Ilzetzki et al., 2013), a finding this paper extends by adding labour mobility as an additional source of state-dependence. Emigration induced by fiscal consolidations feeds back into fiscal space, and I show that the sign of the interaction affects the overall costs of austerity.

Roadmap. The remainder of the paper proceeds as follows. Section II presents the dynamic New Keynesian model of migration and fiscal constraints. Section III provides analytical results showing the fiscal-mobility interactions and how they can be stabilising or amplifying. In Section IV I describe the data collection process, while in Section V I present my empirical strategy and the empirical results. Section VI concludes.

II Dynamic Model of Migration and Fiscal Constraints

The model presented in this section takes the canonical static labour mobility model of Farhi and Werning (2014), and extends it into an infinite horizon to allow for dynamic fiscal rules and debt accumulation. In doing so, the relevant endogenous state variable for agents becomes their history of regions of residence.

There are two regions $i \in \mathcal{I} = \{\text{North } (N), \text{South } (S)\}$ that form a currency union. Agents make decisions over time $t > 0$, which is discrete and of infinite horizon, taking their starting position at $t = 0$ as given. At $t = 0$, the union's economy is at a fully symmetric steady-state equilibrium: regions are initially of equal size, and all prices across regions and firms are identical and normalised to 1. Shocks in the economy are unanticipated MIT shocks, meaning agents and firms expect the economy to remain at its current steady-state, but realised shocks change the equilibrium path. Following each shock, agents and firms have perfect foresight over the resulting deterministic transition path.

Households. There is a unit mass of worker-agents split across the two regions. Let $s_t \in \mathcal{I}$ denote the country in which an agent resides at time t, and $s^t \in \mathcal{I}^{t+1}$ the history of regions of residence for the agent up to period t, including the region of origin s_0. Agents are ex-ante identical except for their origin region s_0, and all ex-post differences result from having different residence histories s^t. A worker with residence history s^t gains log-utility in each period t from per-capita consumption $c_t(s^t)$ and disutility from supplying per-capita labour $\ell_t(s^t)$.[1] Preferences are as in Greenwood, Hercowitz and Huffman (GHH), implying no wealth effects on labour supply. Formally, utility from having residence history s^t is

$$U(s^t) = \max_{\{c_t(s^t), \ell_t(s^t), a_t(s^t)\}} u_t(s^t) + \beta \, \mathbb{E}_t U(s^{t+1}), \tag{1}$$

$$u_t(s^t) = \log\left(c_t(s^t) - \psi \frac{\ell_t(s^t)^{1+\varphi}}{1+\varphi}\right) + \theta \log\left(\kappa_t(s^t)\right), \quad \kappa_t(s^t) = \begin{cases} \kappa, & \text{if } s_t \neq s_{t-1} \\ 1, & \text{if } s_t = s_{t-1} \end{cases}, \tag{2}$$

with region of origin s_0 given. For notational brevity, aggregate state variables are suppressed. The parameter $\kappa \in [0, 1]$ measures the degree of labour mobility within the union, with $\kappa = 0$ indicating prohibitively costly mobility, and $\kappa = 1$ indicating free mobility. In essence, κ can be thought of as capturing preferences, institutional barriers, and other costs associated with moving across regions. Under costly mobility ($\kappa < 1$), migration costs may prevent full reallocation across regions, so shocks can leave persistent population imbalances even after the shock has subsided. The model can easily be extended to allow for time- and region-varying $\kappa_{i,t}$, accommodating the possibility of exogenous migration cost shocks. Furthermore, φ is the inverse Frisch elasticity, ψ is a labour supply disutility shifter, and θ is a migration cost sensitivity parameter, useful for calibration purposes.

[1] Unless stated otherwise, throughout the model lower-case variables are per-capita outcomes, whereas upper-case indicates aggregate variables.

There is an incomplete set of asset markets, and households can only save through purchasing government bonds $a_t(s^t)$ which are traded union-wide with nominal net return r_t. Households start with the same assets regardless of region of origin, $a_0(s^0) = a_0 \geq 0$, and their period budget constraint is

$$P_t(s_t)\, c_t(s^t) + a_t(s^t) = W_{s_t,t}\, \ell_t(s^t) + \pi_t(s^t) + (1 + r_t)a_{t-1}(s^t), \tag{3}$$

where $W_{s_t,t}$ is the wage rate in the agent's current region of residence s_t, and $\pi_t(s^t)$ are per-capita nominal profits distributed to workers with residence history s^t. $P_t(s_t)$ is the consumer price index (CPI) for an agent residing in region s_t. The consumption term $c_t(s^t)$ is an aggregate which comprises consumption of the final good from each region i, $c_t^{(i)}(s^t)$. More concretely, $c_t(s^t)$ is a CES aggregator of the form

$$c_t(s^t) = \left(\alpha_{s_t,t}^{\frac{1}{\sigma}} c_t^{(s_t)}(s^t)^{\frac{\sigma-1}{\sigma}} \;+\; (1 - \alpha_{s_t,t})^{\frac{1}{\sigma}} c_t^{(-s_t)}(s^t)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{4}$$

where the notation $-s_t$ (or $-i$) is used, throughout the model, to indicate the other region from the one being indexed. The exogenous variable $\alpha_{i,t} \in (0, 1)$ captures the degree of home bias in consumption. Crucially, it is allowed to vary across regions and time, and this is the source of demand imbalance shocks to the model. Under this aggregation, the consumer price index is in turn given by

$$P_t(s_t) = \left(\alpha_{s_t,t} P_{s_t,t}^{1-\sigma} + (1 - \alpha_{s_t,t}) P_{-s_t,t}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \tag{5}$$

where $P_{i,t}$ is the price of the final good produced in region i, to be defined shortly. A no-Ponzi condition applies.

Agents' first order conditions pin down per-capita labour supply

$$\ell_t(s^t) = \ell_t(s_t) = \left(\frac{W_{s_t,t}}{\psi P_t(s_t)} \right)^{\frac{1}{\varphi}}, \tag{6}$$

the Euler equation

$$1 = \beta \mathbb{E}_t (1 + r_{t+1}) \frac{P_t(s_t)}{P_{t+1}(s_{t+1})} \frac{\tilde{c}_{t+1}(s^{t+1})}{\tilde{c}_t(s^t)} \tag{7}$$

where $\tilde{c}_t(s^t) \equiv c_t(s^t) - \psi \frac{\ell_t(s^t)^{1+\varphi}}{1+\varphi}$, and per-capita consumption of each region's final good

$$c_t^{(s_t)}(s^t) = \alpha_{s_t,t} \left(\frac{P_{s_t,t}}{P_t(s_t)} \right)^{-\sigma} c_t(s^t) \quad \text{and} \quad c_t^{(-s_t)}(s^t) = (1 - \alpha_{s_t,t}) \left(\frac{P_{-s_t,t}}{P_t(s_t)} \right)^{-\sigma} c_t(s^t). \tag{8}$$

Notice that, due to GHH preferences, there are no wealth effects on labour supply, which depends only on the current wage rate and CPI, both of which are independent of prior residence history. Therefore, labour supply does not depend on the entire history of regions of residence s^t, but on the current place of residence s_t alone, which simplifies the problem.

Migration and population. Agents choose their region of residence s_t for each period, taking as given their prior history of residence, in order to maximise utility. More concretely, they choose

$$s_t = \underset{\widehat{s}_t \in \mathcal{I}}{\operatorname{argmax}}\, U(\{s^{t-1}, \widehat{s}_t\}), \quad s^{t-1} \text{ given,} \tag{9}$$

where agents also take as given the overall population distribution of workers across the two regions, affecting aggregate variables. The probability mass function of this distribution is the mass of agents who have residence history s^t at any point in time and is denoted by $n(s^t)$. The population constraint satisfies

$$\sum_{s^t \in \mathcal{I}^{t+1}} n(s^t) = 1, \quad \forall t. \tag{10}$$

For notational brevity, the population mass in region i at time t is denoted as $n_{i,t} \equiv \sum_{s^t | s_t = i} n(s^t)$. The symmetric starting point implies $n_{N,0} = n_{S,0} = \frac{1}{2}$.

Firms. Each region has a competitive final good producer that aggregates a continuum of non-tradable intermediate varieties indexed by $j \in [0,1]$ with a constant elasticity of substitution $\varepsilon > 1$ production technology

$$Y_{i,t} = \left(\int_0^1 Y_{ij,t}^{\frac{\varepsilon-1}{\varepsilon}} \mathrm{d}j \right)^{\frac{\varepsilon}{\varepsilon-1}}. \tag{11}$$

The final good firm minimises its expenditure subject to the above production technology, resulting in a demand for each variety given by

$$Y_{ij,t} = \left(\frac{P_{ij,t}}{P_{i,t}} \right)^{-\varepsilon} Y_{i,t}, \tag{12}$$

and a competitive price of final goods

$$P_{i,t} = \left(\int_0^1 P_{ij,t}^{1-\varepsilon} \mathrm{d}j \right)^{\frac{1}{1-\varepsilon}}. \tag{13}$$

Each variety is in turn produced by an intermediate monopolist that hires labour $L_{ij,t}$ in competitive labour markets at a nominal wage rate $W_{i,t}$, and intermediate firms need to pay a payroll tax rate $\tau_{i,t}$ on top of this. Labour is used to produce intermediate varieties in a decreasing returns to scale[2] production function

$$Y_{ij,t} = A_{i,t} L_{ij,t}^{\eta}, \tag{14}$$

[2] Decreasing returns is required in order for wages to be a function of population even in a flexible price setting, ensuring there is always a solution to the migration condition.

with $\eta \in (0,1)$ governing the returns to scale parameter of the production function, and $A_{i,t}$ representing regional productivity, which is initially symmetric but potentially subject to shocks. Intermediate firms set prices monopolistically, but they do so one-period ahead, meaning their period t price is set at time $t-1$ before the realisation of any period t shocks. In period t, firms can only adjust next period's price, following

$$P_{ij,t+1} = \frac{\varepsilon}{\varepsilon - 1}\mathbb{E}_t \frac{(1+\tau_{i,t+1})W_{i,t+1}L_{ij,t+1}}{\eta Y_{ij,t+1}}. \tag{15}$$

This setup implies that prices are flexible dynamically and to anticipated shocks, but they suffer from complete within-period stickiness relative to any unanticipated shock. The main advantage of this form of price setting is that it provides a very clean form of aggregate labour demand, useful for analytical purposes, but the model could easily instead incorporate more standard forms of nominal price rigidity – such as Rotemberg (1982) or Calvo (1983) pricing – at the expense of analytical tractability. Namely, due to symmetry, all intermediate firms are identical and employ the same amount of labour, implying that aggregate production in the region is simply equal to

$$Y_{i,t} = A_{i,t}L_{i,t}^{\eta}, \tag{16}$$

$L_{i,t} \equiv \int_0^1 L_{ij,t}\mathrm{d}j$. Since prices are within-period sticky, all firms demand whatever amount of labour they need to satisfy product demand at the pre-determined prices, conditional on making non-negative profits. I impose that productivity $A_{i,t}$ is always high enough so that this is the case. Aggregate labour demand then takes the clean form of

$$L_{i,t} = \left(\frac{Y_{i,t}}{A_{i,t}}\right)^{\frac{1}{\eta}}. \tag{17}$$

Aggregate nominal profits in each region are in turn given by

$$\Pi_{i,t} = P_{i,t}Y_{i,t} - (1+\tau_{i,t})W_{i,t}L_{i,t}. \tag{18}$$

For simplicity, I assume that firms are equally owned by all households in the union, regardless of where they reside. This can be institutionalised through a union that allows for cross-border firm ownership. Then, per-capita profits are equally distributed to all workers in the union and given by

$$\pi_t(s^t) = \pi_t = \Pi_{N,t} + \Pi_{S,t}. \tag{19}$$

This results in all agents receiving the same dividend income regardless of their region of residence, and labour income becomes the only source of income differentials across regions. This setup is particularly useful as it implies that regional real wage differentials are the only incentive for migration.

Regional governments. There is no fiscal union alongside the currency union, and each region i has its own regional government. The regional government uses its labour income tax to finance a per-capita level of consumption of final goods $g_{i,t}$. Government spending is "thrown into the ocean", providing no direct utility to households. Furthermore, for simplicity, I assume that the government is entirely home-biased, implying that it only buys final goods from its own region.

The regional government targets a counter-cyclical fiscal rule, raising spending and cutting taxes during busts, and reversing this during booms, according to

$$g_{i,t} - g_0 = \rho_g(y_{i,t} - y_0) \qquad \text{and} \qquad \tau_{i,t} - \tau_0 = \rho_\tau(y_{i,t} - y_0),$$

where $\rho_g < 0$ and $\rho_\tau > 0$ govern the cyclicality of spending and taxes, $y_{i,t}$ is per-capita real output, and g_0, τ_0, y_0 denote the initial symmetric steady-state values of per-capita real government spending, labour taxes, and per-capita real output, respectively. Debt constraints, introduced shortly, may prevent the government from following this rule exactly in any given period, or doing so today compromises following it in the future. The government therefore treats the rule as a benchmark, choosing a path of per-capita real government spending $\{g_{i,t}\}_{t=1}^{\infty}$, labour taxes $\{\tau_{i,t}\}_{t=1}^{\infty}$, and per-capita end-of-period nominal debt $\{b_{i,t}\}_{t=1}^{\infty}$ that minimises quadratic deviations from its target,

$$\min_{\{g_{i,t}\geq 0, \tau_{i,t}, b_{i,t}\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \beta^{t-1} \left[\left(g_{i,t} - g_0 - \rho_g(y_{i,t} - y_0)\right)^2 + \lambda \left(\tau_{i,t} - \tau_0 - \rho_\tau(y_{i,t} - y_0)\right)^2 \right], \tag{20}$$

with λ being the relative weight the government puts on the tax rule. In choosing its fiscal variables, the government is subject to a period budget constraint which can be written in per-capita nominal terms as

$$P_{i,t} g_{i,t} + (1 + r_t)\frac{n_{i,t-1}}{n_{i,t}} b_{i,t-1} = \tau_{i,t} W_{i,t} \ell_{i,t} + b_{i,t}, \tag{21}$$

in which $\ell_{i,t}$ is per-capita labour supply from the household optimisation problem (which is equal for all residents of region i at time t regardless of residence history, as noted before) and starting per-capita debt stock is given and equal for both regional governments, $b_{i,0} = b_0 \geq 0$. A no-Ponzi condition applies, and the government is further constrained by an exogenous per-capita real debt limit $\bar{b} \geq b_0$ that applies every period, forcing

$$\frac{b_{i,t}}{P_{it}} \leq \bar{b}. \tag{22}$$

Endogenising or microfounding this debt limit is beyond the scope of this paper, but it can be interpreted as either being imposed union-wide institutionally (such as deficit and debt limits enshrined in the Maastricht Treaty), or imposed by some exogenous market force (see Eaton and Gersovitz 1981; Arellano 2008; Ghosh et al. 2013 for ways to endogenise $\bar{b}$).

Monetary authority. The currency union has a common monetary authority that sets the path of nominal interest rates r_t. This central bank follows a Taylor rule that targets deviations in union-wide CPI inflation and output from their initial symmetric steady-state values,

$$r_t = \frac{1}{\beta} + \phi_P \frac{P_t - P_{t-1}}{P_{t-1}} + \phi_Y \frac{Y_t - Y_0}{Y_0} - 1, \tag{23}$$

where union-wide CPI and output are population-weighted averages of their regional counterparts, given by

$$P_t = \left(n_{N,t} P_t(N)^{1-\sigma} + n_{S,t} P_t(S)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \quad \text{and} \quad Y_t = \left(n_{N,t}^{\frac{1}{\sigma}} Y_{N,t}^{\frac{\sigma-1}{\sigma}} + n_{S,t}^{\frac{1}{\sigma}} Y_{S,t}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{24}$$

with $\phi_P > 1$ satisfying the Taylor principle and $\phi_Y > 0$.

Equilibrium. Given initial prices and allocations in the symmetric steady-state equilibrium

$$\{P_t(s_0) = P_{i,0} = P_{ij,0} = P_0 = 1, a_0(s^0) = b_{i,0} = a_0 = b_0 \geq 0, g_{i,0} = g_0, \tau_{i,0} = \tau_0, n_{i,0} = n_0 = \tfrac{1}{2}\},$$

initial regions of residence s_0, real per-capita debt limit $\bar{b}$, regional productivities $A_{i,t}$, and consumption biases $\alpha_{i,t}$, an equilibrium for $t > 0$ is a set of per-capita allocations $\{c_t(s^t), c_t^{(i)}(s^t), \ell_t(s_t), a_t(s^t), \pi_t(s^t), g_{i,t}, b_{i,t}\}$, aggregate allocations $\{L_{i,t}, L_{ij,t}, \Pi_{i,t}, Y_{i,t}, Y_{ij,t}, Y_t\}$, a system of prices and taxes $\{W_{i,t}, P_t(s_t), P_{i,t}, P_{ij,t}, P_t, \tau_{i,t}, r_t\}$, residence histories s^t, and population masses $n(s^t)$, such that conditions (1)-(24) are satisfied, Ponzi schemes are ruled out, and markets clear in every period and region.

The goods market clearing condition in region i is

$$Y_{i,t} = \sum_{s^t \in \mathcal{I}^{t+1}} n(s^t) c_t^{(i)}(s^t) + n_{i,t} g_{i,t}. \tag{25}$$

Labour markets clear whenever aggregate labour demand equals aggregate labour supply in each region i, reading

$$L_{i,t} = n_{i,t} \ell_t(i). \tag{26}$$

Union-wide assets market clearing requires

$$n_{N,t} b_{N,t} + n_{S,t} b_{S,t} = \sum_{s^t \in \mathcal{I}^{t+1}} n(s^t) a_t(s^t). \tag{27}$$

III Fiscal-Mobility Propagation

III.A Additional assumptions and auxiliary results

This section shows the key theoretical results of the paper, regarding how fiscal policy and labour mobility interact with each other and propagate shocks. To show these results, I make additional simplifying assumptions to the model that allow for greater analytical tractability. To show the results hold more generally, the model can be solved using numerical methods.

First, this section only analyses the propagation of shocks throughout the economy on impact. Given that shocks are completely unanticipated by firms (MIT shocks) and that prices are pre-determined due to the one-period lag in their setting, on impact this implies prices are fully sticky at their initial symmetric steady-state level, normalised to 1, and can hence be suppressed throughout this section. Under more conventional Calvo or Rotemberg pricing, partial price stickiness and the results derived in this section also apply along the transition path. The choice of period-ahead price setting is, as noted before, purely motivated by analytical tractability.

Second, with no price changes, I assume that on impact the central bank just focuses on stabilising union-wide output. More concretely, the central bank sets r_t such that union-wide aggregate demand Y_t remains completely fixed in response to any shock. Besides using this in one of the proofs, this property is also useful as it implies that any effects of shocks or fiscal policy simply redirect economic activity and population from one region to another, allowing to abstract from global size effects.

Third, to simplify the government's problem, I assume that, due to political economy constraints, governments cannot adjust their tax rates $\tau_{i,t}$ which remain fixed at their initial symmetric steady-state τ_0 level, and fiscal policy is enacted through government spending $g_{i,t}$ alone.

Last, the flexible price equilibrium requires decreasing returns to scale ($\eta < 1$) to pin down the migration solution, as noted in footnote 2. However, since the analytical results in this section concern comparative statics under sticky prices, population masses are well-defined under constant returns, and for analytical simplicity I work with the constant returns limit $\eta \to 1$, which simplifies the expressions for wages and labour demand. I use footnotes throughout to discuss the implications of this approach, and argue the qualitative analytical results are unchanged. In addition, reasonable parametric restrictions on home bias are imposed, as detailed in Lemma 1.

LEMMA 1 (Migration spillovers in origin region)**.** *Keeping fiscal policy fixed and symmetric across regions, emigration strictly increases per-capita output in the origin region, to first order at any equilibrium. The result holds unconditionally under local profit distribution and at a zero-assets baseline; under global profit distribution or at a non-zero-assets baseline, it holds under sufficient parametric restrictions on home bias.*

I prove this result holds true in Appendix A.1. The proof shows that, at any equilibrium, an increase in regional population decreases regional per-capita output,

$$\frac{\mathrm{d}y_{i,t}}{\mathrm{d}n_{i,t}} < 0, \tag{28}$$

implying emigration has a spillover effect that increases per-capita output for the origin region (i.e. $\frac{\mathrm{d}y_{i,t}}{\mathrm{d}(-n_{i,t})} > 0$).

The intuition behind this result is that, since both goods are traded with imperfect home bias, when agents migrate they continue to demand some of their origin region's goods from their new region of residence. Emigration thus reduces a region's population proportionally more than it reduces aggregate demand for that region's goods, raising per-capita output in the origin region. Notably, the result does not depend on decreasing returns to scale. It holds under constant returns as well, since the proof relies only on the regional budget constraint and goods market clearing, not on production-side equations.

This Lemma is the main result derived in the external demand imbalances model of Farhi and Werning (2014), applied here to a dynamic setting, and the proof in the Appendix follows their approach of invoking the Perron-Frobenius theorem. However, it is made more intricate by both the dynamic setting and by global profit sharing. Global profit sharing, as assumed in equation (19) of the model in Section II, allows for permanent trade imbalances financed by cross-regional profit income, as is true with asset migration – since migrants take their assets with them when they move across regions, a region's consumption can be financed by assets that did not originate domestically.

The proof shows the result of the Lemma to hold unconditionally under local profit distribution and at a zero-assets baseline. Nevertheless, the Lemma still holds under global profit distribution and/or at a non-zero-assets baseline provided home bias is not too strong. Concretely, a sufficient (although possibly not necessary) condition is that average home bias $\frac{\alpha_{N,t}+\alpha_{S,t}}{2}$ lies within an admissible range of values $[\frac{1}{2}, \alpha^*]$, for some threshold $\frac{1}{2} < \alpha^* < 1$ determined by other model parameters. This condition still allows for the existence of some home bias ($\alpha_{i,t} > \frac{1}{2}$), and I assume throughout this section that these sufficient parametric conditions are satisfied so that the Lemma holds globally.

LEMMA 2 (Risk-sharing through migration)**.** *Costless labour mobility ($\kappa = 1$) allows agents to achieve perfect risk-sharing, meaning all agents equalise (marginal) utilities regardless of their region of origin s_0 and of any idiosyncratic regional shocks.*

Under global profit sharing, all union residents receive the same profit income regardless of residence. Moreover, agents start with the same level of wealth, and given costless mobility, utility for a given residence history s^t becomes solely determined by local wages along the residence path. Therefore, with costless labour mobility, agents simply choose the residence path which gives them the highest regional wage at each point in time.

Regional wages can be obtained from combining the labour market clearing condition (26), as well as the labour supply and demand equations (6) and (17) to obtain

$$W_{i,t} = \psi \left(\frac{y_{i,t}}{A_{i,t}} \right)^{\varphi}, \tag{29}$$

which under sticky prices coincides with both the nominal and the real wage.

Given this expression, Lemma 1 implies that regional wages are decreasing in population mass,[3] since $\frac{\mathrm{d}y_{i,t}}{\mathrm{d}n_{i,t}} < 0$. This incentivises workers to migrate until wages are equalised at each point in time, satisfying

$$W_{N,t} = W_{S,t} = W_t. \tag{30}$$

Then, since wages too are equal for all agents, together with equal dividend income from global profit distribution, migration being costless, and initial wealth being equal, it must be the case that all outcomes are equalised for all residence histories s^t, namely per-capita consumption $c_t(s^t) = c_t$, per-capita labour supplied $\ell_t(s^t) = \ell_t$, and utilities $U(s^t) = U$ (and consequently marginal utilities), regardless of region of origin s_0 and idiosyncratic regional shocks. This is the Mundellian view of labour mobility adjustment, formalised through Farhi and Werning's migration spillover of Lemma 1.

III.B Fiscal-mobility interactions

THEOREM 1 (Effect of fiscal policy on migration)**.** *Fiscal consolidations that lead to reductions in government spending $g_{i,t}$ incentivise emigration in general equilibrium. With global profit distribution and sticky prices on impact, taxes $\tau_{i,t}$ have no effect on migration decisions.*

To show this result, we can start by again considering the case of free labour mobility ($\kappa = 1$) as in Lemma 2, and then generalising for any value of $\kappa \in [0, 1]$. When mobility is costless, we can use the conclusions from Lemma 2, namely the equilibrium wage (29), and the wage equalisation condition (30). Together with the population constraint (10), this allows to solve for equilibrium regional populations under free mobility,

$$n_{i,t} = \frac{(Y_{i,t}/A_{i,t})^{\frac{1}{\eta}}}{(Y_{N,t}/A_{N,t})^{\frac{1}{\eta}} + (Y_{S,t}/A_{S,t})^{\frac{1}{\eta}}}. \tag{31}$$

That is, regional populations are pinned down by the ratio of regional labour demands.[4] Intuitively, from Lemma 2, per-capita labour supply ℓ_t is equalised across regions, so any cross-regional demand imbalance must be accommodated through the extensive margin, i.e., the number of workers in each region. The key insight, therefore, is that under sticky prices and free mobility, population and migration are purely demand-driven, and in particular $\frac{\mathrm{d}n_{i,t}}{\mathrm{d}Y_{i,t}} > 0$.[5] In so far as aggregate demands are themselves functions of regional populations

[3] With decreasing returns, equilibrium wages would instead take the form $W_{i,t} = \psi n_{i,t}^{\varphi(1-\eta)/\eta} (y_{i,t}/A_{i,t})^{\varphi/\eta}$, featuring a direct positive effect of population on wages. With $\eta < 1$, meeting a given level of output demand requires more than a one-to-one increase in labour input. In order to rule out corner solutions for population masses, wages must remain decreasing in population overall. Otherwise, since migrants move to where wages are highest, under free mobility we would get an equilibrium with a zero-mass region, as migration would continuously increase the wage disparity. Ensuring an interior solution requires $\eta > \eta^*$ for some threshold determined by other model parameters. Under this restriction, the qualitative analytical results coincide with the constant returns limit considered here.

[4] Here, I show the general expression of equilibrium population for any degree of returns to scale η. All that is required to have a well-defined population equilibrium as in (31) under sticky prices is that η satisfies the parametric restrictions laid out in footnote 3.

[5] The total derivative equals $\frac{\mathrm{d}n_{i,t}}{\mathrm{d}Y_{i,t}} = \frac{\partial n_{i,t}}{\partial Y_{i,t}} + \frac{\partial n_{i,t}}{\partial Y_{-i,t}} \frac{\mathrm{d}Y_{-i,t}}{\mathrm{d}Y_{i,t}} = \frac{\partial n_{i,t}}{\partial Y_{i,t}} - \frac{\partial n_{i,t}}{\partial Y_{-i,t}} > 0$, where the second equality results

(concretely, the proof of Lemma 1 in Appendix A.1 shows that $\frac{dY_{i,t}}{dn_{i,t}} > 0$), then equation (31) above becomes a fixed point problem which can be solved numerically, but the bilateral effects reinforce each other, i.e. population increases aggregate demand, which in turn increases population. Furthermore, from regional demands (8) and the goods market condition (25), the fixed point problem is guaranteed to have an interior solution as long as there is foreign demand. This is assured by $\alpha_{-i,t} < 1$, and it implies that, as long as there is trade, no region will ever have all the union's demand, nor all the union's population.

Having established how aggregate demand and population relate to each other, I now turn to how fiscal policy affects aggregate demand. A cut in government spending decreases population through emigration as long as the regional fiscal multiplier is positive. Appendix A.2 shows that the regional fiscal multiplier $\frac{dY_{i,t}}{dg_{i,t}}$ under fixed population masses is indeed positive. As is standard in New Keynesian models, government spending raises regional aggregate demand with incomplete crowding-out. Fiscal consolidations that decrease $g_{i,t}$ therefore, have a partial equilibrium effect of contracting $Y_{i,t}$ and, via equation (31), decrease $n_{i,t}$ as workers emigrate from the consolidating region. The general equilibrium effect is determined by the fixed point problem between migration and aggregate demand, as noted above. Note that under the central bank's policy of keeping union-wide output constant, the union-wide fiscal multiplier is zero by construction. The effects of regional fiscal policy are therefore purely to relocate economic activity and population from one region to another, with no aggregate effects at the union level.

The argument above relies on costless mobility ($\kappa = 1$) for tractability, since wage equalisation gives the clean expression for regional populations in equation (31). To generalise for any $\kappa \in [0, 1]$, it suffices to notice that the equilibrium migration flow balances the marginal cost of moving against the marginal gain from closing the wage gap. The marginal gain is monotonically decreasing in migration (as Lemma 2 shows, the wage gap shrinks with migration) while the marginal cost for a given κ is constant. Therefore, the value of κ determines the magnitude of migration, but its direction follows the wage differential regardless of κ. The result that cuts in government spending $g_{i,t}$ incentivise emigration, therefore, holds more generally for any level of mobility cost.[6] Formalising,

$$\frac{dn_{i,t}}{dg_{i,t}} > 0. \tag{32}$$

Turning the attention to the effects of taxes, notice that $\tau_{i,t}$ does not appear directly in any of the above equations, and it can only affect aggregate demand – and consequently the migration solution – through its effect on private consumption. However, labour demand (17) is perfectly inelastic under pre-determined prices, implying that the economic incidence of this labour tax is fully borne by firms and leaves labour supply decisions unaltered.

from the fact that $\frac{dY_{-i,t}}{dY_{i,t}} = -1$ under the central bank policy of keeping union-wide output constant.

[6] Though it is still possible that the marginal cost of migrating is always higher than the marginal gain, resulting in no migration

Therefore, this labour tax is only reflected in firms' profits that are distributed to households as lump-sum. Under global profit distribution, the change in dividend income will affect all households equally regardless of their region of residence. With identical GHH preferences, the wealth effects on consumption will be proportional across both regions. For this reason, there is no change in relative aggregate demands, and taxes have no effect on migration decisions on impact when prices are sticky, meaning

$$\frac{\mathrm{d}n_{i,t}}{\mathrm{d}\tau_{i,t}} = 0. \tag{33}$$

This further justifies why I assume that in this section taxes are fixed at $\tau_{i,t} = \tau_0$, and focus on fiscal policy enacted through government purchases alone.

THEOREM 2 (Effect of migration on fiscal space)**.** *Labour mobility exerts two opposing forces on fiscal space, having both a relaxing and a tightening effect on fiscal constraints. The sign of the net effect will mainly depend on the magnitude of the migration spillover effect, and on the existing debt servicing cost burdens.*

In any given period t, the debt limit $\bar{b}$ imposes an upper bound on how much the government can spend. Taking the government budget constraint (21), and using labour supply (6) and equilibrium wage (29), the government is fiscally constrained in its maximum period spending by

$$g_{i,t} \leq \tau_{i,t}\psi\left(\frac{y_{i,t}}{A_{i,t}}\right)^{1+\varphi} - \frac{1+r_t}{1+\gamma_{i,t}}b_{i,t-1} + \bar{b} \equiv \mathcal{F}_{i,t}, \tag{34}$$

where $\gamma_{i,t} \equiv \frac{n_{i,t}}{n_{i,t-1}} - 1$ denotes the net population growth rate. The right-hand-side of the above fiscal constraint measures the government's fiscal space, $\mathcal{F}_{i,t}$.

Totally differentiating $\mathcal{F}_{i,t}$ at a symmetric equilibrium[7] to assess how fiscal space is impacted by emigration (written as $\mathrm{d}(-n_{i,t}) > 0$ for sign interpretability) yields

$$\frac{\mathrm{d}\mathcal{F}_{i,t}}{\mathrm{d}(-n_{i,t})} = \underbrace{\tau_{i,t}(1+\varphi)\frac{\psi y_{i,t}^{\varphi}}{A_{i,t}^{1+\varphi}} \cdot \frac{\mathrm{d}y_{i,t}}{\mathrm{d}(-n_{i,t})}}_{\text{Fiscal contribution channel}} - \underbrace{\frac{(1+r_t)b_{i,t-1}}{(1+\gamma_{i,t})n_{i,t}}}_{\text{Debt burden channel}} \gtreqless 0. \tag{35}$$

When workers migrate out of the depressed region ($\mathrm{d}(-n_{i,t}) > 0$), the first term on the right-hand side is positive – as established by Lemma 1, per-capita output rises with emigration ($\mathrm{d}y_{i,t}/\mathrm{d}(-n_{i,t}) > 0$). Since per-capita output is rising as workers leave the region, per-capita tax revenue rises with it, expanding the government's fiscal space.[8] This effect

[7] At a symmetric equilibrium, $\frac{\mathrm{d}Y_{i,t}}{\mathrm{d}n_{i,t}} = -\frac{\mathrm{d}Y_{-i,t}}{\mathrm{d}n_{i,t}}$, meaning union-wide output stays constant without the need of central bank intervention, allowing to abstract from monetary policy responses and giving $\frac{\mathrm{d}r_t}{\mathrm{d}(-n_{i,t})} = 0$.

[8] Under decreasing returns, there would be an additional direct population effect, from the fact that population has a direct positive effect on wages, as noted in footnote 3. Then, as workers emigrate, this channel

is naturally made stronger when the magnitude of the migration spillover on per-capita output from Lemma 1 is larger, as this is the force that drives the positive fiscal contribution channel.[9]

The second term on the right-hand-side indicates that there is a debt burden channel through which emigration contracts fiscal space. This captures the fact that, as workers migrate out of the region, the existing debt stock is spread over fewer workers, increasing the per-capita debt burden and hence shrinking the government's fiscal space. Intuitively, even if government spending scales one-to-one with population, the existing debt stock is incapable of such scaling as it needs to be repaid in full and in aggregate terms. Emigration leads to there being fewer workers to repay this debt, and the per-capita burden of debt repayment increases with emigration. More generally, notice that whether the debt burden is increasing or decreasing depends on the sign of $r_t - \gamma_{i,t}$, a condition analogous to the classic $r - g$ determinant of debt sustainability in the public finance literature (Domar, 1944; Blanchard et al., 1991; Blanchard, 2019; Mehrotra and Sergeyev, 2021), here with population growth replacing GDP growth. Emigration shrinks the population ($\gamma_{i,t} < 0$) which, for a given interest rate on sovereign debt r_t, makes the per-capita debt burden grow faster, contracting the government's fiscal space.

The ambiguity of how fiscal space reacts to emigration holds even though aggregate government spending scales proportionally with population, as assumed by the government choosing a per-capita $g_{i,t}$ rather than an aggregate $G_{i,t}$. The possibility of emigration shrinking fiscal space is not driven by the fact that there are fewer taxpayers to finance the same level of total spending, but rather by the fact that there are fewer taxpayers to bear the burden of the existing total debt stock, which cannot scale with population. If government expenditure had a fixed non-scaling component (e.g., infrastructure maintenance, administration costs, defence), an analogous burden effect would arise on the spending side as well.

III.C *Fiscal-mobility stabilisers and amplifiers*

Theorems 1 and 2 inform us that the relationship between labour mobility and fiscal space is bidirectional. Most importantly, the possibility of labour mobility having either expansionary or contractionary effects on fiscal space, as given by Theorem 2, implies that this mutual dependency can be neutralising or reinforcing, giving rise to two possible and distinct fiscal-mobility equilibria: fiscal-mobility propagation can be stabilising or amplifying.

Suppose that region i is in a bust, due to an external demand shock driven by an asym-

depresses wages, partially offsetting the positive spillover of increased per-capita output. However, under the same parametric restrictions $\eta > \eta^*$ argued in footnote 3 to be needed for a non-degenerate model, the fiscal contribution channel remains positive, and the qualitative results remain the same under decreasing returns.

[9] It is also stronger when the Frisch elasticity is smaller (higher φ). Intuitively, under sticky prices, firms hire whatever labour is required to meet demand, with the per-capita labour hour requirement rising with the emigration-induced higher $y_{i,t}$. A lower Frisch elasticity means a steeper wage hike is required to increase labour hours supplied, amplifying the wage bill and hence per-worker tax revenue. The corresponding fall in firm profits is not taxed (besides being borne by all union households under global profit sharing), so does not offset the regional fiscal gain.

metric increase in $\alpha_{-i,t}$, i.e. residents of region $-i$ had a preference shock that made them redirect demand towards their locally produced goods, at the expense of demand for region i's goods. Further suppose that the unconstrained optimum to the fiscal rule (20) prescribes an increase in government spending $g^*_{i,t} > \mathcal{F}_{i,t}$, so that the fiscal constraint (34) binds with equality. Finally, assume that labour mobility is imperfect ($\kappa < 1$) so that the Mundellian stabilising role of labour mobility from Lemma 2 cannot fully neutralise the shock, and there is a role for fiscal stabilisation.[10]

The Lemmas and Theorems discussed in subsections III.A and III.B provide us with a system of equations mapping how variables $y_{i,t}$, $g_{i,t}$ and $n_{i,t}$ relate to each other. Particularly, from Lemma 2 we obtain a labour mobility condition (*LM*)

$$\frac{\mathrm{d}n_{i,t}}{\mathrm{d}y_{i,t}} > 0. \tag{LM}$$

Theorem 2 provides us with a fiscal space equation (*FS*) for when fiscal constraints are binding ($g^*_{i,t} > \mathcal{F}_{i,t}$ implying $g_{i,t} = \mathcal{F}_{i,t}$),

$$\frac{\mathrm{d}g_{i,t}}{\mathrm{d}n_{i,t}} \gtreqless 0. \tag{FS}$$

The goods market clearing condition (25) can be used to obtain a per-capita demand equation (*pcD*) which, due to the positive regional fiscal multiplier shown in Appendix A.2, implies

$$\frac{\mathrm{d}y_{i,t}}{\mathrm{d}g_{i,t}} > 0. \tag{pcD}$$

I am implicitly already incorporating the migration spillover effect from Lemma 1 ($\frac{\mathrm{d}y_{i,t}}{\mathrm{d}n_{i,t}} < 0$) into the slope (*FS*). However, the regional fiscal multiplier in (*pcD*) is for a fixed level of population, and so the same migration spillover effect acts as *shifter* of this curve (which will in turn shift (*LM*)).

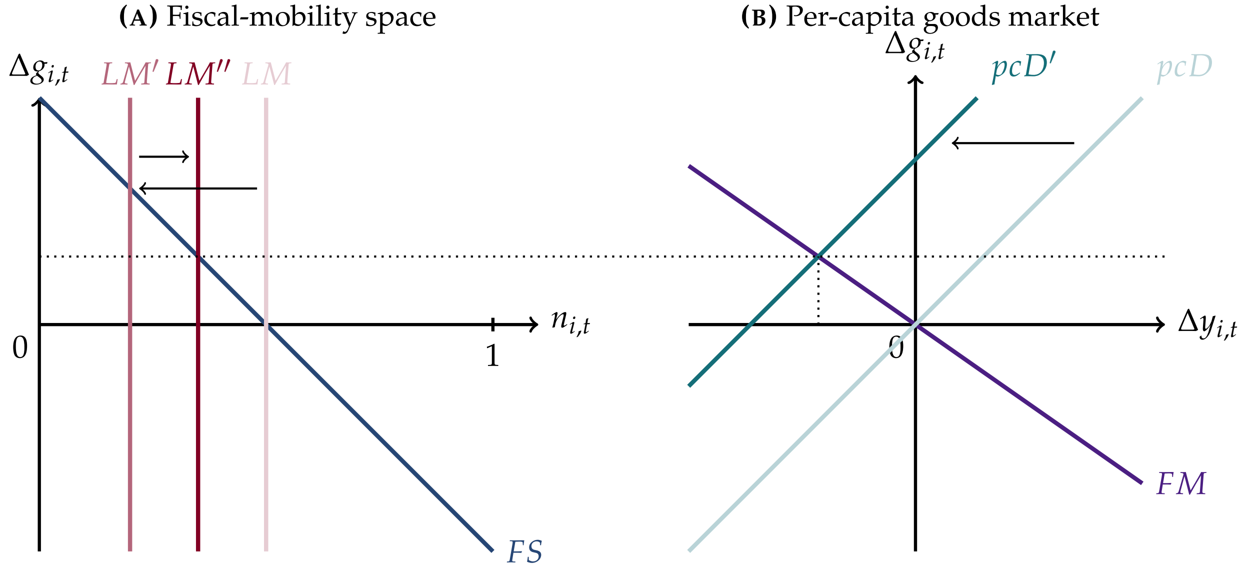
Together, these three equations characterise a system in (y, g, n). The diagrams that follow are projections of this (y, g, n) system onto the (n, g) and (y, g) planes.

Fiscal-mobility stabilisers. Start by considering the case in which the migration impact on fiscal space is such that the fiscal contribution channel in Theorem 2 dominates, and $\frac{\mathrm{d}\mathcal{F}_{i,t}}{\mathrm{d}(-n_{i,t})} > 0$. At a binding fiscal constraint, this implies that the *FS* curve, with the migration spillover effect already incorporated in it, takes the sign $\frac{\mathrm{d}g_{i,t}}{\mathrm{d}n_{i,t}} < 0$. Figure 2 shows the comparative static response in the fiscal-mobility (n, g) space at fixed $y_{i,t}$, and in the per-capita goods market (y, g) space at fixed $n_{i,t}$.

The verticality of *LM* in the fiscal-mobility space reflects the partial-equilibrium framing

[10] In the extreme case of full mobility $\kappa = 1$, labour mobility perfectly stabilises the region and there is no role for fiscal stabilisation, as seen in Lemma 2. This would mean that $g^*_{i,t}$ would just equal g_0. I focus here on the case in which, due to imperfect mobility, $g^*_{i,t} > \mathcal{F}_{i,t}$. The focus is then on the channel running through labour mobility's impact on $\mathcal{F}_{i,t}$ and how it allows $g_{i,t}$ to come closer to or further away from $g^*_{i,t}$.

FIGURE 2: Fiscal-Mobility Stabilisation



at fixed $y_{i,t}$, since $g_{i,t}$ has no direct effect on $n_{i,t}$ except through $y_{i,t}$, which is captured by the pcD curve in the goods market diagram. The FS curve in the same diagram, by contrast, embeds the migration spillover $\frac{dy_{i,t}}{dn_{i,t}} < 0$ from Lemma 1, which generates the ambiguous slope of FS per Theorem 2. The full general equilibrium is captured by combining the (n, g) subsystem with the (y, g) analysis discussed below.

When region $-i$ shifts demand toward its own good (positive shock to $\alpha_{-i,t}$), the per-capita demand of region i contracts for a given level of $g_{i,t}$. If government spending $g_{i,t}$ stays fixed, then per-capita output $y_{i,t}$ falls, and workers are incentivised to emigrate, shifting LM to LM' in the fiscal-mobility (g, n) space. This emigration will have a positive spillover effect ($\frac{dy_{i,t}}{dn_{i,t}} < 0$) that dampens the shift of pcD – this is the Mundellian adjustment at play. However, with imperfect mobility, the Mundellian adjustment is incapable of fully neutralising the negative demand shock. The shift pcD' is then the negative demand shock net of any offsetting migration spillovers.

Strictly speaking, the fall in $y_{i,t}$ should also have a direct effect on fiscal space, shifting FS downwards, capturing how the original shock itself reduces tax revenue for the government. However, the mechanism I am illustrating here concerns changes in fiscal space due to migration alone. This should then be regarded as a comparative static exercise that holds fixed the direct effect of the demand shock on fiscal space, and for this reason the fiscal space curve FS does not move.[11]

In the fiscal-mobility space, the leftward shift of LM travels up a downward sloping FS curve, due to the dominating fiscal contribution channel of Theorem 2, raising $g_{i,t}$. This captures how emigration relaxes the fiscal constraint and expands fiscal space, allowing the government to more closely pursue its desired counter-cyclical fiscal policy and bringing

[11]A further justification for this choice could be that the fiscal constraint (34) was slack until the shock, and it is the shock that makes it binding. In this case, the shock would not shift the FS curve, but rather it would *create* the binding relationship between $n_{i,t}$ and $g_{i,t}$ in fiscal space.

$g_{i,t}$ closer to $g^*_{i,t} > \mathcal{F}_{i,t}$. In the goods market, we can draw a fiscal-mobility (FM) curve that represents the locus of equilibria of the fiscal-mobility (n, g) space at each level of per-capita output $y_{i,t}$. Due to the pro-cyclicality of population, this fiscal-mobility curve FM inherits the slope of the fiscal space FS curve.

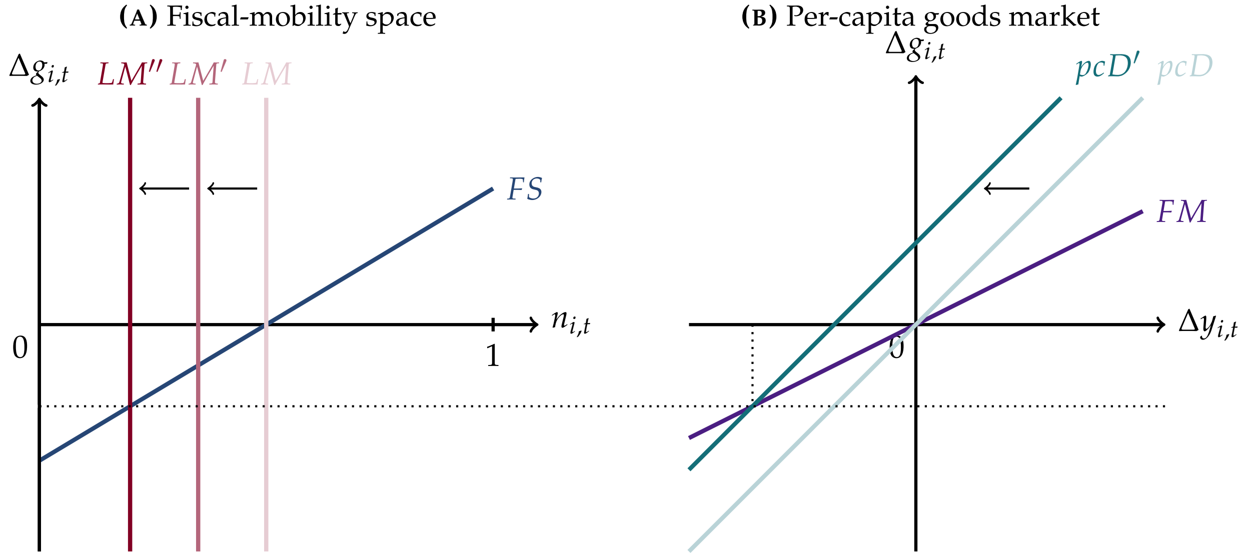
Then, the shift in per-capita demand also moves up along a downward sloping fiscal-mobility equilibrium curve, and the equilibrium fall in $y_{i,t}$ is smaller than the direct negative demand shock (net of the Mundellian adjustment), due to the government being able to pursue a counter-cyclical fiscal policy and expanding $g_{i,t}$. Correspondingly, the total population shift to LM'' is also smaller than the direct shift LM' would have been absent the expansionary fiscal response.

In equilibrium, we end up with lower emigration and a lower drop in per-capita output than the direct and Mundellian effects alone would imply. Labour mobility can relax fiscal constraints, raising $g_{i,t}$ toward $g^*_{i,t}$, and better enabling the government to implement the stabilising counter-cyclical fiscal policy it wishes to pursue. Labour mobility then has a stabilising role that complements the one envisioned by Mundell. This mechanism I call fiscal-mobility stabilisation.

Fiscal-mobility amplifiers. Consider now that the debt burden channel of Theorem 2 dominates, such that emigration has a contracting effect on fiscal space, $\frac{\mathrm{d}\mathcal{F}_{i,t}}{\mathrm{d}(-n_{i,t})} < 0$. With a binding fiscal constraint, FS now has a slope $\frac{\mathrm{d}g_{i,t}}{\mathrm{d}n_{i,t}} > 0$. I use the same fiscal-mobility (n, g) space and goods market (y, g) representation to illustrate the equilibrium response in Figure 3.

FIGURE 3: Fiscal-Mobility Amplification

(A) Fiscal-mobility space **(B)** Per-capita goods market



The same negative demand shock shifting pcD' (again, net of the migration spillover) will, as before, incentivise emigration, leading to a leftward shift of the LM' curve. However, the LM curve is now travelling down an upward sloping fiscal space FS curve, due to the fact that emigration raises the debt burden more than it increases tax revenue, forcing the government into fiscal consolidations that decrease $g_{i,t}$ at a binding fiscal constraint. The fiscal-mobility FM curve again inherits the slope of FS, now upward sloping, capturing how emigration imposes pro-cyclical fiscal policies on the government, despite the government wanting to pursue the counter-cyclical policy $g^*_{i,t}$. The shifted pcD' curve then travels down the FM curve, and the equilibrium fall in per-capita output is larger than the demand shock (net of spillovers) alone would imply, since there is also a reduction in government demand.

The fiscal-mobility equilibrium in this case is such that fiscal consolidations depress regional demand further, leading to even more emigration, and the need for further fiscal consolidations. The economy enters a vicious cycle, in which emigration and shrinking fiscal space reinforce each other, and the negative change in output is amplified beyond the direct demand shock. This mechanism I call fiscal-mobility amplification.

Model-selected equilibrium. A central implication of this framework is that fiscal-mobility amplification is not merely one of two possible equilibria – it is the outcome the model is likely to select. The mechanism of fiscal-mobility interactions only operates when the fiscal constraint (34) binds, which occurs under high legacy debt $b_{i,t-1}$. But the debt burden channel in (35) itself scales directly with $b_{i,t-1}$, while the fiscal contribution channel does not: its magnitude depends on the migration spillover, which does not affect fiscal constraints. Moving into the regime in which fiscal-mobility interactions are active, therefore, is likely to mechanically strengthen the debt burden channel, while leaving the fiscal contribution channel unchanged. If the debt burden channel overwhelms the fiscal contribution channel, we enter the fiscal-mobility amplifying vicious cycle described above. A binding fiscal constraint is, by its very nature, the regime in which emigration is most likely to contract fiscal space rather than expand it. I confirm this prediction in the empirical results of Section V.

III.D Summary of analytical results

At this point in the paper, it is helpful to take stock of the key analytical results derived from the model, before taking their predictions to the data.

Migration spillovers. As in Farhi and Werning (2014), Lemma 1 proves that emigration generates a positive spillover for workers who remain in the origin region, increasing per-capita output. Lemma 2 goes on to show that wages depend positively on per-capita output, and since workers are incentivised to migrate to the region with higher real wages, migration contributes to wage equalisation and to risk-sharing across regions.

Equilibrium populations and effects of fiscal consolidations. Since emigration increases the per-capita output that raises wages, and wages are what incentivise migration, Theorem 1 shows that equilibrium regional populations are determined by a fixed point problem between population and regional demand, guaranteed to have an interior solution due to trade. This means that a fiscal consolidation that cuts government spending, and consequently depresses regional demand, leads to a lower equilibrium population through emigration. Fiscal consolidations through tax hikes have no impact on equilibrium populations, since under sticky prices the incidence of the tax is fully absorbed by firms, and profits are shared globally.

Effects of migration on fiscal space. The exogenous debt limit creates an upper bound on how much the government can consume per-capita, defining the regional government's fiscal space. Theorem 2 shows that emigration exerts two opposing forces on fiscal space. The spillover from emigration raises wages, and consequently the intensive margin of labour supply, expanding per-capita fiscal contributions. At the same time, the existing debt is spread over fewer taxpayers, raising per-capita debt burden and contracting the government's fiscal capacity. The fiscal contribution channel is strengthened by the magnitude of the migration spillover, while the debt burden channel is stronger when legacy debt is high.

Fiscal-mobility stabilisation and amplification. The net effect of emigration on fiscal space determines whether fiscal-mobility propagation leads to a stabilising or amplifying equilibrium. If emigration has a net positive effect on fiscal space, then the emigration wave resulting from a negative demand shock will expand the possible fiscal response of a constrained government. The government is able to enact more expansionary fiscal policy, attenuating the loss in regional demand. If emigration has a net contractionary impact on fiscal space, then the initial emigration will contract fiscal space further and the forced cut in government consumption reinforces the original demand shortage, feeding back into more emigration in a vicious cycle.

Fiscal-mobility amplification as the probable equilibrium. Both fiscal-mobility stabilisation and fiscal-mobility amplification are two possible equilibria of the model, but they are not equally likely. Labour mobility only feeds into fiscal policy when fiscal constraints are binding. Yet, the conditions for this to happen, namely high legacy debt, are also what strengthens the debt burden channel, making it more likely that emigration shrinks fiscal space and triggers the amplifying vicious cycle. The condition that strengthens the fiscal contribution channel, the magnitude of the migration spillover, has no direct impact on fiscal constraints.

IV Data

In order to empirically test some of the predictions of the model, I compile a monthly panel dataset on intra-EU migration, public finance, and economic activity statistics for the 28 countries that have been member states of the European Union in the 21st century. My data begins in January 2000, a year after the introduction of the euro and when many of the data series begin. I end my sample period in December 2019 to exclude the Covid shock, which had very particular consequences on public finances and labour mobility, which may significantly differ from the mechanisms I try to capture. The choice of including all EU countries as opposed to Euro Area countries is due to the fact that monetary policy plays a minimal role in the predictions of Section III, and the key institutional features of the model – legal freedom of movement of labour and autonomous regional fiscal policy – are characteristics of the EU, and not of the Euro Area.

Migration flows and rates. Empirical studies on migration have been extremely constrained by data availability. Official national statistics are extremely lacking in terms of granularity, and are often very incomplete. In terms of micro data, there is very little official information on who migrates, and consequentially applied micro studies often have to rely on data for very niche movers, such as footballers, inventors, or millionaires (see Kleven et al. 2020 for a review). Aggregate data is equally very incomplete, only available at yearly frequencies, and varying a lot in quality - many countries do not record all bilateral flows, a problem which is exacerbated within the Schengen Area. Furthermore, aggregate data does not capture many types of migration flows, such as seasonal or circular migration.

As a solution to these limitations, I use data from Revelio Labs which collects information on LinkedIn job positions and education. Through this, I construct a detailed monthly series of self-reported work- and education-related mobility within the EU. Besides being reported at monthly rather than yearly frequency, other advantages include capturing migration patterns left out by official statistics, such as seasonal and circular migration, as well as capturing intra-Schengen migration which is not recorded by many national authorities. I record a migration *flow* whenever a LinkedIn user's CV states they started a new job or education in an EU country, where their chronologically previous position was in a different EU country. I apply a centred 12-month moving average to aggregate migration flows in order to deal with seasonality and measurement error. Aggregate migration *rates* are then computed as a share of the cubic trend of users in active employment or education. More details on data cleaning can be found in Appendix A.3.1.

There are, nonetheless, also many concerns on the validity of migration flows implied by LinkedIn. Not everyone has a LinkedIn account, not everyone who has an account might update it regularly or accurately,[12] and those who do have an account are highly selected into white collar jobs. To mitigate these concerns, I use the sample weights calculated by Revelio Labs to take into account the probability of each user having an account based on their listed characteristics. I furthermore perform some validation exercises in the Appendix A.4. First, Figure A.1 plots annual bilateral migration flows implied from aggregating the LinkedIn

[12] The sample starts in January 2000 but LinkedIn only publicly launched its platform in May 2003. Moreover, many users may only have created an account later in the sample. This is not a concern as long as users update their profiles retroactively to include job positions existing prior to the creation of their account. Moreover, while the lower usage of the platform in early years may affect migration flows, it should not affect migration rates.

series against available national data,[13] showing a strong log-log correlation of 0.83, and a slope indistinguishable from 1. Second, Figure A.2 plots the time series of the net migration rate for each country, constructed from the monthly LinkedIn series and the annual official statistics, again showing a very strong overlap between the two series for most countries.[14]

While these validations are reassuring of the representativeness of the LinkedIn migration series, the more conservative interpretation is still to regard this series as capturing skilled labour migration. For this reason, while I use the LinkedIn data for identified estimation of *how many* migrate, future work should use alternative data sources – such as labour force surveys – for descriptive evidence of *who* migrates.

Other variables and data sources. Another key variable that is difficult to obtain at a monthly frequency is government debt stocks, which are mostly reported on a quarterly basis. However, I construct monthly debt stocks series by exploiting the fact that debt securities – the largest instrument of total government debt – are widely available at monthly frequencies. The main data source used for this procedure is the ECB's and Eurostat's Government Finance Statistics dataset, complemented with the ECB's alternative CSDB-derived Securities Issues Statistics to cover some missing data gaps. These data reveal that debt securities, reported at a monthly frequency, constitute on average 72% of total government debt, and are available for 75% of observations. This implies that roughly 55% of monthly variation in sovereign debt stocks can be observed and constructed directly. The variation in the remaining debt instruments (loans, and currency and deposits) is linearly interpolated from quarterly to monthly, and the same is done for the missing observations of debt securities. Since debt is a slow moving stock variable, it is unlikely that there will be a lot of deviation from this linear interpolation over a three-month window, minimising concerns of measurement error. Furthermore, since I am mostly interested in variations in debt level rather than changes in output, I construct debt-to-GDP ratios as the ratio between the monthly debt series and *trend* GDP. Trend GDP is estimated by regressing quarterly log GDP on country-specific cubic time trends and exponentiating the monthly fitted values. A more detailed description of how the monthly debt stock series was constructed and treated, namely data consolidation, is included in Appendix A.3.2.

Additional variables used in the regression analysis include monthly unemployment rates, industrial production, and government bond yields. Unemployment rates are taken from the monthly Eurostat seasonally adjusted series for all EU-28 countries.[15] Monthly industrial production is also taken from Eurostat's seasonally and calendar adjusted data, indexed at 2015 volume levels. It covers production in mining and quarrying, manufacturing, electricity, gas, steam, and air conditioning supply. Finally, government bond yields are equally sourced from Eurostat, based on their series of long-term interest rates based on the convergence

[13]For 28 EU countries and a 20 year period between 2000 and 2019, there exists a total of 15,680 origin-destination-year flow triads. While from LinkedIn we get data for all these observations, national statistics only has data for 8,178 of these flows, demonstrating how poorly migration flows within Schengen are reported.

[14]The Appendix A.4 discusses further possible reasons for existing discrepancies in more detail.

[15]Estonia is missing one observation, which is filled in with data from the OECD.

criterion of the European Monetary Union (EMU). This is based on Maastricht Treaty EMU convergence criterion, related to central government bond-yields with residual maturity of around 10 years. This variable is the binding impediment in obtaining a fully balanced panel, as some countries do not have 10-year government bonds over the sample period. Instead of using bonds with different maturities that would reduce comparability between countries, I opt to drop these observations, resulting in an unbalanced panel. The detailed list of missing observations is included in Appendix A.3.3.

Overall, in the main panel dataset, I have monthly observations on 28 countries for most of the 240 month period ranging from January 2000 to December 2019. Due to the unavailability of 10-year government bonds for some months and countries, the final dataset is an unbalanced panel of 6,196 observations in total. The empirical section also estimates the response of fiscal variables which are only available at quarterly frequency. For this purpose, government consumption was also obtained for the same panel of EU-28 countries between 2000 Q1 and 2019 Q4, sourced from Eurostat.

V Empirical Evidence

I use the monthly panel of EU countries between January 2000 and December 2019 to empirically test the predictions of Section III. The EU during this period is a natural laboratory for fiscal-mobility interactions. Most member states shared a monetary authority and therefore relied on labour and fiscal adjustments to absorb cross-country imbalances. The EU allows for free movement of labour, but mobility is too low (Arpaia et al., 2016) to dispense with the need for fiscal stabilisation. Furthermore, there is no federal fiscal authority, so each member state must rely on its own fiscal capacity. During the sovereign debt crisis, many countries breached the institutionally-imposed 60% Maastricht debt ceiling, and several reached the market-implied debt limits. Fiscal constraints were therefore binding, and with workers emigrating *en masse* from depressed peripheral economies, the EU provides an ideal setting to test fiscal-mobility interactions.

V.A SVAR model

Identification. I estimate a structural vector autoregression (SVAR) model on the monthly panel of EU countries. The SVAR specification estimates a system of equations with 36 monthly lags, according to

$$\mathbf{Y}_{i,t} = \sum_{k=1}^{36} \mathbf{A}_k \mathbf{Y}_{i,t-k} + \alpha_i + \alpha_{EU/€,t} + \delta_i \cdot t + \mathbf{B}\varepsilon_{i,t}. \tag{36}$$

$\mathbf{Y}_{i,t}$ is a vector of endogenous variables on migration, fiscal space, and economic activity for country i in month t. The matrix $\mathbf{A}_k$ encodes own- and cross-variable effects, from the kth lag to the contemporaneous values. Matrix $\mathbf{B}$ maps the vector of orthogonal i.i.d. structural shocks $\varepsilon_{i,t}$ to the contemporaneous responses of the endogenous variables. It is assumed that all matrices $\mathbf{A}_k$ and $\mathbf{B}$ are invariant across time and countries, and that there is no cross-dependence of endogenous variables across countries, i.e. a country's endogenous variables respond to their own lags, but not the lags of others.

The vector of endogenous variables $\mathbf{Y}_{i,t}$ includes the monthly immigration and emigration rates constructed from the LinkedIn data (both annualised), the debt-to-trend-GDP ratio constructed from the monthly debt securities series, the unemployment rate, the natural logarithm of an industrial production index, and the harmonised 10-year government bond yield. The system is estimated by OLS, with the inclusion of a country fixed effect α_i,[16] a time fixed effect $\alpha_{EU/€,t}$, and a country-specific linear time trend $\delta_i \cdot t$. Since not all EU member states are part of the Euro Area (and hence maintain monetary autonomy), and since some countries in my panel joined the EU mid-sample, the time fixed effect $\alpha_{EU/€,t}$ is allowed to differ according to EU and Euro Area membership status. This flexibility accounts for different exposure to common Euro Area monetary policy, or other EU policies commonly affecting migration and fiscal space.

OLS estimation of the reduced-form VAR does not separately identify the vector of structural shocks $\varepsilon_{i,t}$ and its mapping matrix $\mathbf{B}$. Instead it only recovers their product $\mathbf{B}\varepsilon_{i,t}$, the reduced-form residuals. As is standard in SVAR estimation, identification requires additional restrictions. I impose short-run timing restrictions (Sims, 1980) via a Cholesky decomposition of the reduced-form variance-covariance matrix, with variables ordered as: immigration rate, emigration rate, debt-to-trend-GDP, log industrial production, unemployment, bond yield. I follow the timing logic of Blanchard and Perotti (2002) in treating slow-moving fiscal variables (debt in my case) as pre-determined relative to real activity, and Favero and Giavazzi (2007) in ordering fast-moving financial variables (bond yields) last. The identifying assumption is that migration does not respond within the same month to shocks to debt, real activity, or bond yields. I order immigration before emigration on the assumption that workers residing outside a country respond more slowly to its economic conditions than workers already residing within it, who can observe and react to local conditions directly. Results are robust to reversing this ordering between migration rates.

The SVAR approach offers two advantages relative to alternative estimation strategies. First, as Theorems 1 and 2 establish, the causality between labour mobility and fiscal space is bidirectional. The SVAR is well-suited to jointly estimating this mutual dependency, as the system of equations ensures that the estimated effects of labour mobility on fiscal space and vice versa are internally consistent and jointly determined, which might not be the case if each direction was instead separately estimated. Second, the SVAR achieves identification without resorting to external instruments. Finding monthly, country-heterogeneous instruments

[16] The inclusion of country fixed effects in the dynamic SVAR model introduces Nickell (1981) bias in estimates. However, given that I have a long panel (average $\bar{T}$ for each country is 229, for a maximum T of 240 between January 2000 and December 2019), the average scale of the bias is $O(1/\bar{T})$, which with 36 lags gives an average bias of around $\frac{1}{T-K} = \frac{1}{229-36} \approx 0.5\%$, a negligible amount (see Alvarez and Arellano 2003 for the formal result that the within-groups estimator is consistent and asymptotically unbiased as $T \to \infty$). For this reason, I ignore possible Nickell biases and include country fixed effects to avoid model misspecification.

for both fiscal space and labour mobility is impractical. National policy shocks apply only to the country in question, while EU-wide shocks are scarce and their differential impact across countries is difficult to identify exogenously. The SVAR identification circumvents this problem by relying instead on short-run timing restrictions, as done by the literature when instruments for a large panel of countries are unavailable (Ilzetzki et al., 2013).

This last point highlights the importance of constructing a higher frequency monthly panel, as opposed to the more readily available lower frequency annual data on migration and debt. Since identification relies on the short-run timing restrictions rather than some exogenous variation in an instrument, the meaning of "contemporaneous effects" across variables is highly sensitive to the frequency of the data. The identifying assumption that migration does not respond contemporaneously to any fiscal space or economic activity shock is particularly plausible if we are talking about same-*month* responses. The decision to migrate is a costly one, both financially and personally, and it is believable that families do not relocate across national borders within the same month that fiscal space contracts or economic activity drops. The same assumption is less believable if contemporaneous response means same-*year* response. If a persistent shock that contracts fiscal space or leaves families unemployed hits early in the year, it is more plausible that workers would choose to emigrate by the end of the year, violating the identifying assumption under annual frequency but not monthly frequency. Monthly frequency is therefore a key feature of my structural identification.

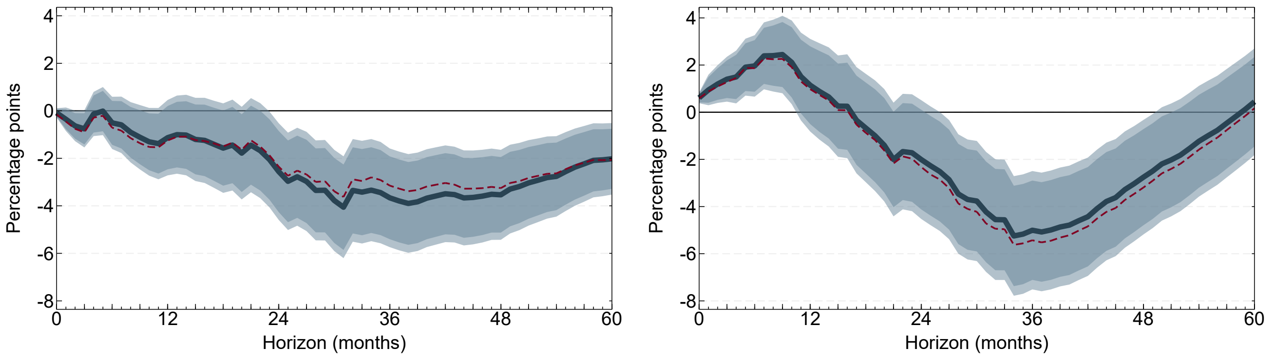
Results. I now turn to presenting and discussing the impulse response functions (IRFs) that most closely relate to the predictions of Section III. The full set of IRFs is shown in Figure A.3 in Appendix A.5. Most of the analytical discussion of Section III was on the effects and responses of emigration, and while this will also be the focus of my discussion in this subsection, I present the analogous immigration results for comparison of any (a)symmetries. All figures show IRFs for a 60 month (5 year) horizon under the variable ordering previously discussed. Shaded areas show 95% and 90% confidence bands, in which standard errors were estimated under a normal approximation of 10,000 recursive wild bootstraps. The dashed red line on the IRFs for migration shocks show the point estimates under the alternative in which emigration is ordered before immigration in the Cholesky decomposition. All shocks are normalised to increase their corresponding variable by 1 unit.

Figure 4 plots the response of the unemployment rate to a shock that raises either the immigration (panel A) or emigration (panel B) rate by 1 percentage point. Note that these are rather large migration shocks, respectively corresponding to 4.3 and 5.2 standard deviations of the migration rates residualised from the same fixed effects and country-specific linear trends as the SVAR. Swapping immigration and emigration in the Cholesky ordering has visually almost no impact on results.

The estimates provide some evidence for the migration spillover effect from Lemma 1. A positive 1pp emigration rate shock leads to a significant reduction in unemployment in the

FIGURE 4: Responses of Unemployment Rate (SVAR)

(A) Immigration Rate Shock **(B)** Emigration Rate Shock



Notes: Shaded areas show 95% and 90% confidence bands using 10,000 recursive wild bootstraps under a normal approximation. Dashed red line plots point estimates when emigration is instead ordered before immigration in the Cholesky decomposition.

origin region, peaking at a 5pp decline after 36 months (3 years). This can be interpreted in numerous ways. From the perspective of the model and predictions of Sections II and III, emigration raised per-capita output, which increased wages, and consequently increased labour supply. While the model did not have unemployment defined explicitly, this is consistent with the predicted fall in $1 - \ell_{i,t}$. In reality, the drop in unemployment can be indication that the unemployed are the most likely to emigrate. The initial spike of 2pp in unemployment in the first 9 months could also indicate some on-the-job search by employed workers who leave the country and inflate unemployment statistics. The resulting vacant jobs could then be taken up by the unemployed, explaining the fall in the metric.

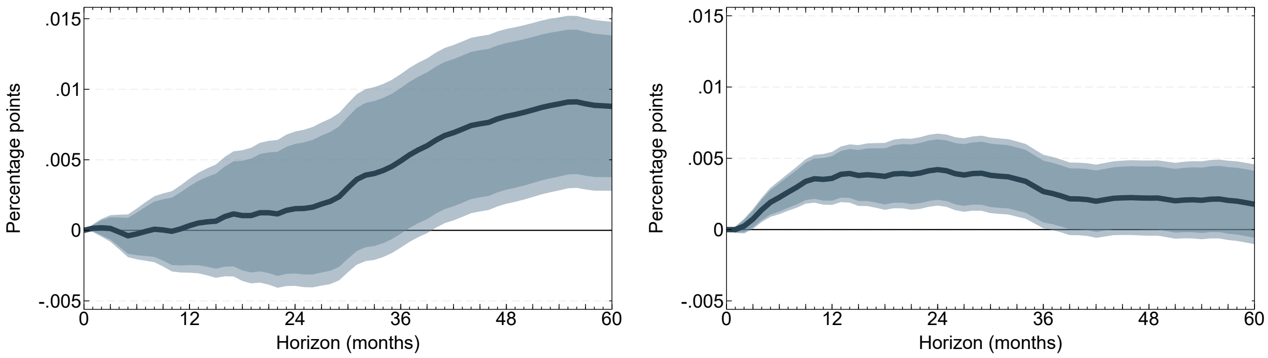
Curiously, an immigration rate shock also seems to decrease unemployment in the receiving country, with a peak decline of roughly 4 percentage points. This is harder to reconcile with the symmetric setup of my model, but there are a couple of potential explanations. First, alternative directed search models could predict that the unemployed in one country search for vacancies elsewhere, so successful migration reduces measured unemployment in both origin and destination. Second, and more importantly, this result may be driven by data limitations. The LinkedIn migration measure records a migration flow whenever a user reports starting a job in a new country. This means that a migration flow is recorded regardless of employment status at origin, but by construction is only recorded when accompanied by a new job (or education) at destination. This could be driving the immigration shock IRF, while not affecting much the one for the emigration shock.

Figure 5 plots the responses of immigration (panel A) and emigration (panel B) rate to a shock that increases government debt by 1 percentage point of trend GDP. This is a relatively small shock in the data, corresponding to a 0.2 standard deviation of debt-to-trend-GDP, again residualised from the same fixed effects and country-specific linear trends as the SVAR.

This is an imperfect test of Theorem 1, which predicts emigration in response to cuts in government spending rather than to debt shocks *per se*. A direct test would require an exogenous spending shock, but monthly aggregate government spending data is not available

FIGURE 5: Migration Responses to a Debt Shock (SVAR)

(A) Response of Immigration Rate **(B)** Response of Emigration Rate



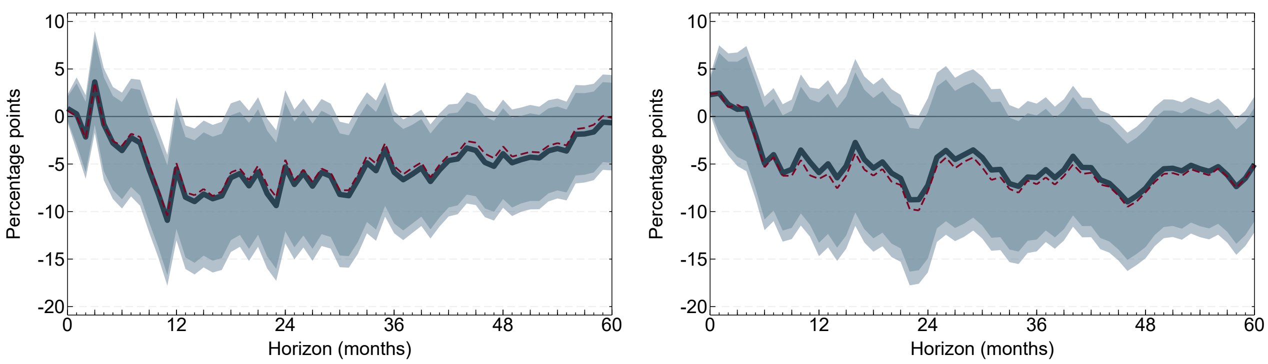
Notes: Shaded areas show 95% and 90% confidence bands using 10,000 recursive wild bootstraps under a normal approximation.

for the EU panel. The debt shock is the closest available proxy: in contracting fiscal space, it forces spending cuts, but only when the debt limit binds. For most country-months in the panel, the constraint is slack, so a 1pp debt shock (which as noted before is already a relatively small shock) requires no offsetting spending response and produces little to no emigration. This could explain the muted average effect, with the response of emigration rate peaking at 0.005pp after 24 months (2 years), roughly 0.025 standard deviations of the residualised series. Nonetheless, it is reassuring that the emigration response has the sign predicted by Theorem 1, even when averaged across regimes where the fiscal constraint is mostly slack. The immigration rate also rises, but only at longer horizons (past 36 months), where the total magnitude is imprecisely estimated.

Finally, Figure 6 plots the response of debt-to-trend-GDP to an immigration (panel A) and an emigration (panel B) shock. As before, swapping the ordering of the two migration rates in the Cholesky decomposition makes no significant difference to the point estimates.

FIGURE 6: Responses of Debt/GDP (SVAR)

(A) Immigration Rate Shock **(B)** Emigration Rate Shock



Notes: Shaded areas show 95% and 90% confidence bands using 10,000 recursive wild bootstraps under a normal approximation. Dashed red line plots point estimates when emigration is instead ordered before immigration in the Cholesky decomposition.

When the emigration rate exogenously increases by 1pp, debt-to-trend-GDP in the origin country falls by around 5pp after 6 months, and remains stable and persistent at that level for at least 60 months (5 years). An immigration rate shock produces an effect of similar magnitude on debt-to-trend-GDP, albeit reverting back to the mean within 60 months.

These responses relate to the predictions of Theorem 2, though the mapping is not immediate. Equation (35) characterises how the origin region's fiscal space responds to emigration, with the fiscal contribution channel and the debt burden channel pulling in opposite directions. The immigration shock IRF in panel A instead captures the destination's response, in which both channels flip sign: per-capita output falls with population inflows (by Lemma 1), shrinking the per-capita tax base, while the existing debt stock is spread over more workers, easing the per-capita burden. The fact that the two IRFs are not mirror images is therefore consistent with Theorem 2 once asymmetries in labour supply parameters, spillover effects, and legacy debt servicing costs across origin and destination are accounted for. Interestingly, empirically it seems to be the case that migration reduces public debt, both for the origin and the destination country. This is consistent with the reduction in unemployment under both shocks (Figure 4), which would also indicate a positive gain in net fiscal contributions.

Most importantly, (negative) debt-to-trend-GDP is not the same object as fiscal space $\mathcal{F}_{i,t}$ as defined in Section III. Both channels of (35) can rationalise the observed fall in debt. If the fiscal contribution channel dominates, emigration raises per-capita tax revenue, primary surpluses improve, and total debt declines. If instead the debt burden channel dominates, the fiscal constraint (34) binds and forces the government into a fiscal consolidation, which also reduces total debt. Therefore, while these results are consistent with the predictions of Theorem 2, the sign of the debt response is uninformative about which channel dominates, whether labour mobility relaxes or tightens fiscal constraints, and consequently about whether fiscal-mobility interactions stabilise or amplify the original shock. Answering this question requires looking at the response of other fiscal variables, a task that I turn to next.

V.B Response of fiscal variables

Whether fiscal-mobility interactions are stabilising or amplifying depends on the sign of how migration affects fiscal space, as shown in (35). When the constraint binds and fiscal space reacts positively to emigration, the government can pursue a counter-cyclical fiscal policy and fiscal-mobility has a stabilising role. When fiscal space instead contracts following emigration, the government is forced into pro-cyclical fiscal consolidations and fiscal-mobility has an amplifying role.

Testing this in the data is complicated by the fact that the fiscal space measure $\mathcal{F}_{i,t}$ used in Section III is a model object: it represents the maximum the government can spend per-capita, and depends on model parameters that cannot be directly observed. The empirical literature has instead used the (negative) debt-to-GDP ratio as a measure of fiscal space (Romer and Romer, 2019; Bellifemine et al., 2025), but the two are not the same object and, as argued in the previous subsection, the debt response is uninformative about which channel of (35) dominates. The model nonetheless provides an indirect test. When the fiscal constraint (34) binds, government spending equals the fiscal space measure, $g_{i,t} = \mathcal{F}_{i,t}$, and the constraint is more likely to bind when the existing debt stock $b_{i,t-1}$ is high. The high-debt regime is therefore precisely the regime in which government consumption tracks $\mathcal{F}_{i,t}$, and the impact of labour mobility on fiscal space can be inferred from the response of government consumption to migration shocks during high-debt periods.

This test requires moving to quarterly frequency, since data on government consumption is not available at monthly frequency for EU countries. I obtain quarterly emigration shocks by summing the monthly emigration rate structural residuals $\widehat{\varepsilon}^{Emi}_{i,t}$ from the SVAR (36) within each quarter.[17] Using the un-normalised estimated shocks, I estimate the response of government consumption $G_{i,t}$ to an emigration shock, differentially across low- and high-debt regimes, with the following local projection (Jordà, 2005),

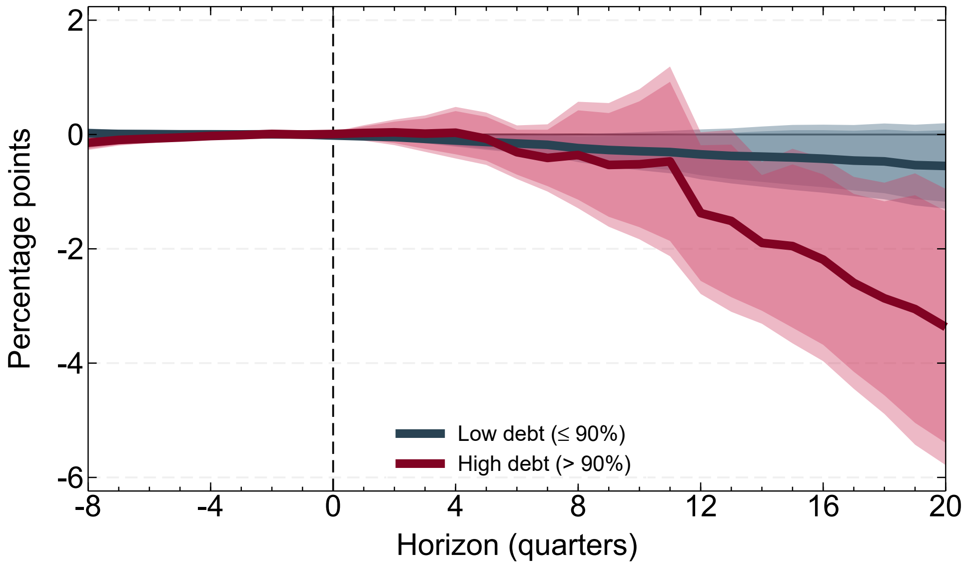
$$\sum_{s=0}^{h} \frac{G_{i,t+s} - G_{i,t-1}}{Y_{i,t-1}} = \beta^L_h \cdot \widehat{\varepsilon}^{Emi}_{i,t} \times \mathbb{1}\left\{\frac{B_{i,t-1}}{Y_{i,t-1}} \leq 90\%\right\} + \beta^H_h \cdot \widehat{\varepsilon}^{Emi}_{i,t} \times \mathbb{1}\left\{\frac{B_{i,t-1}}{Y_{i,t-1}} > 90\%\right\} \\ + \mathbf{\Gamma}'_{i,t}\gamma_h + \alpha_{i;h} + \alpha_{EU/€,t;h} + \delta_{i;h} \cdot t + v_{i,t;h}, \tag{37}$$

where t now corresponds to a quarter instead of a month. The left-hand side denotes the cumulative change in government consumption relative to the quarter prior to the shock, scaled by pre-shock trend GDP $Y_{i,t-1}$. While the model defines fiscal space $\mathcal{F}_{i,t}$ in terms of per-capita government spending $g_{i,t}$ rather than aggregate spending $G_{i,t}$, the ratio $G_{i,t}/Y_{i,t}$ coincides with the per-capita ratio $g_{i,t}/y_{i,t}$, the model-relevant object. The coefficients of interest are β^L_h and β^H_h, capturing the cumulative response of government consumption at each horizon h in low- and high-debt regimes, respectively. I define the high-debt regime as debt $B_{i,t-1}$ exceeding 90% of trend GDP, a threshold taken from Reinhart and Rogoff (2010). Results are robust to instead using the higher 120% limit considered by Herndon et al. (2014) (see Figure A.4 in Appendix A.6). Although the emigration shocks are by construction orthogonal to all lags of the endogenous variables in the SVAR (36), I include in $\mathbf{\Gamma}_{i,t}$ a vector of controls comprising the direct effect of the high-debt dummy and four lags of the debt-to-trend-GDP ratio, to absorb residual variation in debt dynamics that might otherwise be conflated with the regime split. Results are robust to removing these lags, although confidence bands widen. As in the SVAR (36), $\alpha_{i;h}$ is a country fixed effect, $\alpha_{EU/€,t;h}$ is a time fixed effect that varies with EU and Euro Area membership status, and $\delta_{i;h} \cdot t$ is a country-specific linear time trend. Standard errors are clustered at the country level.

Figure 7 plots the impulse response functions under the two debt regimes. There are no visible pre-trends prior to the shock, as expected given the orthogonality of the SVAR structural residuals to past observables. In low-debt regimes, emigration has no statistically significant cumulative impact on government consumption over a 20-quarter (five-year) horizon. This is expected. When governments have low debt, the fiscal constraint (34) is

[17] The applied micro literature often uses a shift-share approach to construct exogenous changes in migration, using shares of migrant population stocks (Card, 2009). That approach does not work here as these shift-share instruments are not shocks and are almost perfectly predicted by their lags, losing all power and making them unsuitable for dynamic settings.

FIGURE 7: Cumulative Response of Government Consumption to an Emigration Rate Shock (LP)



Notes: Figure shows the cumulative response of government consumption, expressed as a percentage of pre-shock trend GDP. The shock is the (unscaled) emigration rate structural residual from (36), therefore corresponding to a positive 1 standard deviation shock. Shaded areas show 95% and 90% confidence bands using standard errors clustered at the country level.

likely slack, and any effects of migration on fiscal space $\mathcal{F}_{i,t}$ will not bind on government spending. If anything, the positive spillover effects from emigration reduce the need for stimulative government consumption. The same cannot be said of high-debt regimes. An emigration shock reduces government consumption by a cumulative 3.4pp of trend GDP over 20 quarters, and the cumulative response is statistically significantly different from the low-debt response at the 10% level after 14 quarters.

This result is striking, and the most direct empirical evidence for fiscal-mobility amplification. When the fiscal constraint binds and $g_{i,t} = \mathcal{F}_{i,t}$, emigration forces a reduction in government consumption, indicating a contraction of fiscal space and that the debt burden channel of (35) dominates the fiscal contribution channel. The result also suggests that fiscal-mobility amplification is a more likely outcome than fiscal-mobility stabilisation in practice. Fiscal-mobility interactions only operate when the fiscal constraint binds, which requires high debt. But the debt burden channel in (35) scales directly with the legacy debt stock, so the regime in which the channel is active is also the regime in which the amplifying case is selected by construction. The fiscal contribution channel, by contrast, depends mainly on the migration spillover, which is not regime-dependent. Taken together, these results are highly suggestive that labour mobility amplified shocks to high-debt countries in the EU between 2000 and 2019, by further shrinking their fiscal space and forcing pro-cyclical fiscal consolidations.

VI Conclusion

The shock propagation role of labour mobility in a currency union is fundamentally tied to the fiscal space of its member governments, an interdependence that the existing literature, in treating labour mobility and fiscal policy as separable adjustment mechanisms, has so far overlooked. When workers emigrate from a depressed region, they generate spillover effects that raise per-capita fiscal contributions, but they also spread the existing debt stock over fewer taxpayers, raising the per-capita debt burden. The dominating channel determines whether fiscal-mobility interactions reinforce labour mobility stabilisation or amplify the original shock. Critically, while both equilibria are possible, the model selects fiscal-mobility amplification as the more likely outcome. The very condition that activates fiscal-mobility interactions – high legacy debt constraining the government's fiscal response – mechanically strengthens the debt burden channel over the fiscal contribution channel. I confirm this prediction empirically using a novel monthly panel of intra-EU migration flows for 2000-2019, showing that in high-debt regimes emigration reduces cumulative government consumption by 3.4pp of GDP over 20 quarters, whereas in low-debt regimes the effect is essentially zero.

These results have policy implications that should provide a new lens through which we view and interpret austerity programmes in currency unions, with a clear focus on the Euro Area. The conventional framing during the sovereign debt crisis is that austerity was necessary for the stability of the union, while emigration was a natural outcome which was separately helpful in union-wide stabilisation, but this interpretation misses a key feedback loop. Emigration from fiscally constrained southern European economies likely deepened the required fiscal consolidations and prolonged the associated recessions, in direct conflict with the simultaneous Mundellian adjustment effects. Austerity and emigration are not parallel adjustment mechanisms, but rather mutually reinforcing forces.

This naturally raises normative policy questions for future research. The first is quantitative: what is the welfare-optimal degree of labour mobility in a currency union, once the Mundellian stabilisation benefit is weighed against the potential fiscal-mobility amplification cost? The second is institutional: can fiscal-mobility amplification be avoided under a federal fiscal architecture, where a supranational authority distributes fiscal burdens to compensate for the loss of an emigrating workforce, thereby eliminating the potential negative impact of mobility on stabilisation? The question this paper answers – whether fiscal-mobility propagation is stabilising or amplifying – is the necessary foundation to answer such normative questions, and should frame how we think about optimal currency area design going forward.

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A Appendix

A.1 Proof of Lemma 1

Proof. Define

$$C_{i,t} \equiv \sum_{s^t|s_t=i} n(s^t)c_t(s^t), \qquad G_{i,t} \equiv n_{i,t}g_{i,t}, \quad \text{and} \quad B_{i,t} \equiv n_{i,t}b_{i,t}$$

as regional aggregate private and public consumption, and regional aggregate public debt, respectively. Further define

$$D_{i,t} \equiv n_{i,t}\pi_t - \Pi_{i,t}$$

as the net foreign income flow received from global distribution of firm profit dividends, assumed in equation (19), and

$$S_{i,t} \equiv \left(\sum_{s^t|s_t=i} n(s^t)a_t(s^t) - (1+r_t) \sum_{s^t|s_t=i} n(s^t)a_{t-1}(s^{t-1}) \right) - (B_{i,t} - (1+r_t)B_{i,t-1})$$

as the aggregate net savings of region i's resident households and government at time t.

Aggregating the household and the government budget, we obtain the region's budget constraint,

$$C_{i,t} = Y_{i,t} + D_{i,t} - G_{i,t} - S_{i,t}. \tag{A.1}$$

The market clearing condition in aggregate terms is

$$Y_{i,t} = \alpha_{i,t}C_{i,t} + (1-\alpha_{-i,t})C_{-i,t} + G_{i,t}. \tag{A.2}$$

Combining the two generates a linear demand system represented by

$$(I - \Omega_t)(\mathbf{Y}_t + \mathbf{D}_t - \mathbf{G}_t - \mathbf{S}_t) = \mathbf{D}_t - \mathbf{S}_t, \tag{A.3}$$

with

$$\Omega_t = \begin{bmatrix} \alpha_{N,t} & 1-\alpha_{S,t} \\ 1-\alpha_{N,t} & \alpha_{S,t} \end{bmatrix}$$

capturing the spending shares, I being the identity matrix, $\mathbf{Y}_t \equiv [Y_{N,t}, Y_{S,t}]'$, and $\mathbf{G}_t$, $\mathbf{D}_t$, and $\mathbf{S}_t$ defined analogously.

Given that: (i) entries of Ω_t are strictly positive, as imposed by $\alpha_{i,t} \in (0,1)$; (ii) columns of Ω_t sum up to 1; and (iii) $D_{N,t} + D_{S,t} = 0$ and $S_{N,t} + S_{S,t} = 0$, implying $\mathbf{D}_t - \mathbf{S}_t$ lies in the range of $(I - \Omega_t)$; then, by the Perron-Frobenius theorem, Ω_t has a unique (up to scale) strictly positive eigenvector $\mathbf{C}^* \equiv [C_N^*, C_S^*]'$ corresponding to eigenvalue 1.

The general solution to the inhomogeneous system (A.3) consists of a particular solution plus any element of the null space of $(I - \Omega_t)$. To find a particular solution, observe that

$$I - \Omega_t = \begin{bmatrix} 1 - \alpha_{N,t} & -(1 - \alpha_{S,t}) \\ -(1 - \alpha_{N,t}) & 1 - \alpha_{S,t} \end{bmatrix},$$

which applied to any zero-summing vector $(z, -z)'$ gives

$$(I - \Omega_t) \begin{bmatrix} z \\ -z \end{bmatrix} = \begin{bmatrix} (1 - \alpha_{N,t})z + (1 - \alpha_{S,t})z \\ -(1 - \alpha_{N,t})z - (1 - \alpha_{S,t})z \end{bmatrix} = (2 - \alpha_{N,t} - \alpha_{S,t}) \begin{bmatrix} z \\ -z \end{bmatrix}.$$

Since $\mathbf{D}_t - \mathbf{S}_t$ is a zero-summing vector (cross-region sum of net dividend flow is zero, and union-wide sum of household and government savings is also zero), a particular solution is

$$\frac{\mathbf{D}_t - \mathbf{S}_t}{2 - \alpha_{N,t} - \alpha_{S,t}}.$$

The general solution to the inhomogeneous system is therefore

$$\mathbf{Y}_t + \mathbf{D}_t - \mathbf{G}_t - \mathbf{S}_t = \Lambda_t \mathbf{C}^* + \frac{\mathbf{D}_t - \mathbf{S}_t}{2 - \alpha_{N,t} - \alpha_{S,t}}. \tag{A.4}$$

Rearranging at the regional level,

$$Y_{i,t} = \Lambda_t C_i^* + G_{i,t} + \frac{\alpha_{N,t} + \alpha_{S,t} - 1}{2 - \alpha_{N,t} - \alpha_{S,t}} (D_{i,t} - S_{i,t}), \tag{A.5}$$

for some scalar Λ_t, which is pinned down by monetary policy and fiscal policy. Concretely, summing (A.5) across regions,

$$\Lambda_t = \frac{Y_{N,t} + Y_{S,t} - G_{N,t} - G_{S,t}}{C_N^* + C_S^*}. \tag{A.6}$$

Crucially, under the assumption that the central bank keeps union-wide aggregate output constant, implying $\frac{\mathrm{d}(Y_{N,t}+Y_{S,t})}{\mathrm{d}n_{i,t}} = 0$, together with symmetric government spending under fixed fiscal policy such that $\frac{\mathrm{d}(G_{N,t}+G_{S,t})}{\mathrm{d}n_{i,t}} = 0$, then Λ_t becomes independent of $n_{i,t}$. Furthermore, C_i^* also depends only on $\alpha_{N,t}$ and $\alpha_{S,t}$, and not on $n_{i,t}$.

Using these insights, differentiating (A.5) yields

$$\begin{aligned} \frac{\mathrm{d}Y_{i,t}}{\mathrm{d}n_{i,t}} &= \frac{\mathrm{d}G_{i,t}}{\mathrm{d}n_{i,t}} + \frac{\alpha_{N,t} + \alpha_{S,t} - 1}{2 - \alpha_{N,t} - \alpha_{S,t}} \left(\frac{\mathrm{d}D_{i,t}}{\mathrm{d}n_{i,t}} - \frac{\mathrm{d}S_{i,t}}{\mathrm{d}n_{i,t}} \right) \\ &= g_{i,t} + \frac{\alpha_{N,t} + \alpha_{S,t} - 1}{2 - \alpha_{N,t} - \alpha_{S,t}} \left(\frac{\mathrm{d}D_{i,t}}{\mathrm{d}n_{i,t}} - \frac{\mathrm{d}S_{i,t}}{\mathrm{d}n_{i,t}} \right). \end{aligned} \tag{A.7}$$

In turn, using the above result to differentiate per-capita output gives

$$\frac{\mathrm{d}y_{i,t}}{\mathrm{d}n_{i,t}} = -\frac{y_{i,t} - g_{i,t}}{n_{i,t}} + \frac{\alpha_{N,t} + \alpha_{S,t} - 1}{n_{i,t}(2 - \alpha_{N,t} - \alpha_{S,t})} \left(\frac{\mathrm{d}D_{i,t}}{\mathrm{d}n_{i,t}} - \frac{\mathrm{d}S_{i,t}}{\mathrm{d}n_{i,t}} \right). \tag{A.8}$$

Signing this derivative depends on the nuisance second summation term on the right-hand-side, since the first term is always negative for any positive value of private demand.

If profits are distributed locally, then there are no flows of net foreign dividend income and $D_{i,t} = 0$, $\forall t$. Furthermore, at a zero-asset and zero-migration baseline, the change in relative savings with respect to changes in population is second order, and $\mathrm{d}S_{i,t}/\mathrm{d}n_{i,t} = 0$ to first order. In this case, the nuisance term is zero, and we obtain $\mathrm{d}y_{i,t}/\mathrm{d}n_{i,t} < 0$ unconditionally.

Global profit distribution, as assumed in equation (19) of the model in Section II, allows for $D_{i,t} \neq 0$. Furthermore, at a baseline with positive asset holdings, $\mathrm{d}S_{i,t}/\mathrm{d}n_{i,t}$ becomes first-order. Under either scenario, the sign of $\mathrm{d}y_{i,t}/\mathrm{d}n_{i,t}$ becomes non-trivial. Nonetheless, under additional parametric restrictions, it is possible to bound the nuisance term so that it can never offset the negative first term, regardless of the signs of $\mathrm{d}D_{i,t}/\mathrm{d}n_{i,t}$ and $\mathrm{d}S_{i,t}/\mathrm{d}n_{i,t}$. This can be done directly through sufficiently neutral home-bias, since as $\alpha_{N,t} + \alpha_{S,t} \to 1$, the entire nuisance term, including both dividend and savings contributions, vanishes.

In particular, if $\frac{\mathrm{d}D_{i,t}}{\mathrm{d}n_{i,t}} - \frac{\mathrm{d}S_{i,t}}{\mathrm{d}n_{i,t}} > 0$ (the only scenario where the sign of $\mathrm{d}y_{i,t}/\mathrm{d}n_{i,t}$ is ambiguous), the sufficient condition on home bias is that average home bias satisfies

$$\frac{\alpha_{N,t} + \alpha_{S,t}}{2} \in \left[\frac{1}{2}, \alpha^*\right],$$

where

$$\alpha^* \equiv \min_{i \in \mathcal{I}} \left\{ \frac{1 + 2\delta_{i,t}}{2(1 + \delta_{i,t})} \right\},$$

and

$$\delta_{i,t} \equiv \frac{y_{i,t} - g_{i,t}}{\mathrm{d}D_{i,t}/\mathrm{d}n_{i,t} - \mathrm{d}S_{i,t}/\mathrm{d}n_{i,t}}.$$

Since $\alpha^* > \frac{1}{2}$, there is an admissible range of $\alpha_{i,t}$ values that allows both for home bias ($\alpha_{i,t} > \frac{1}{2}$) and for which $\mathrm{d}y_{i,t}/\mathrm{d}n_{i,t}$ is still guaranteed to be negative. Under such sufficient (possibly not necessary if $\frac{\mathrm{d}D_{i,t}}{\mathrm{d}n_{i,t}} - \frac{\mathrm{d}S_{i,t}}{\mathrm{d}n_{i,t}} < 0$) parametric conditions, the result

$$\frac{\mathrm{d}y_{i,t}}{\mathrm{d}n_{i,t}} < 0 \tag{A.9}$$

holds under the global profit distribution and non-zero-assets baseline, without having to determine the sign of $\mathrm{d}D_{i,t}/\mathrm{d}n_{i,t} - \mathrm{d}S_{i,t}/\mathrm{d}n_{i,t}$.

Hence, an increase in population in any period t strictly decreases per-capita output. This holds unconditionally under local profit distribution and at a zero-assets baseline and, with sufficient parametric restrictions on home bias, under global profit sharing or at a non-zero-assets baseline, completing the proof. $\square$

A.2 Sign of regional fiscal multiplier

Using the same notation for aggregate consumption as in Appendix A.1, the market clearing condition is

$$Y_{i,t} = \alpha_{i,t}C_{i,t} + (1-\alpha_{-i,t})C_{-i,t} + n_{i,t}g_{i,t}. \tag{A.10}$$

Adding the market clearing conditions for each region, we obtain the union-wide resource constraint

$$Y_{N,t} + Y_{S,t} = C_{N,t} + C_{S,t} + n_{N,t}g_{N,t} + n_{S,t}g_{S,t}. \tag{A.11}$$

Consider that region i increases its spending. Under the central bank policy of keeping union-wide output fixed, and holding populations and $g_{-i,t}$ fixed, the crowding-out effects on private consumption must be such that

$$\mathrm{d}C_{N,t} + \mathrm{d}C_{S,t} = -n_{i,t}\,\mathrm{d}g_{i,t}. \tag{A.12}$$

When the government increases its spending, the central bank achieves its policy goal of keeping union output constant by raising interest rates r_t, which depresses private consumption in both regions through the Euler equation. Hence $\mathrm{d}C_{N,t} \leq 0$ and $\mathrm{d}C_{S,t} \leq 0$, with the split depending on factors such as migration costs, but with the same sign in both regions.

Differentiating region i's goods market clearing condition, and using (A.12), the regional output response is

$$\begin{aligned} \mathrm{d}Y_{i,t} &= \alpha_{i,t}\,\mathrm{d}C_{i,t} + (1-\alpha_{-i,t})\,\mathrm{d}C_{-i,t} + n_{i,t}\,\mathrm{d}g_{i,t} \\ &= (1-\alpha_{i,t})|\mathrm{d}C_{i,t}| + \alpha_{-i,t}|\mathrm{d}C_{-i,t}| > 0. \end{aligned} \tag{A.13}$$

The multiplier is hence strictly positive as long as there is bilateral trade ($0 < \alpha_{i,t}, \alpha_{-i,t} < 1$). Therefore

$$\frac{\mathrm{d}Y_{i,t}}{\mathrm{d}g_{i,t}} > 0, \tag{A.14}$$

and under fixed population

$$\frac{\mathrm{d}y_{i,t}}{\mathrm{d}g_{i,t}} > 0, \tag{A.15}$$

In particular, at a symmetric equilibrium, (A.12) becomes

$$\mathrm{d}C_{N,t} = \mathrm{d}C_{S,t} = -\frac{n_{i,t}}{2}\mathrm{d}g_{i,t} = -\frac{\mathrm{d}g_{i,t}}{4}, \tag{A.16}$$

and (A.13) and (A.15) can be written as

$$\mathrm{d}Y_{i,t} = \mathrm{d}C_{i,t} + n_{i,t}\,\mathrm{d}g_{i,t} = \frac{\mathrm{d}g_{i,t}}{4}, \tag{A.17}$$

and

$$\mathrm{d}y_{i,t} = \frac{\mathrm{d}C_{i,t}}{n_{i,t}} + \mathrm{d}g_{i,t} = \frac{\mathrm{d}g_{i,t}}{2}. \tag{A.18}$$

Specifically, the partial equilibrium regional fiscal multiplier at a symmetric equilibrium is, in aggregate and per-capita responses, respectively

$$\frac{\mathrm{d}Y_{i,t}}{\mathrm{d}g_{i,t}} = \frac{1}{4}, \tag{A.19}$$

and

$$\frac{\mathrm{d}y_{i,t}}{\mathrm{d}g_{i,t}} = \frac{1}{2}. \tag{A.20}$$

A.3 Details on data collection and cleaning

A.3.1 LinkedIn migration flows

I record a migration flow whenever a LinkedIn user's CV states they started a new job or education in an EU country that differs from their chronologically previous position, also in an EU country. I then take the implied aggregate immigration and emigration flows and apply a centred 12-month moving average. The raw series is highly seasonal, which can reflect either true seasonality (many jobs start in January or after the summer) or measurement error. Users may not remember the exact month they started a job and leave it blank, which Revelio Labs codes as a January start – implying that the true month of migration is later than reported. This concern is sharper for education, since despite LinkedIn users reporting the start month, Revelio Labs only records the start year and codes the start month to January. Since most educational programmes begin in September, I assume all education starts in September of the reported year. Measurement error can also go the other way, with workers moving to the country a few months before they start a new job.

The centred 12-month moving average addresses many of these issues. It seasonally adjusts the data and spreads leading and lagging measurement error across the year, helping to cancel them out. The trade-off is that I also average out high-frequency shocks to migration, but I expect low-frequency persistent shocks to be the main drivers of migration flows. Revelio Labs does not have information on the number of active users in a country, so I measure migration rates not as a share of population, but as a share of users actively employed or in active education in a given month and country. Since this measure fluctuates with the business cycle, I scale by the cubic *trend* of active users rather than the raw count.

A.3.2 Sovereign debt

The highest frequency at which government debt stock data are publicly available is quarterly. Here, I describe in more detail the methods I take to infer monthly public debt. The procedure mostly involves exploiting the fact that debt securities – the largest instrument of total government debt – are widely available at monthly frequencies.

The main data source used is the ECB's and Eurostat's Government Finance Statistics (GFS) dataset. From this, I first extract quarterly debt stocks and debt-to-GDP ratios for the entire sample period of EU-27 countries (the United Kingdom is treated separately).

Next, noticing that government debt is made up of debt securities, loans, and currency and deposits, I obtain GFS data for the stock of debt securities, which constitutes on average 72% of total government debt. Crucially, the GFS provides these data at monthly frequency, albeit only starting in late 2009. In order to fill in this gap, I use the ECB's alternative CSDB-derived Securities Issues Statistics (CSEC), which allows me to obtain monthly debt securities for the remaining earlier sample period. Where monthly GFS data are available, they are preferred over CSEC, since both the monthly and quarterly GFS series are compiled under the same accounting framework, ensuring internal consistency. Despite some missing observations, GFS combined with CSEC provides 75% observational coverage of monthly debt securities for EU-28 countries between 2000 and 2019.

A caveat of the monthly debt securities data is that it is unconsolidated, meaning it includes loans from one level of government to another, as well as between different government agencies. Consolidated debt securities are available only at a quarterly frequency. To correct for this, I take the difference between the monthly unconsolidated series and the quarterly consolidated series to obtain intra-government debt at the end of quarter months. I linearly interpolate intra-government debt for the remaining months of the quarter and subtract this from the monthly unconsolidated debt securities series to infer monthly consolidated securities.

I follow a similar procedure for the remaining instruments. Only debt securities are available at a monthly frequency, with the remaining debt instruments – loans, and currency and deposits – again only being available at a quarterly frequency. I take the difference between total government debt and debt securities to obtain the value of other debt instruments at end of quarter months. I linearly interpolate this series for the remaining months in the quarter, to infer monthly values of other debt instruments. I add this to the (consolidated) monthly debt securities, to obtain monthly total government debt.

Whenever there are gaps in the monthly GFS and CSEC series, I fill them in also by linearly interpolating the quarterly values of total debt. In summary, my final monthly series of government debt uses as much directly observable monthly variation as possible – there is monthly coverage on debt securities for 75% of observations, and debt securities make up 72% of the value of total debt. The remaining gaps are filled through linear interpolation of quarterly data. GFS and CSEC don't have detailed data for the United Kingdom, and so for this country I instead use data from the World Bank's Quarterly Public Sector Debt dataset, and the whole series is linearly interpolated into monthly.

A.3.3 10-year government bond yields

The data on 10-year government bond yields are taken from Eurostat, based on the European Monetary Union convergence criterion series of long-term interest rates. The definition of such long-term interest rates is taken as central government bond yields with residual maturity of around 10 years. The exact data series code is `[irt_lt_mcby_m]`. Regarding the methodology for countries lacking outstanding long-term sovereign debt, the metadata for this data series states:

> *A harmonised long-term interest rate for Luxembourg is presented starting mid-May 2010. Before, the Luxembourg Government did not have outstanding long-term debt securities with a residual maturity of close to ten years. Therefore, the yield on long-term bond(s) issued by a private credit institution with a residual maturity close to 10 years is presented for the period up to mid-May 2010 and is thus not fully harmonised for that period.*
>
> *For Cyprus, primary market yields are reported up to April 2015. The same applies to Bulgaria [and] Romania up to December 2005, Slovenia up to October 2003 and Lithuania up to October 2007. For Greece, no data are available for July 2015 owing to market closure.*[18]

The summary of number of observations on bond yields for each country is shown in the table below.

TABLE A.1: 10-year Government Bond Yield Data Coverage

Country	Obs.	Missing Period	Country	Obs.	Missing Period
Austria	240	—	Italy	240	—
Belgium	240	—	Latvia	228	2000m1–2000m12
Bulgaria	204	2000m1–2002m12	Lithuania	228	2000m1–2000m12
Croatia	169	2000m1–2005m11	Luxembourg	240	—
Cyprus	228	2000m1–2000m12	Malta	228	2000m1–2000m12
Czechia	237	2000m1–2000m3	Netherlands	240	—
Denmark	240	—	Poland	228	2000m1–2000m12
Estonia	0	full sample	Portugal	240	—
Finland	240	—	Romania	177	2000m1–2005m3
France	240	—	Slovakia	228	2000m1–2000m12
Germany	240	—	Slovenia	214	2000m1–2002m2
Greece	239	2015m7	Spain	240	—
Hungary	228	2000m1–2000m12	Sweden	240	—
Ireland	240	—	United Kingdom	240	—
			Total	**6,196**	

Notes: Sample period is January 2000 to December 2019, giving a maximum of 240 monthly observations per country. Source: Eurostat series `irt_lt_mcby_m`.

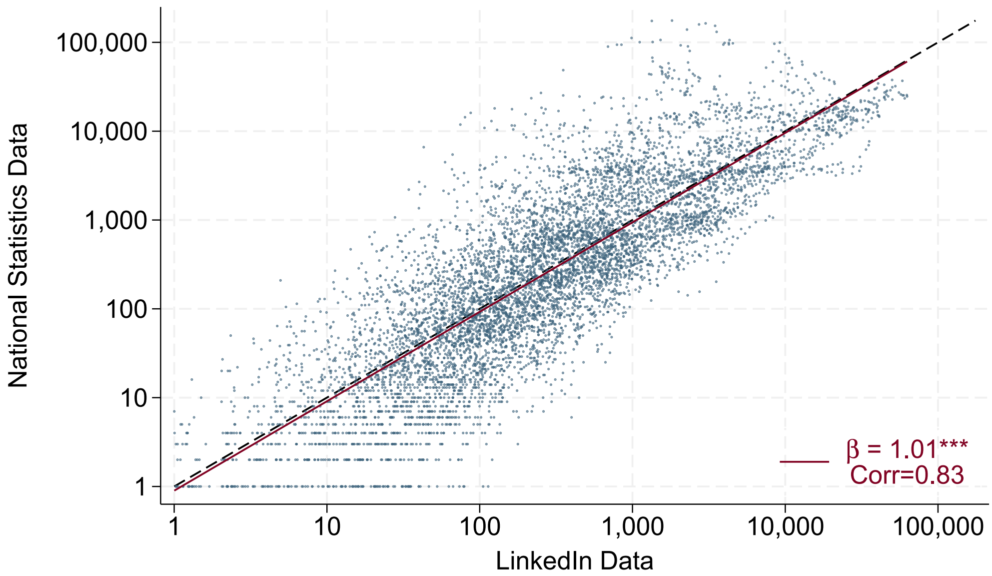
The patterns of missing data in the Eurostat series reflect institutional features of EU accession and sovereign debt issuance. Coverage for new EU member states begins at or shortly after the start of harmonised reporting under the EMU convergence criterion framework, which typically followed the formal opening of accession negotiations. This explains the 2000 gap for Cyprus, Hungary, Latvia, Lithuania, Malta, Poland, and Slovakia (which joined the EU in 2004), as well as the longer gaps for Bulgaria and Romania (2007

[18] Source: Eurostat, series `irt_lt_mcby_m`, metadata accessed 22nd May 2026. URL: https://ec.europa.eu/eurostat/cache/metadata/en/irt_lt_mcby_esms.htm.

accession) and Croatia (2013 accession). Estonia has no observations over the entire sample period due to its historically low public debt and limited issuance of long-term sovereign bonds – harmonised Eurostat data on Estonian 10-year yields only begins in 2021. The single missing observation for Greece (July 2015) coincides with the closure of the Athens Stock Exchange and capital controls imposed during the height of the Greek sovereign debt crisis.

A.4 Migration data visualisation

FIGURE A.1: Intra-EU28 Bilateral Migration Flows
LinkedIn vs National Statistics

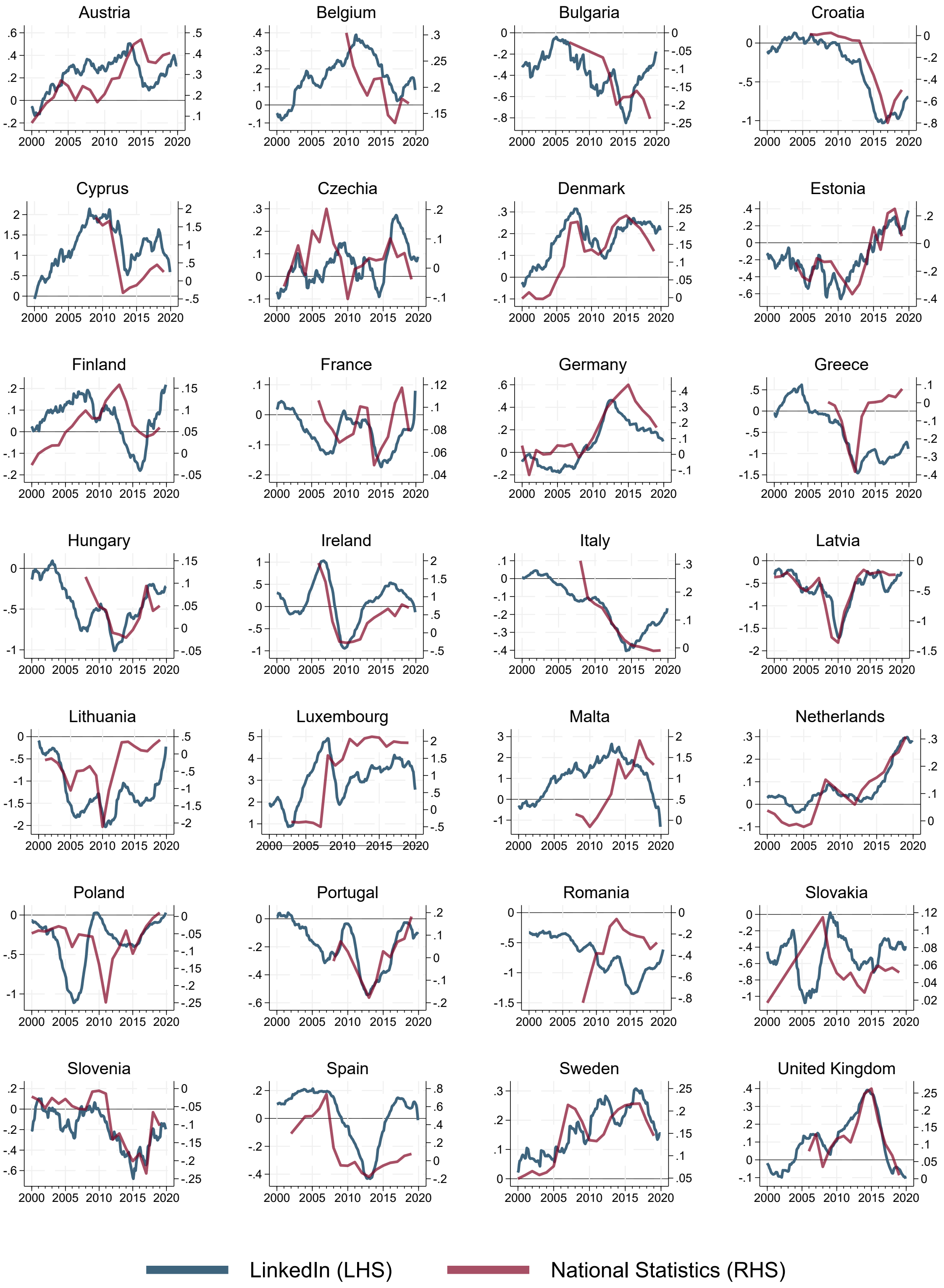


Notes: Each dot corresponds to an origin-destination-year migration flow.

Figure A.2 plots the time series of monthly intra-EU net migration rates constructed from LinkedIn data, and the annual series from official national statistics. The two data series have overall a good match, notably Croatia, Cyprus, Denmark, Estonia, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Portugal, Slovenia, the UK, among others. For other countries, such as Czechia, Poland, Romania, the two series are a serious mismatch.

One possible reason is simply that these national authorities do not collect data for intra-EU migration very accurately. Notice, for instance, that official statistics barely show an outflow of workers from Poland upon joining the EU in 2004, whereas the LinkedIn series shows pattern. Countries such as Germany or the United Kingdom, which have very detailed bilateral migration data relative to other EU countries, have much closer matches. Another possibility is that the mismatched countries mostly have unskilled migration and LinkedIn is biased towards skilled workers, and the sample weights are not enough to account for the difference.

FIGURE A.2: Intra-EU28 Net Migration Rates
LinkedIn vs National Statistics

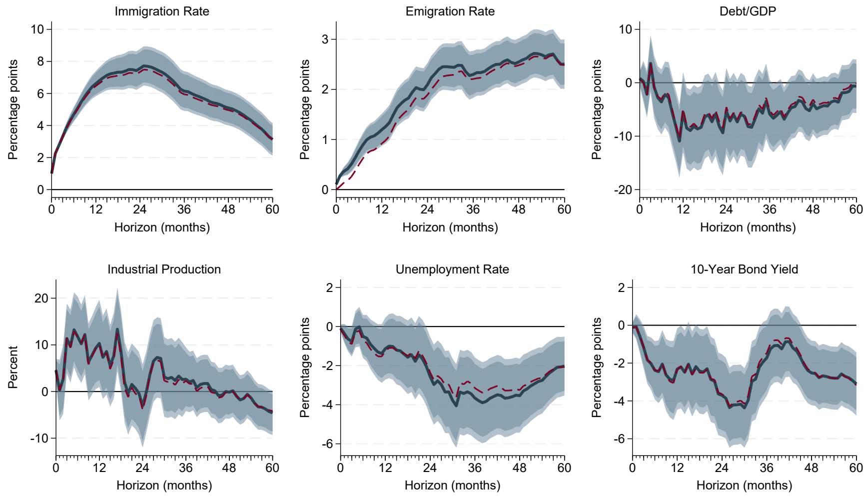


Notes: The monthly series from LinkedIn is annualised for comparability with the annual series from official national statistics.

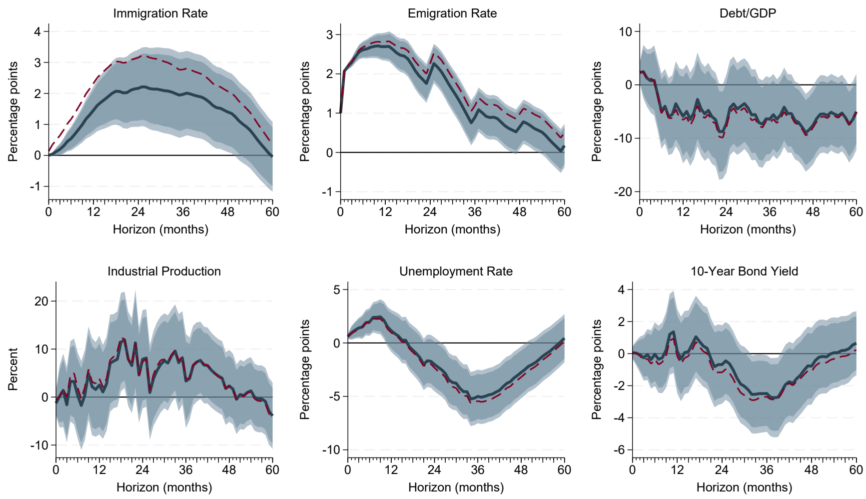
A.5 SVAR Impulse Response Functions

FIGURE A.3: Full Set of IRFs from SVAR (36)

(A) Responses to an Immigration Rate Shock



(B) Responses to an Emigration Rate Shock



(C) Responses to a Debt/GDP Shock

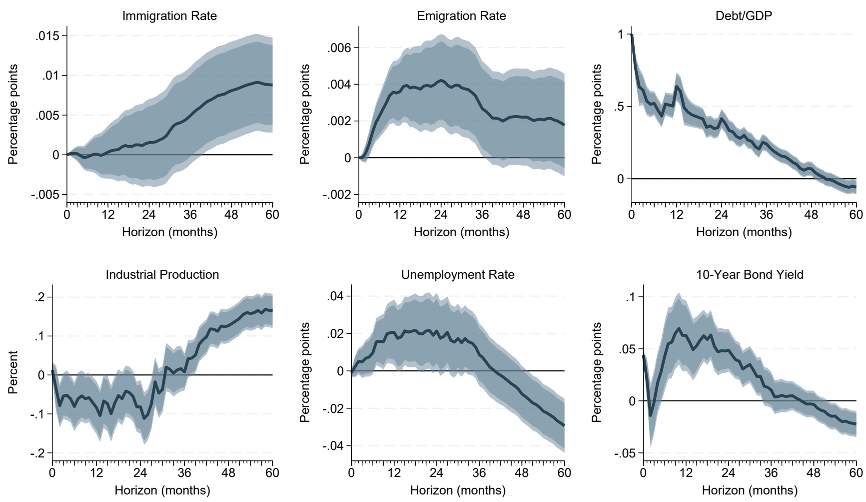
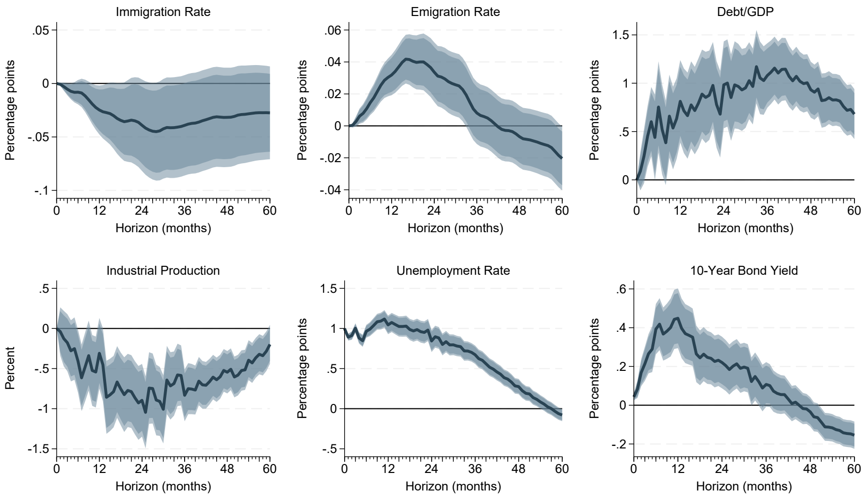
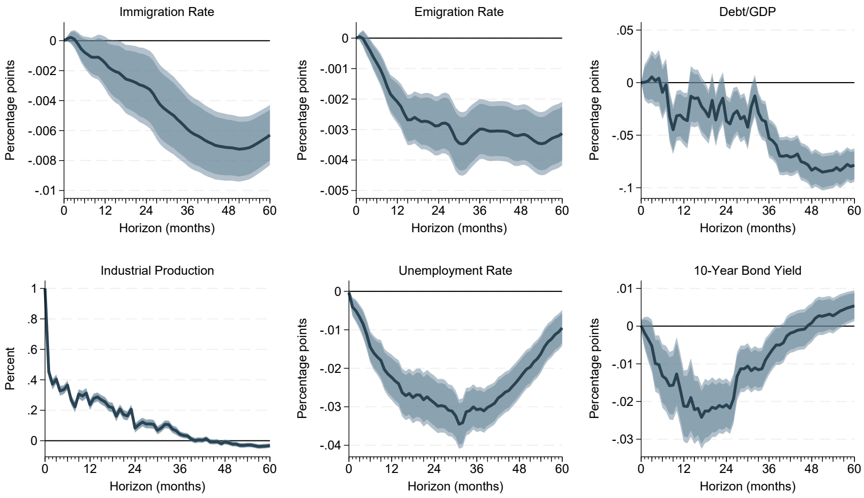


FIGURE A.3: Full Set of IRFs from SVAR (36) (continued)

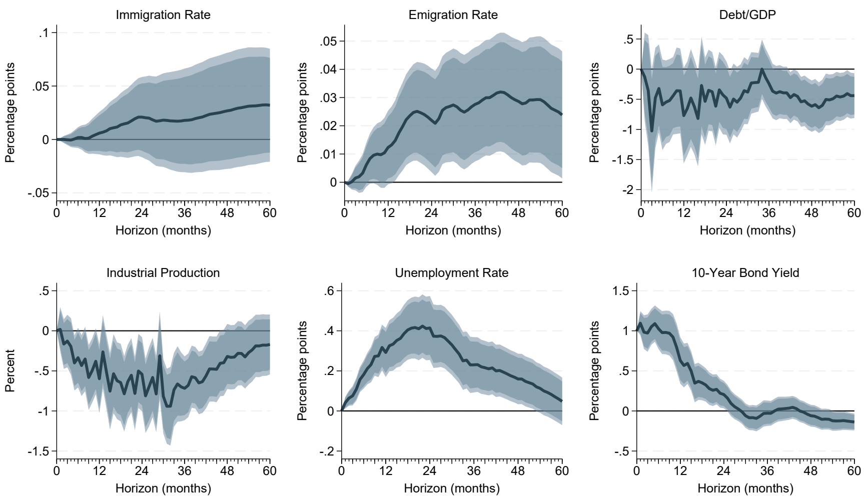
(D) Responses to an Unemployment Rate Shock



(E) Responses to an Industrial Production Shock



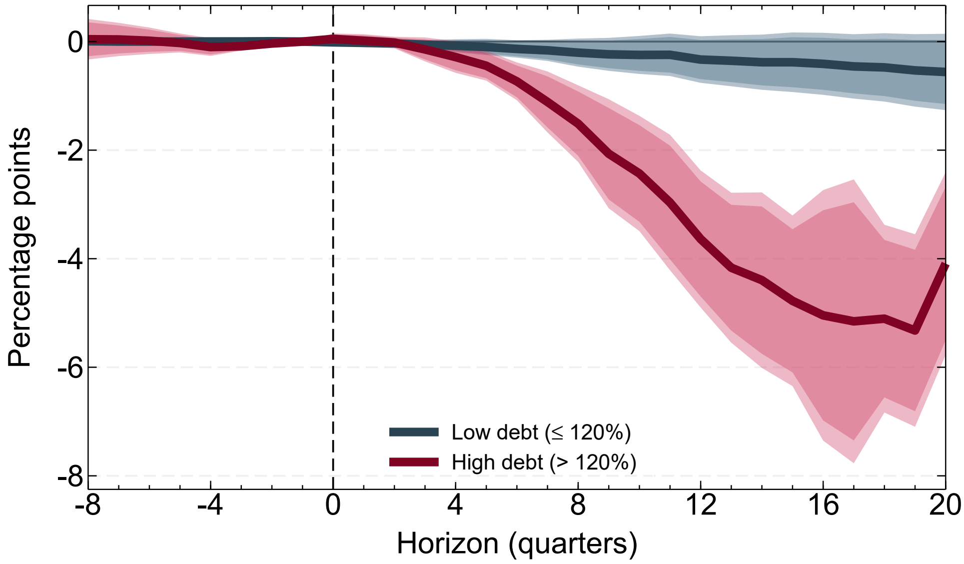
(F) Responses to a Bond Yield Shock



Notes: Shaded areas show 95% and 90% confidence bands using 10,000 recursive wild bootstraps under a normal approximation. Dashed red line plots point estimates when emigration is instead ordered before immigration in the Cholesky decomposition.

A.6 Robustness Checks for Fiscal Variables Local Projection

FIGURE A.4: Cumulative Response of Government Consumption to an Emigration Rate Shock with a 120% Threshold Rule (LP)



Notes: Figure shows the cumulative response of government consumption, expressed as a percentage of pre-shock trend GDP. The shock is the (unscaled) emigration rate structural residual from (36), therefore corresponding to a positive 1 standard deviation shock. Shaded areas show 95% and 90% confidence bands using standard errors clustered at the country level.