DEPARTMENT OF INTERNATIONAL AND EUROPEAN ECONOMIC STUDIES

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Brain Drain, Skills Mismatch and the Fiscal Multiplier

George Liontos

Konstantinos Mavrigiannakis

Eugenia Vella

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Brain Drain, Skills Mismatch and the Fiscal Multiplier[*]

George Liontos[†] Konstantinos Mavrigiannakis[‡] Eugenia Vella[§]

Abstract

We examine how international labor mobility shapes the transmission of fiscal policy in the presence of skills mismatch. We develop a small open economy DSGE model with heterogeneous households, endogenous skill-specific migration decisions, search and matching frictions, over-qualification and capital–skill complementarity (CSC) in production. We show that the effect of migration on the fiscal multiplier depends critically on the presence of CSC, which influences the skill composition of migrants. Following a fiscal contraction, the economy experiences predominantly high-skilled emigration. This "brain drain" mitigates the increase in skills mismatch by easing congestion in domestic labor markets, but it also exacerbates the recession through a demand-depressing mechanism, which translates into a higher fiscal multiplier. By contrast, in an economy without CSC, emigration is mainly low-skilled—driven by competition from high-skilled mismatched stayers for low-skill jobs—and has little effect on the fiscal multiplier. Highlighting the joint dynamics of labor mobility, fiscal policy, and skills mismatch, the results carry important implications for the design of stabilization policies in open economies.

Keywords: fiscal multiplier, migration, skill heterogeneity, DSGE model, vertical skill mismatch.

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[†] Athens University of Economics and Business (AUEB) and Foundation for Economic and Industrial Research (FEIR - IOBE), email: liontosgeo@aueb.gr

[‡] University of Cyprus, Economics Research Centre, email: mavrigiannakis.konstantinos@ucy.ac.cy

[§] Athens University of Economics and Business (AUEB), email: evella@aueb.gr, *corresponding author*

1 Introduction

How does international labor mobility shape the transmission of fiscal policy? While the literature on fiscal multipliers is vast, the role of migration remains surprisingly underexplored. Migration reshapes labor supply, alters the skill composition of the workforce, redistributes income across borders, and affects public finances through changes in the tax base and transfer system. These channels are central to the propagation of fiscal shocks, particularly in small open economies where cross-border labor flows are sizable and responsive to the business cycle.

This paper studies how international labor mobility affects the fiscal multiplier in a small open economy with labor market frictions and skill heterogeneity. We develop a dynamic stochastic general equilibrium (DSGE) model with endogenous migration decisions, search-and-matching (S&M) frictions, skills mismatch in employment (over-qualification), and capital–skill complementarity (CSC) in production. Migration operates through multiple, interacting mechanisms: it influences labor market tightness and wage formation; it modifies public revenues and expenditures as workers exit or enter the domestic tax–transfer system; it affects aggregate demand through remittances and consumption smoothing; and it reshapes productive capacity by changing the joint distribution of skills and capital. Whether migration amplifies or dampens the output response to fiscal policy is therefore theoretically ambiguous.

To fix ideas, consider a contractionary government spending shock. By reducing economic activity, such a shock may induce emigration. On the one hand, outflows reduce domestic labor supply, consumption, and the tax base, potentially deepening the recession—especially if high-skilled workers leave and capital accumulation weakens. On the other hand, emigration may relieve fiscal pressure if migrants are net transfer recipients, support demand through remittances, and increase labor market tightness, thereby limiting wage declines. The net effect depends on who migrates, how migration interacts with capital demand, and whether remittances substitute for lost domestic expenditure.

Existing work has only partially explored these mechanisms. Bandeira et al. (2022), for example, show that migration leaves the standard fiscal multiplier largely unchanged in a small open economy DSGE model with homogeneous labor, with modest dampening effects emerging only gradually. Following a negative shock to government spending, the dampening impact (in terms of absolute value) is driven by a positive wealth effect that induces return migration and by persistent crowding-in of private investment.[1] However, by abstracting from skill heterogeneity, that framework cannot capture how the skill composition of migrants—arguably the most policy-relevant dimension of migration—shapes fiscal transmission.

Our contribution is to show that the interaction between migration and fiscal multipliers crucially depends on capital–skill complementarity and skills mismatch. Introducing skill heterogeneity and CSC fundamentally alters the composition of migration flows following a fiscal shock and, through this channel, the aggregate response of the economy. In the presence of CSC, a fiscal contraction triggers predominantly high-skilled emigration—a "brain drain." The associated loss of complementary human capital depresses capital demand, amplifies the downturn, and raises the fiscal multiplier. By contrast, in a counterfactual economy without CSC, high-skilled

[1] A decrease in government consumption financed by a decrease in lump-sum taxes has a positive wealth effect on households since their income increases by the same amount as the decrease in government consumption. This positive wealth effect leads to a decrease in labor supply at any given real wage reflecting the decrease in their tax burden.

emigration is weaker and low-skilled emigration may prevail if low-skilled workers face strong competition from high-skilled (mismatched) stayers for domestic jobs. In that case, international labor mobility has only muted effects on investment and output, leaving the multiplier largely unchanged.

Our framework is a real business cycle environment with high- and low-skilled households. The S&M approach, pioneered by Mortensen and Pissarides (1994), provides the structural foundation for modeling labor-market mismatch. For simplicity, low-skilled households are modeled as hand-to-mouth consumers. High-skilled workers may accept low-skill jobs during downturns while continuing to search on the job, creating a mismatch buffer that affects both labor market dynamics and migration incentives. Migration decisions are skill-specific and subject to pecuniary costs, allowing the model to generate differential outflows across skill groups. CSC in production, consistent with a large body of empirical evidence, is a key ingredient linking migration composition to investment dynamics. We apply this framework to the emigration wave observed during the Greek Depression. The Greek Crisis was the deepest and longest postwar recession in an OECD country, accompanied by the largest bailout in history under austerity conditionality, a massive emigration wave of about half a million mostly high-skilled workers[2], and a rise in vertical skills mismatch (over-qualification) from about 20% in 2010 to 30% in 2016 (see, e.g., Mavrigiannakis et al. (2023)).

The main results can be summarized as follows. First, when CSC is present, a negative government spending shock induces high-skilled emigration ("brain drain"), which weakens capital accumulation and amplifies the recession, leading to a larger fiscal multiplier, while at the same time mitigating the increase in skills mismatch by reducing congestion in domestic labor markets. Second, in the absence of CSC, migration flows are skewed toward low-skilled workers, due to job competition from high-skilled (mismatched) stayers, leaving the multiplier largely unaffected.[3] Third, skills mismatch plays a nuanced role in the transmission mechanism: by providing domestic employment opportunities during downturns, mismatch employment buffers high-skilled emigration and the associated capital losses (*investment channel*). However, it also dampens wage adjustment and internal devaluation, weakening the *exports channel*. Consequently, mismatch amplifies output losses when CSC is present but mitigates them when CSC is absent. These findings indicate that disregarding skill heterogeneity or mismatch can lead to misguided assessments of the macroeconomic effects of migration and fiscal policy. More broadly, they suggest that effective stabilization policy in open labor markets must account for the forces shaping the skill composition of migration flows.

This paper contributes to three strands of the literature: the macroeconomics of migration, fiscal multipliers in open economies, and the cyclical dynamics of skills mismatch. We extend the literature on cyclical migration by incorporating fiscal policy and skills mismatch. Alessandria et al. (2020) document a feedback loop between emigration and sovereign default in Spain, while Hauser and Seneca (2022) develop a two-region New Keynesian DSGE model with matching frictions and labor mobility to analyze optimal monetary policy. Relatedly, Deng (2024) studies the interaction between taxation, inequality, and migration in a sovereign default framework, showing that progressive taxation can induce emigration of high-income workers and erode the fiscal tax base.

[2]For example, Labrianidis et al. (2016) conducted a nationwide representative survey which found that more than two out of three of the post-2010 emigrants are university graduates. In a similar vein, an ICAP People Solutions (2019) survey, conducted in 2019 with 942 participants (Greek migrants) in 43 countries, found that 87% of them hold a degree from a Higher Education Institute.)

[3]Shutting down skills mismatch in the model generates a "brain-drain" outcome in the no-CSC economy, too. Yet, it is not sufficiently strong to affect the size of the fiscal multiplier.

Closest to our work, Oikonomou (2023) embeds the CSC framework in an open economy RBC model with S&M frictions to analyze high-skilled emigration during the Greek crisis, finding strong negative investment effects that deepened and prolonged the recession.[4] To our knowledge, no study in this literature examines the role of skills mismatch, and Bandeira et al. (2022) is the only paper to examine the interaction between international migration and fiscal policy within a DSGE framework, albeit under the assumption of homogeneous labor.[5] In Bandeira et al. (2022), the demand-depressing mechanism is not sufficiently strong to alter the standard fiscal multiplier; once we introduce skill heterogeneity and CSC, it becomes powerful enough to overturn that result, uncovering a transmission channel through which migration reshapes fiscal multipliers.

We contribute to the skills-mismatch literature by examining its interplay with fiscal policy and international labor mobility. The S&M approach has been widely used to analyze mismatch and immigration, but largely in steady-state settings (see, e.g. Iftikhar and Zaharieva (2019) and Liu et al. (2017)).[6] Whether mismatch is pro- or countercyclical remains unsettled: cleansing mechanisms imply procyclicality (Mortensen and Pissarides 1994; Baley et al. 2022), whereas sullying forces can generate countercyclical dynamics as workers accept inferior matches in downturns (Barnichon and Zylberberg 2019; Brunello et al. 2019). Closest to our paper, Mavrigiannakis et al. (2023) show that fiscal tightening increases mismatch and that stronger capital–skill complementarity (CSC) attenuates its cyclical response. We extend their framework by introducing skill-specific emigration decisions and uncover a brain-drain channel through which CSC further weakens mismatch cyclicality. More importantly, incorporating migration allows us to quantify how labor mobility reshapes the output effects of fiscal policy — a dimension absent from the existing literature.

Finally, the paper relates to the vast literature on fiscal multipliers (see, e.g., Ramey (2019) for a review) as well as to research examining the role of fiscal policy in labor market dynamics (see, e.g., Pappa (2009), Monacelli et al. (2010), Ramey (2011), Brückner and Pappa (2012), Rendahl (2016)). We contribute to these strands by providing novel evidence on how skills mismatch and migration jointly shape the transmission of fiscal policy. More broadly, our results highlight that fiscal policy may have substantially different macroeconomic effects in economies characterized by high labor mobility. Ignoring endogenous migration and the skill composition of migrant flows may therefore lead to significant mismeasurement of fiscal multipliers.

Layout. The remainder of the paper is organized as follows. Section 2 presents the DSGE model and Section 3 outlines the calibration strategy. Section 4 reports the model's impulse responses and Section 5 provides counterfactual analysis to clarify the roles of CSC and skills mismatch. Section 6 concludes.

2 Model with emigration and skills mismatch

In this section, we outline our DSGE model, which combines skills mismatch with skill-specific migration in a small open economy (SOE) setting.

[4] Importantly, in our model, the wage of high-skilled workers declines after a negative fiscal shock, which is empirically relevant for the Greek Depression, while in Oikonomou (2023) the wages of high-skilled workers increase following a risk premium shock.

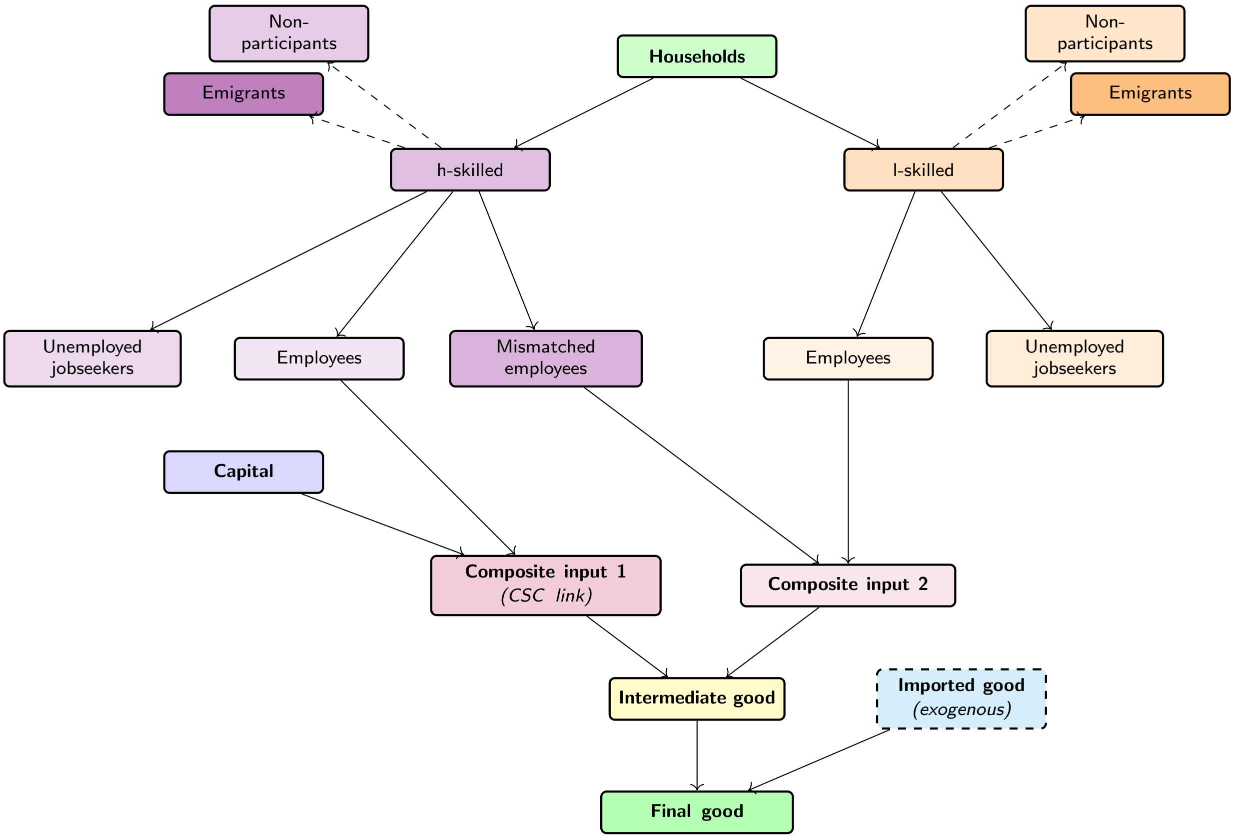
[5] Other micro-founded macroeconomic models for the Greek episode include, e.g., Gourinchas et al. (2017); de Córdoba et al. (2017); Economides et al. (2020); Papageorgiou et al. (2021); Chodorow-Reich et al. (2023).

[6] For additional steady-state analyses of skills mismatch, see, e.g., Albrecht and Vroman (2002), Dolado et al. (2009), Chassamboulli (2011), Garibaldi et al. (2025).

2.1 Model overview

We build a SOE model with two types of households (high and low-skilled), endogenous participation, search and matching frictions and endogenous migration for both skill types. A pecuniary cost to migrate micro-founds migration flows. The production technology is characterized by CSC as in Krusell et al. (2000). The model also features trade links and investment adjustment costs to capture empirically relevant features of the business cycle dynamics. Figure 1 presents a graphical illustration of the model, which we analyze below.

Figure 1: Graphical illustration of the model



Notes: CSC denotes capital-skill complementarity.

2.2 Population and labor force

The economy is comprised by households of two skill types, $j = h, l$. Type $h = 1, ..., N^h$ supplies high-skilled labor and type $l = 1, ..., N^l$ supplies low-skilled labor. Total population is given by $N = N^h + N^l$. We denote by $t^h \equiv N^h/N$ and $t^l \equiv N^l/N$ the non-equal population shares of household types h and l, respectively.

Each household h consists of members that are employed n_t^h, unemployed u_t^h, and out of the labor force enjoying leisure l_t^h. The high-skilled employees may occupy in the home economy (H) a high-skill position, $n_t^{h,H}$, or a low-skill (mismatch) position, $n_t^{hl,H}$, as well as a high-skill position abroad (F), $n_t^{h,F}$, so that:

$$n_t^h = n_t^{h,H} + n_t^{hl,H} + n_t^{h,F} \tag{1}$$

Total members of the high-skilled household are normalized to unity:

$$n_t^{h,H} + n_t^{hl,H} + u_t^h + l_t^h + n_t^{h,F} = 1 \tag{2}$$

where $1 - n_t^{h,F} = n_t^{h,H} + n_t^{hl,H} + u_t^h + l_t^h$ represents the high-skilled stayers in the SOE.

Household h allocates its unemployed members across three search options: pursuing high-skilled employment abroad, O_t^h; searching for a high-skill position in the SOE, $\left(1 - O_t^h\right) s_t$; and seeking a low-skill (mismatch) job in the SOE, $\left(1 - O_t^h\right)(1 - s_t)$. Consequently, total unemployment can be expressed as:

$$u_t^h = \left(1 - O_t^h\right) s_t u_t^h + \left(1 - O_t^h\right)(1 - s_t) u_t^h + O_t^h u_t^h = u_t^{h,H} + u_t^{hl,H} + u_t^{h,F} \tag{3}$$

where $u_t^{h,H} \equiv \left(1 - O_t^h\right)) s_t u_t^h$, $u_t^{hl,H} \equiv \left(1 - O_t^h\right)(1 - s_t) u_t^h$ and $u_t^{h,F} \equiv O_t^h u_t^h$.

Similarly, each household l consists of members that are employed, n_t^l, unemployed, u_t^l, and labor force non-participants, l_t^l. In contrast to high-skilled searchers, low-skilled workers cannot be mismatched, since the model abstracts from under-qualification. Low-skilled employees, n_t^l, are employed in the domestic economy, $n_t^{l,H}$, or abroad, $n_t^{l,F}$, so that:

$$n_t^{l,H} + u_t^l + l_t^l + n_t^{l,F} = 1 \tag{4}$$

where $1 - n_t^{l,F} = n_t^{l,H} + u_t^l + l_t^l$ represents the low-skilled stayers.

The low-skilled household chooses the fraction of her unemployed searchers for a job abroad O_t^l versus in the SOE $\left(1 - O_t^l\right)$:

$$u_t^l = \left(1 - O_t^l\right) u_t^l + O_t^l u_t^l = u_t^{l,H} + u_t^{l,F} \tag{5}$$

where $u_t^{l,h} \equiv \left(1 - O_t^l\right) u_t^l$ and $u_t^{l,F} \equiv O_t^l u_t^l$.

2.3 Labor market

Skills mismatch Some high-skilled job seekers apply for low-skill (mismatch) positions due to less intense competition and, consequently, a higher hiring probability relative to high-skill vacancies. Skills mismatch in the model is thus driven by involuntary unemployment and emerges endogenously from the interaction between households' search decisions and firms' vacancy-posting behavior. The high-skilled household determines the share of job seekers willing to accept low-skill employment, while firms choose the fraction of low-skill vacancies open to high-skilled applicants. Once employed in a mismatch position, workers engage in on-the-job search for an upgraded high-skill match, for simplicity in the domestic economy. If successful, they quit the mismatch job and transition to a high-skill position. The efficacy of on-the-job search, $\phi(z_t)$, depends positively on endogenous effort, z_t, while the associated search cost is $b(z_t)$, with $db(z_t)/dz_t > 0$. Mismatch generates a trade-off for firms: although a high-skilled worker is more productive than a low-skilled counterpart, they command a higher wage and face a greater probability of separation upon securing a suitable high-skill job.[7]

[7] All unemployed workers search with unit intensity and incur no pecuniary search cost.

Migration Searching for a job abroad entails a pecuniary cost $X^h(\tilde{O}_t^h \tilde{u}_t^h)$, where $\tilde{O}_t^h$ and $\tilde{u}_t^h$ are the average shares of O_t^h and u_t^h per household.[8] Emigrants can return to the source country via exogenous separation. Residents and emigrants belong to a family, or representative household, that (imperfectly) pools income and takes consumption, savings, labor, and job search decisions, in line with evidence about strong family ties in Southern European countries (see, e.g., Alesina and Giuliano (2014), Giuliano (2007)).[9] Consumption c_t^j is the sum of residents' and emigrants' consumption, $c_t^{j,H}$ and $c_t^{j,F}$, respectively.

$$c_t^j = \left(1 - n_t^{j,F}\right) c_t^{j,H} + e_t n_t^{j,F} c_t^{j,F}, j = h, l \tag{6}$$

where e_t is the real exchange rate.

Emigrants send to the origin economy a constant fraction η of their labor income as remittances, Ξ_t^j:

$$c_t^{j,F} n_t^{j,F} = \left(1 - \tau^{n,F}\right) w^{j,F} n_t^{j,F} - \Xi_t^j n_t^{j,F} = \left(1 - \tau^{n,F} - \eta\right) w^{j,F} n_t^{j,F}, j = h, l \tag{7}$$

Employment and wages abroad are exogenous and this effectively pins down emigrant consumption. The margin of adjustment comes from the number of emigrants, which is controlled by choosing the share of unemployed looking for domestic versus foreign jobs.

Matching functions The model considers three labor sub-markets in the domestic economy, depending on the workers' skill type and the position's qualifications. Total matches in the low-skill labor market, $M_t^{l,H}$, in in the high-skill labor market, $M_t^{h,H}$, as well as total mismatches, $M_t^{hl,H}$, are given by the following functions:

$$M_t^{l,H} = \mu_1 \left((1 - x_t) V_t^l \right)^{\mu_2} \left(\left(1 - O_t^l\right) u_t^l N^l \right)^{1-\mu_2} \tag{8}$$

$$M_t^{h,H} = \mu_1 \left(V_t^h\right)^{\mu_2} \left(\left(1 - O_t^h\right) s_t u_t^h N_t^h + \phi(z_t) n_t^{hl,H} N^h \right)^{1-\mu_2} \tag{9}$$

$$M_t^{hl,H} = \mu_1 \left(x_t V_t^l\right)^{\mu_2} \left(\left(1 - O_t^h\right) (1 - s_t) u_t^h N^h \right)^{1-\mu_2} \tag{10}$$

where μ_1 denotes the efficiency of the matching process, μ_2 denotes the elasticity of matches with respect to vacancies, V_t^j denotes the aggregate vacancies posted by firms for skill type $j = h, l$, and x_t is the fraction of low-skill vacancies that firms allocate to high-skilled applicants, thus creating a mismatch. In equation (9), searchers for a high-skill position comprise the high-skilled job seekers, $(1 - O_t^h) s_t u_t^h N^h$, and the mismatched employees searching on-the-job, $\phi(z_t) n_t^{hl,H} N^h$.

Probabilities and labor market tightness We define the hiring probabilities as follows:

$$\psi_{H,t}^{l,H} \equiv \frac{M_t^{l,H}}{\left(1 - O_t^l\right) u_t^l N^l} \quad \psi_{H,t}^{h,H} \equiv \frac{M_t^{h,H}}{\left(1 - O_t^h\right) s_t u_t^h N^h + \phi(z_t) n_t^{hl,H} N^h} \quad \psi_{H,t}^{hl,H} \equiv \frac{M_t^{hl,H}}{\left(1 - O_t^h\right)(1 - s_t) u_t^h N^h} \tag{11}$$

[8] See, e.g., Bandeira et al. (2022) for a similar cost specification.

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

We also define the vacancy-filling probabilities:

$$\psi_{F,t}^{l,H} \equiv \frac{M_t^{l,H}}{(1-x_t)\,V_t^l} \qquad \psi_{F,t}^{h,H} \equiv \frac{M_t^{h,H}}{V_t^h} \qquad \psi_{F,t}^{hl,H} \equiv \frac{M_t^{hl,H}}{x_t V_t^l} \tag{12}$$

In turn, labor market tightness in each case is given by:

$$\theta_t^{l,H} \equiv \frac{(1-x_t)\,V_t^l}{\left(1-O_t^l\right)u_t^l N^l} \qquad \theta_t^{h,H} \equiv \frac{V_t^h}{\left(1-O_t^h\right)s_t u_t^h N^h + \phi\left(z_t\right)n_t^{hl,H}N^h} \qquad \theta_t^{hl,H} \equiv \frac{x_t V_t^l}{\left(1-O_t^h\right)\left(1-s_t\right)u_t^h N^h} \tag{13}$$

Employment laws of motion The law of motion for aggregate *mismatch* employment is given by:

$$N^h n_{t+1}^{hl,H} = \left(1-\sigma^l-\phi(z_t)\psi_{H,t}^{h,H}\right)n_t^{hl,H}N^h + M_t^{hl,H} \tag{14}$$

where σ^l is the exogenous destruction rate of low-skill positions (whether there is a mismatch or not), and $\phi(z_t)\psi_{H,t}^{h,H}$ is the endogenous destruction rate due to on-the-job search, leading to quits if successful. Aggregate non-mismatch employment in the Home economy evolves according to:

$$N^j n_{t+1}^{j,H} = \left(1-\sigma^j\right)n_t^{j,H}N^j + M_t^{j,H},\ j=h,l \tag{15}$$

The law of motion of emigrant employment (16) is given by:

$$N^j n_{t+1}^{j,F} = \left(1-\sigma^{j,F}\right)n_t^{j,F}N^j + \psi^{j,F}O_t^j u_t^j N^j,\ j=h,l \tag{16}$$

where the foreign separation and job-finding rates, $\sigma^{j,F}$ and $\psi^{j,F}$, respectively, are taken as given.[10]

2.4 Households

The representative household j maximizes the following lifetime utility:

$$\mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \left\{ \frac{\left(c_t^j - \chi c_{t-1}^j\right)^{1-\eta^c}}{1-\eta^c} + \Phi^h \frac{{l_t^j}^{1-\phi^j}}{1-\phi^j} \right\} \tag{17}$$

where c_t^j is the per household member consumption, η^c is the inverse of the intertemporal elasticity of substitution, χ governs habits, c_{t-1}^j captures last period's consumption (taken as given) and Φ^h governs the labor disutility.

High-skilled household's budget constraint and optimization problem In addition to the shares of unemployed workers, s_t and O_t, who choose between searching for high-skill and low-skill (mismatch) jobs and between employment abroad or in the domestic economy, the h household chooses consumption c_t^h, leisure l_t^h,

[10]The SOE has no impact on foreign labor market conditions which are exogenous. This is a reasonable assumption even in the presence of large migration outflows if their relative size compared to the destination country's labor force is small (e.g., due to dispersed search across several destination countries).

and investment in physical capital, k_t^h, and in an international non-state contingent bond, d_t^h. Thus, she receives interest incomes $r_t^k k_t^h$ and $r_t^d d_t^h$ from capital and net foreign assets, where r_t^k and r_t^d denote the respective returns. As the firm owner, the household also receives a share of profits $\pi_{d,t}$. The budget constraint is given by:

$$c_t^h + i_t^h + X^h\left(\tilde{O}_t^h \tilde{u}_t^h\right) O_t^h u_t^h + e_t r_t^d d_t^h + b\left(z_t\right) n_t^{hl,H} = \left(1 - \tau_t^{n,H}\right)\left(w_t^{h,H} n_t^{h,H} + w_t^{hl,H} n_t^{hl,H}\right) + \left(1 - \tau^{n,F}\right) e_t w^{h,F} n_t^{h,F} + \left(1 - \tau_t^k\right) r_t^k k_t^h - \tau_t^h + \pi_{d,t} + e_t d_{t+1}^h + \bar{\omega} u_t^h \tag{18}$$

where $\tau_t^{n,H}$ and $\tau^{n,F}$ are the domestic and foreign labor taxes respectively, τ_t^k is the capital tax, τ_t^h are lump-sum taxes, $w_t^{h,H}$ and $w_t^{hl,H}$ are the domestic wages in high-skill and mismatch positions respectively, $e_t w^{h,F}$ is the exogenous real-exchange-rate-adjusted foreign wage, and $\bar{\omega}$ is the unemployment benefit. As mentioned above, the mismatched workers' on-the-job search and the search for jobs abroad entail per-worker costs $b\left(z_t\right)$ and $X^h(\tilde{O}_t^h \tilde{u}_t^h)$, respectively.

The capital law of motion evolves according to:

$$i_t^h = k_{t+1}^h - \left(1 - \delta\right) k_t^h + \frac{\Xi}{2}\left(\frac{k_{t+1}^h}{k_t^h} - 1\right)^2 k_t^h \tag{19}$$

where δ is the depreciation rate and Ξ controls the capital adjustment costs, which, like consumption habits, are useful to obtain smooth impulse responses.

The optimization problem is subject to the time constraint (2), the budget constraint (18), the employment and capital laws of motion (14, 15, 16, 19), and the hiring probabilities (11). Appendix A shows the first-order conditions with respect to c_t^h, k_{t+1}^h, d_{t+1}^h, $n_{t+1}^{h,H}$, $n_{t+1}^{hl,H}$, $n_{t+1}^{h,F}$ u_t^h. We focus here on the first-order conditions with respect to O_t^h, s_t, z_t, which are relevant for migration and skills mismatch:

$[O_t^h]$

$$\lambda_{n_t^{h,H}} \psi_{H,t}^{h,H} s_t + \lambda_{n_t^{hl,H}} \psi_{H,t}^{hl,H} \left(1 - s_t\right) = \lambda_{n_t^{h,F}} \psi^{h,F} - \lambda_{c_t^h} X^h(\tilde{O}_t^h \tilde{u}_t^h) \tag{20}$$

$[s_t]$

$$\lambda_{n_t^{h,H}} \psi_{H,t}^{h,H} = \lambda_{n_t^{hl,H}} \psi_{H,t}^{hl,H} \tag{21}$$

$[z_t]$

$$\lambda_{c_t^h} \frac{b'\left(z_t\right)}{\phi'\left(z_t\right)} = \psi_{H,t}^{h,H}\left(\lambda_{n_t^{h,H}} - \lambda_{n_t^{hl,H}}\right) \tag{22}$$

Equation (20) states that the value of job search in the domestic labor market must equal the value of searching abroad, with the latter expressed net of the utility-adjusted search cost. Equation (21) sequates the value of searching for a non-mismatch job with that of searching for a mismatch job, conditional on their respective hiring probabilities. Equation (22) states that the marginal cost of on-the-job search intensity, expressed in units of consumption, must equal the expected excess value of transitioning to a non-mismatch job, weighted by the job-finding probability.

Low-skilled household's budget constraint and optimization problem

For simplicity, low–skilled households are modelled as hand-to-mouth consumers. The budget constraint is:

$$c_t^l + X^l\left(\tilde{O}_t^l \tilde{u}_t^l\right) O_t^l u_t^l = \left(1 - \tau_t^{n,H}\right) w_t^{l,H} n_t^{l,H} + \left(1 - \tau^{n,F}\right) e_t w^{l,F} n_t^{l,F} - \tau_t^l + \bar{\omega} u_t^l \tag{23}$$

The optimization problem of household l is subject to the time constraint (4), the budget constraint (23), the employment laws of motion (15) and (16), and the hiring probabilities in (11). Appendix A shows the first-order conditions with respect to c_t^l, $n_{t+1}^{l,H}$, $n_{t+1}^{l,F}$, u_t^l. We focus here on the first-order condition with respect to O_t^l, which is relevant for migration:

$$\lambda_{n_t^{l,H}} \psi_{H,t}^{l,H} = \lambda_{n_t^{l,F}} \psi^{l,F} - \lambda_{c_t^l} X^l \left(\tilde{O}_t^l \tilde{u}_t^l \right) \tag{24}$$

The interpretation is analogous to equation (20) for the high-skilled household, abstracting from mismatch.

2.5 Firms

Final good The representative firm aggregates the domestic intermediate good, Y_t^H, and imported goods, Y_t^F, to produce the economy-wide final good, Y_t, using a CES technology:

$$Y_t = \left(\omega^{\frac{1}{\gamma}} \left(Y_t^H \right)^{\frac{\gamma-1}{\gamma}} + (1-\omega)^{\frac{1}{\gamma}} \left(Y_t^F \right)^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}} \tag{25}$$

where ω denotes the degree of home bias and γ is the elasticity of substitution between Y_t^H and Y_t^F. The firm maximizes profits, $\Pi_t = P_t Y_t - p_t^H Y_t^H - p_t^F Y_t^F$, where p_t^H and p_t^F are the relative prices of Y_t^H and Y_t^F, respectively. This yields the following optimal demand schedules:

$$Y_t^H = \omega \left(\frac{p_t^H}{P_t} \right)^{-\gamma} Y_t \tag{26}$$

$$Y_t^F = (1-\omega) \left(\frac{p_t^F}{P_t} \right)^{-\gamma} Y_t \tag{27}$$

Combining equations (26) and (27) yields:

$$Y_t^H = \frac{\omega}{1-\omega} \left(\frac{p_t^H}{p_t^F} \right)^{-\gamma} Y_t^F \tag{28}$$

The associated price index is given by:

$$P_t = \left(\omega \left(p_t^H \right)^{1-\gamma} + (1-\omega) \left(p_t^F \right)^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \tag{29}$$

where we have assumed that the law of one price holds:

$$p_t^H = e_t p_t^F \tag{30}$$

Intermediate good Each intermediate good firm $f = 1, 2, ..., N^f$ requires capital k_t^f, low-skilled employment $n_t^{l,f}$, and high-skilled employment $n_t^{h,f}$ to produce the intermediate good $y_{i,t}^f$ with a CES technology:

$$y_{i,t}^f = A_t \left(\alpha \left(n_t^{l,f} \right)^{\frac{\epsilon-1}{\epsilon}} + (1-\alpha) \left(x_{i,t}^f \right)^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \tag{31}$$

$$x_{i,t}^f = \left(\zeta \left(k_t^f \right)^{\frac{\rho-1}{\rho}} + (1-\zeta) \left(n_t^{h,f} \right)^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \tag{32}$$

where $0 \leq \alpha$ and $0 \leq \zeta$ control the income shares, $0 \leq \epsilon$ is the elasticity of substitution both between $n_t^{l,f}$ and k_t^f, and between $n_t^{l,f}$ and $n_t^{h,f}$, and $0 \leq \rho$ is the elasticity of substitution between k_t^f and $n_t^{h,f}$. For capital-skill complementarity, we need $\rho < \epsilon$ (see, e.g. Krusell et al. (2000)).

As in e.g. Iftikhar and Zaharieva (2019), we assume different productivity between the two types of workers employed in low-skill positions. Thus, for every firm f in the intermediate goods sector, the input of low-skill positions is equal to:

$$n_t^{l,f} = n_t^{ll,f} + q^h n_t^{hl,f} \tag{33}$$

where $n_t^{ll,f}$ and $q^h n_t^{hl,f}$ denote the labor demand for low-skilled and high-skilled (mismatched) workers in a low-skill position. The parameter $q^h \geq 1$ reflects the effective productivity of a mismatched worker.
The intermediate good, $y_{i,t}^f$, is sold domestically, y_t^H, and abroad, $y_t^{F^*}$, which in aggregate terms implies:[11]

$$Y_{i,t} = Y_t^H + Y_t^{F^*} \tag{34}$$

where foreign aggregate demand $Y_t^{F^*}$ is given exogenously by:

$$Y_t^{F^*} = (1-\omega^*) \left(\frac{p_t^H}{e_t} \right)^{-\gamma^*} Y_t^* \tag{35}$$

We define the real exchange rate as $e_t = \frac{P_t^*}{P_t}$. We also consider the parameters ω^* and γ^* to be the foreign counterparts for the home bias and elasticity of substitution, while Y_t^* denotes the foreign GDP.

Firm's profit maximization problem

In addition to choosing capital demand, firms post vacancies for-high skill positions, $v_t^{h,f}$, and low-skill positions, $v_t^{l,f}$. Given that a share of high-skilled searchers apply for low-skill positions, firms also choose the fraction x_t of $v_t^{l,f}$ allocated to mismatched applicants. The firm solves maximizes the discounted expected value of future profits:

$$\begin{aligned} Q(n_t^{ll,f}, n_t^{h,f}, n_t^{hl,f}) = \max_{v_t^{l,f}, v_t^{h,f}, k_t^f, x_t} \Big\{ & p_t^H y_{i,t}^f - w_t^{l,H} n_t^{ll,f} - w_t^{hl,H} n_t^{hl,f} - w_t^{h,H} n_t^{h,f} - r_t^k k_t^f - \kappa^l v_t^{l,f} - \kappa^h v_t^{h,f} \\ & + E_t \left[\Lambda_{t,t+1} Q \left(n_{t+1}^{ll,f}, n_{t+1}^{h,f}, n_{t+1}^{hl,f} \right) \right] \Big\} \end{aligned} \tag{36}$$

where κ^j denotes the marginal cost of posting a vacancy requiring j type skills and $\Lambda_{t,t+1} = \beta \frac{\partial u_{c_{t+1}}}{\partial u_{c_t}}$ denotes the stochastic discount factor as the high-skilled household owns the firm.

The optimization is subject to the production function given by equations (31) and (32), firm's demand for low-skilled employment in equation (33), and the employment laws of motion as re-arranged in the next two equations[12]:

[11] Aggregation simply implies the following: $Y_t^H = \sum_{f=1}^{N^f} y_t^H$ and $Y_t^{F^*} = \sum_{f=1}^{N^f} y_t^{F^*}$.
[12] Appendix B provides the detailed derivation of equations (37) and (38).

$$v_t^{l,f} = \frac{n_{t+1}^{ll,f} - \left(1-\sigma^l\right) n_t^{ll,f}}{\psi_{F,t}^{l,H}} + \frac{n_{t+1}^{hl,f} - \left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right) n_t^{hl,f}}{\psi_{F,t}^{hl,H}} \tag{37}$$

$$v_t^{h,f} = \frac{n_{t+1}^{h,f} - \left(1-\sigma^h\right) n_t^{h,f}}{\psi_{F,t}^{h,H}} \tag{38}$$

Then, using the definitions of the marginal products $y_{i,t}^{k,f} = \frac{\partial y_{i,t}^f}{\partial k_t^f}$, $y_{i,t}^{ll,f} \equiv \frac{\vartheta y_{i,t}^f}{\vartheta n_t^{ll,f}}$, $y_{i,t}^{h,f} \equiv \frac{\vartheta y_{i,t}^f}{\vartheta n_t^{h,f}}$, $y_{i,t}^{hl,f} \equiv \frac{\vartheta y_{i,t}^f}{\vartheta n_t^{hl,f}}$, the first-order conditions are given by:

$[k_t^f]$:

$$r_t^k = p_t^H y_{i,t}^{k,f} \tag{39}$$

$[n_{t+1}^{ll,f}]$

$$\frac{\kappa^l}{\psi_{F,t}^{l,H}} = \mathbb{E}_t \Lambda_{t,t+1} \left\{ p_{t+1}^H y_{i,t+1}^{ll,f} - w_{t+1}^{l,H} + \kappa^l \frac{\left(1-\sigma^l\right)}{\psi_{F,t+1}^{l,H}} \right\} \tag{40}$$

$[n_{t+1}^{h,f}]$

$$\frac{\kappa^h}{\psi_{F,t}^{h,H}} = \mathbb{E}_t \Lambda_{t,t+1} \left\{ p_{t+1}^H y_{i,t+1}^{h,f} - w_{t+1}^{h,H} + \kappa^h \frac{\left(1-\sigma^h\right)}{\psi_{F,t+1}^{h,H}} \right\} \tag{41}$$

$[n_{t+1}^{hl,f}]$

$$\frac{\kappa^l}{\psi_{F,t}^{hl,H}} = \mathbb{E}_t \Lambda_{t,t+1} \left\{ p_{t+1}^H y_{i,t+1}^{hl,f} - w_{t+1}^{hl,H} + \kappa^l \frac{\left(1-\sigma^l - \phi\left(z_{t+1}\right)\psi_{H,t+1}^{h,H}\right)}{\psi_{F,t+1}^{hl,H}} \right\} \tag{42}$$

where x_t is given by:

$$x_t = \frac{n_{t+1}^{hl,f} - \left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right) n_t^{hl,f}}{v_t^{l,f}\psi_{F,t}^{hl,H}} \tag{43}$$

Equations (40)–(42) state that the marginal cost of hiring should equal the expected marginal benefit, namely the value of the marginal product of labor minus the wage cost plus the continuation value. Matches terminate exogenously with probability σ^j where $j = h, l$ and, in mismatch employment, also endogenously when workers quit to take up an upgraded position with probability $\phi\left(z_{t+1}\right)\psi_{H,t+1}^{h,H}$. Equation (43) shows that this quit risk reduces the share of low-skill positions that firms allocate to high-skilled applicants, x_t. Firms, therefore, face a trade-off: mismatched workers are more productive than correctly matched ones, but the match may dissolve if they move to a high-skill position through on-the-job search.

2.6 Government

The government imposes a lump-sum tax, T_t, a capital tax, τ_t^k, and a labor tax, $\tau_t^{n,H}$, to finance aggregate unemployment benefits, $\bar{\omega}U_t^h$ and $\bar{\omega}U_t^l$, as well as government consumption, G_t^c, which is modelled as a waste. In aggregate terms, the government budget constraint is written as:[13]

[13]Aggregation simply implies the following: $U_t^j = \sum_{j=1}^{N^j} u_t^j, T_t^j = t^j T_t$.

$$\bar{\omega}U_t^h + \bar{\omega}U_t^l + G_t^c = T_t + \tau_t^k r_t^k \sum_{h=1}^{N_t^h} k_t^h + \tau_t^{n,H}\left(w_t^{h,H}\sum_{h=1}^{N_t^h} n_t^{h,H} + w_t^{hl,H}\sum_{h=1}^{N_t^h} n_t^{hl,H} + w_t^{l,H}\sum_{l=1}^{N_t^l} n_t^{l,H}\right) \tag{44}$$

Under a balanced government budget, T_t adjusts to satisfy equation (44). For simplicity, we assume that $\tau_t^h = \tau_t^l = T_t$ or equivalently $T_t = t^h\tau_t^h + t^l\tau_t^l = T_t\left(t^h + t^l\right)$.

2.7 Stochastic process

The share of government spending in output, $s_t^c \equiv \frac{G_t^c}{Y_t}$, follows an univariate stochastic $AR(1)$ process:

$$\ln s_{t+1}^c = \rho_g \ln s_t^c + (1-\rho_g)\ln s_0^c + \epsilon_{t+1}^g \tag{45}$$

where s_0^c is the mean, ρ_g is the first-order correlation coefficient, and ϵ_{t+1}^g is an i.i.d. shock.

2.8 Wage bargaining

The Nash bargaining problem is to maximize the weighted sum of log surpluses for each employment status:

$$\max_{w_t^{j,H}}\left\{\left(1-\theta^j\right)\ln V_{n_t^j}^h + \theta^j \ln V_{n_t^j}^f\right\}, \quad j \in \{h,l\} \tag{46}$$

$$\max_{w_t^{hl,H}}\left\{\left(1-\theta^{hl}\right)\ln V_{n_t^{hl}}^h + \theta^{hl}\ln V_{n_t^{hl}}^f\right\} \tag{47}$$

where θ^j and θ^{hl} denote the firms' bargaining power for non-mismatch and mismatch positions, respectively.

The values for a household of having an additional member employed in a non-mismatch and mismatch position follow from equations (A.4), (A.6), and (A.9):

$$V_{n_t^j}^h = -\Phi^j {l_t^j}^{-\phi^j} + \lambda_{c_t^j}\left(1-\tau_t^{n,H}\right)w_t^{j,H} + \lambda_{n_t^{j,H}}\left(1-\sigma^j\right), \quad j \in \{h,l\} \tag{48}$$

$$V_{n_t^{hl}}^h = -\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_t^h}\left[\left(1-\tau_t^{n,H}\right)w_t^{hl,H} - b(z_t)\right] + \lambda_{n_t^{hl,H}}\left(1-\sigma^l - \phi(z_t)\psi_{H,t}^{h,H}\right) + \lambda_{n_t^{h,H}}\psi_{H,t}^{h,H}\phi\left(z_t\right) \tag{49}$$

The firm's value functions of an additional unit of non-mismatch and mismatch employment follow from equations (40), (41), and (42):

$$V_{n_t^j}^f = p_t^H y_{i,t}^{j,f} - w_t^{j,H} + \kappa^j \frac{\left(1-\sigma^j\right)}{\psi_{F,t}^{j,H}}, \quad j \in \{h,l\} \tag{50}$$

$$V_{n_t^{hl}}^f = p_t^H y_{i,t}^{hl,f} - w_t^{hl,H} + \kappa^l \frac{\left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right)}{\psi_{F,t}^{hl,H}} \tag{51}$$

The equilibrium wage rate in a non-mismatch position, $w_t^{j,H}$, is given by (see Appendix C for details):

$$w_t^{j,H} = \left(1-\theta^j\right)\left(p_t^H y_{i,t}^{j,f} + \kappa^j \frac{\left(1-\sigma^j\right)}{\psi_{F,t}^{j,H}}\right) - \frac{\theta^j}{\lambda_{c_t^j}\left(1-\tau_t^{n,H}\right)}\left(-\Phi^j l_t^{j^{-\phi^j}} + \lambda_{n_t^{j,H}}\left(1-\sigma^j\right)\right), \quad j \in \{h,l\} \tag{52}$$

The wage rate in a mismatch position, $w_t^{hl,H}$, is given by:

$$\begin{aligned} w_t^{hl,H} &= \left(1-\theta^{hl}\right)\left(p_t^H y_{i,t}^{hl,f} + \kappa^l \frac{\left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right)}{\psi_{F,t}^{hl,H}}\right) \\ &- \frac{\theta^{hl}}{\lambda_{c_t^h}\left(1-\tau_t^{n,H}\right)}\left(-\Phi^h l_t^{h^{-\phi^h}} - \lambda_{c_t^h} b\left(z_t\right) + \lambda_{n_t^{hl,H}}\left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right) + \lambda_{n_t^{h,H}}\psi_{H,t}^{h,H}\phi\left(z_t\right)\right) \end{aligned} \tag{53}$$

In both above equations, the term weighed by the bargaining power of workers, $\left(1-\theta^j\right)$, includes the value of the marginal product of labor and the continuation value for the firm. This continuation value accounts, in the case of the mismatch wage (see equation (53)), for the fact that there is an increased probability of a match termination due to the search on the-job, which pushes down the wage. In turn, the terms weighted by the firm's bargaining power, θ^j, include the disutility of work and the continuation value for the household. Additionally, equation (53) implies that the likelihood of quitting because of on-the-job search, $\phi\left(z_t\right)\psi_{H,t}^{h,H}$, enables firms to bargain a lower mismatch wage. On the other hand, the on-the-job search cost, $b(z_t)$, increases the wage that firms need to pay if workers accept a mismatch job.

2.9 Market clearing conditions and closing the model

Appendix D.4 includes the market clearing conditions. Next, we look at the resource constraint. The final output must equal private and public demand, with costs related to vacancy posting, on-the-job search by mismatched workers, and job search abroad reducing the amount of resources available:

$$\begin{aligned} y_t = &\left(1-n_t^{h,F}\right)c_t^{h,H}t^h + \left(1-n_t^{l,F}\right)c_t^{l,H}t^l + i_t + g_t^c + X^h\left(\tilde{O}_t^h\tilde{u}_t^h\right)O_t^h u_t^h t^h \\ &+ X^l\left(\tilde{O}_t^l\tilde{u}_t^l\right)O_t^l u_t^l t^l + b\left(z_t\right)n_t^{hl,H}t^h + \kappa^h v_t^h + \kappa^l v_t^l \end{aligned} \tag{54}$$

Real GDP is defined, in units of the final good, as follows:

$$gdp_t \equiv y_t + nx_t \tag{55}$$

where net exports, nx_t, are defined as:

$$nx_t \equiv \underbrace{p_t^H y_t^{F^*}}_{exports} - \underbrace{p_t^F y_t^F}_{imports} \tag{56}$$

Aggregating the household's budget constraint and using the market clearing conditions, the government's budget constraint, and the expression for aggregate profits, we obtain the law of motion for net foreign assets:

$$e_t\left(r_t^d d_t - d_{t+1}\right) = nx_t + e_t \underbrace{\left(\left(1-\tau^{n,F}\right) w^{h,F} - c_t^{h,F}\right) n_t^{h,F}}_{\Xi_t^h:\ remittances\ of\ high\text{-}skilled} t^h + e_t \underbrace{\left(\left(1-\tau^{n,F}\right) w^{l,F} - c_t^{l,F}\right) n_t^{l,F}}_{\Xi_t^l:\ remittances\ of\ low\text{-}skilled} t^l \quad (57)$$

where remittances $\Xi_t^j, j = h, l$ are pinned down by the budget constraint of emigrants in equations (7).[14] We address the standard issue of non-stationarity in SOE models with a debt-elastic interest rate:

$$r_t^d = r_t^* + rp_t \quad (58)$$

where r_t^* is the foreign interest rate, taken as given, and rp_t is the risk premium, which depends on the deviation of the net foreign liabilities–to–GDP ratio from its steady-state level:

$$rp_t = \psi^{rp}\left(exp\left(\frac{e_t d_{t+1}}{gdp_t} - \frac{ed}{gdp}\right) - 1\right) \quad (59)$$

where ψ^{rp} is the elasticity of the country risk premium with respect to the economy's net foreign asset position. Variables without time subscripts take steady-state values.

3 Calibration

In this section, we discuss our parameterization. We calibrate the model at an annual frequency to match salient features of the Greek economy at the onset of the Global Financial Crisis around 2008-2009. For conventional parameters, we follow the literature. For less conventional parameters, we target related moments of the Greek economy. To match the model to the data, we define output in the model y as the difference between real Gross Domestic Product and net exports (see equation (S.58)). Following usual practice (e.g., Kehoe and Prescott (2002); Conesa et al. (2007)), we define investment in the model as total investment (gross fixed capital formation, private and public) in the data. We report the key parameter values in Table 1 and the selected steady-state targets in Table 2. Online Appendices E and F present the set of equations characterizing the Decentralized Competitive Equilibrium and the Steady-State Equilibrium, respectively. Online Appendix G provides detailed documentation of the calibration strategy.

Households. Using data on population by educational attainment from Eurostat, we set the population weights of the two households, t^l and t^h, equal to 0.69 and 0.31, respectively.[15] As in Oikonomou (2023), we set $u^h = 0.065$ and $u^l = 0.08$ targeting unemployment rates of 7% and 14% for the high- and low-skilled, respectively.[16] Using data on employment by educational attainment, we have the skill-specific employment variables, $n^l = 0.49$ and $n^h = 0.81$.[17] As expected, the employment rate is higher for the high-skilled than

[14] See Appendix D.3 for the detailed derivation of the law of motion for net foreign assets.

[15] See online data code: EDAT-LFS-9903. The population share 15-64 with non-tertiary education is defined as the sum of ISCED 2011 classifications 0-2 and 3-4.

[16] See online data code: LFSA-URGAED. For the high-skilled and the low-skilled, we consider ISCED 5-8 and ISCED 0-4, respectively. The definition of the unemployment rate is simply $u^i/(1 - l^i - n^{i,F})$ for $i = h, l$.

[17] See again online data code: LFSA-ERGAED. Following the International Labor Organization and OECD definitions, the employment rate is simply the employment-to-population ratio.

the low-skilled household. For the mismatched employment, we employ the International Labor Organization's (ILO) definition and, according to Eurostat data, we set $n^{hl,H} = 0.185$.[18] Then, we derive residually the measure of non-mismatched high-skilled workers from $n^{h,H} = n^h - n^{hl,H} = 0.625$. The steady-state mismatch employment rate is given by the ratio of the high-skilled employed in low-skill positions to the total number of high-skilled, $n^{hl,H}/(1 - l^h - n^{h,F}) = 21\%$. Setting $n^{l,F} = 0.0025$ and $n^{h,F} = 0.0048$, we get a steady-state ratio of high-skilled to total emigrants, $t^h n^{h,F}/\left(t^h n^{h,F} + t^l n^{l,F}\right) = 0.49$, which reflects a nearly symmetric skill composition of emigrants. This choice ensures that we start from a neutral benchmark, as data on the pre-crisis skill distribution of emigrants is not available. Through the household-composition equations (S.19) and (S.33), we pin down $l^h = 0.1202$ and $l^l = 0.4275$, indicating a much higher share of labor market non-participation among low-skilled households than among high-skilled households.

Using equation (S.15), we set the interest rate for net foreign assets $r^d = 3.5\%$ and calculate the subjective discount factor $\beta = 0.9662$ using equation (S.16). We set the share of foreign-earned income remitted home $\eta = 0.68$ to match the data, where remittances averaged 0.25% of GDP over the period. We calibrate $\Phi^l = 0.4090$ and $\Phi^h = 0.0251$, indicating that low-skilled households receive higher utility from leisure compared to high-skilled ones. Furthermore, we set the inverse Frisch elasticity of labor supply equal to 1.5, which is close to the value adopted by Pappa et al. (2015) and in line with Domeij and Floden (2006). We examine the robustness of our main findings to a less elastic labor supply in Online Appendix J, which shows that the main results continue to hold. We also calibrate the value of the depreciation rate equal to 0.0481, using equation (S.13). Based on the data, we set the aggregate investment and aggregate capital to output ratios, $(i/y) = 0.19$ and $(k/y) = 3.95$.

Labor market. Assuming identical destruction rates across domestic and foreign markets, and higher separation for low- than high-skill jobs, we set $\sigma^h = \sigma^{h,F} = 0.06$ and $\sigma^l = \sigma^{l,F} = 0.08$. The latter is close to the values found for total employment destruction rates in Hobijn and Şahin (2009). We set the low-skill vacancy-filling rate to $\psi_F^{l,H} = 0.5$ and the hiring probabilities $\psi_H^{h,H} = 0.17$ and $\psi_H^{hl,H} = 0.85$, indicating that a high-skilled searcher is more likely to find a low-skill (mismatch) position rather than a high-skill one. We set the hiring probabilities abroad as $\psi^{h,F} = 0.2550$ and $\psi^{l,F} = 0.9$, respectively.

We obtain from equations (S.16) and (S.31) matches, $m^{h,H} = 0.0116$ and $m^{l,H} = 0.0270$. From (S.32), the share of low-skilled unemployed workers searching for a job abroad is $O^l = 0.0028$. We set the high-skill vacancy-filling probability as $\psi_F^{h,H} = 0.70$, following Bandeira et al. (2022). The hiring probability for a low-skilled position, from equation (S.2), is $\psi_H^{l,H} = 0.4914$. From (S.18), the share of high-skilled unemployed workers searching for a job abroad is $O^h = 0.0174$. Using equations (S.16) and (S.17), we calibrate $\phi(z) = 1.1766$ and the share of searchers for a high-skill position, $s = 0.0458$. From equation (S.17), we derive mismatches, $m^{hl,H} = 0.0161$. Using (S.4), the steady-state vacancy requiring high skills is (in per capita terms) $v^h = 0.0166$. We calculate $\mu_1 = 0.4979$ and $\mu_2 = 0.7593$ by solving a system of two equations (S.7 and S.8). We obtain values that are common in the literature (e.g., Petrongolo and Pissarides (2001), Oikonomou (2023) for Greece). From (S.5), we obtain $(1-x)v^l = 0.0541$ and from (S.4), $xv^l = 0.0382$. Solving yields $x = 0.4140$ for the share of

[18] See online data code: LFSA-EGISED. For the ILO definition, see here: https://ilostat.ilo.org/methods/concepts-and-definitions/description-education-and-mismatch-indicators/

low-skill vacancies allocated to high-skilled employees and $v^l = 0.0923$ for the per capita low-skill vacancies. From (S.6), we get the mismatch vacancy-filling probability, $\psi_F^{hl,H} = 0.4203$.

Using the final-good equation (S.28), data on the private consumption to output ratio ($c/y = 0.60$), data on the aggregate investment to output ratio ($i/y = 0.19$), and by setting the marginal cost of posting a high-skill vacancy as $\kappa^h = 0.05$, we find the ratio of total vacancy costs to output equal to 2.5%, and the marginal cost of posting a low-skill vacancy, $\kappa^l = 0.2059$.[19] This indicates that it is more costly to post a low-skill vacancy than a high-skill vacancy as in Oikonomou (2023). By solving a system of equations, we calibrate the efficiency of mismatch workers q^h to 1.16, indicating that they are more productive than low-skilled workers in low-skill occupations by 16%. Using data on the average annual compensation per employee and the per educational attainment level from the "Survey on the structure and distribution of wages in firms (2006)", we obtain the wage premia of high-skilled versus low-skilled workers, $w^{h,H}/w^{l,H} = 1.5379$ and of mismatched versus low-skilled workers, $w^{hl,H}/w^{l,H} = 1.01$. We then use these wage ratios, along with equations (S.45) and (S.46), to find the three wages $w^{h,H}, w^{l,H}, w^{hl,H}$. The firms' bargaining power parameters, θ^h, θ^l, and θ^{hl}, are set to 0.0271, 0.4353, and 0.4888, respectively, so that equations (S.39)–(S.41) are satisfied.

Finally, the marginal values of the pecuniary costs associated with job search abroad for the high-and low-skilled, $x_1^h = 0.1441$ and $x_1^l = 0.2039$, are derived from equations (S.62) and (S.63), respectively. These values indicate that it is more costly for low-skilled employees to search abroad for work, compared to high-skilled employees (see also Oikonomou (2023)). We calibrate the cost elasticities to small and equal values, $x_h^2 = x_l^2 = 0.047$, to ensure that migration flows respond smoothly to shocks avoiding implausibly large waves of emigration. It also ensures empirical consistency: migration costs change slowly over time (visa restrictions, relocation logistics, family networks). Last but not least, our aim is to explore potential skill asymmetry in emigration under capital–skill complementarity arising from production-side forces and wage dynamics, not from differential elasticities of migration costs.

Production. We set the elasticity of substitution between high-skilled labor and capital ρ to 0.9260, a value which is close to Krusell et al. (2000). We also set the weight attached to low-skilled labor $\alpha = 0.42$, close to Oikonomou (2023), and the elasticity of substitution between low-skilled labor, capital and high-skilled labor $\epsilon = 1.3575$. By setting the elasticity of substitution between home-produced and imported goods $\gamma = 3.96$ and targeting y^{F^*}/y, y^F/y and d/y, we calibrate the home-bias parameter $\omega = 0.8268$ and the income share of capital $\zeta = 0.6698$, which are close to values commonly used in the literature (Chodorow-Reich et al. (2023)). Capital-skill complementarity requires that $\rho < \epsilon$, which is satisfied. In Section 5.1, we perform counterfactual analysis, setting $\rho = \epsilon$, to study an economy without CSC.

By normalizing the price level P to 1 and using equation (S.51) and data on the imports to output ratio (y^F/y=0.26), we calibrate the price of imported goods $p^F = 0.9025$. We use equations (S.50) and (S.52) to calibrate the price of domestic goods $p^H = 1.0264$. We normalize total factor productivity in equation (S.42) to one, $A = 1$. Furthermore, using the production function, (S.50), we pin down the ratio of the intermediate good distributed domestically to output, $y^H/y = 0.7456$. Finally, using the production function, we solve for

[19]The value is in the range reported in 1997 National Employer Survey, https://census.gov/econ/overview/mu2400.html, which shows that 2% – 3% of GDP is dedicated to recruiting.

output, $y = 0.7935$, which pins down $y^* = 1.7535$ from equation (S.49).

Government. Based on Eurostat data, we set the share of government consumption to output $s^{g,c}$ equal to 0.1724. We also set the capital and labor income tax rates as $\tau^k = 0.18$ and $\tau^{n,H} = \tau^{n,F} = 0.29$, respectively. Using the high-skilled household's budget constraint, (S.10), and the government budget constraint, (S.53), we pin down the lump-sum transfers, $\tau = -0.0344$, and the unemployment benefit parameter, $\bar{\omega} = 0.23$. The latter implies that the unemployment benefit corresponds to 50% of the net low-skill wage.

Risk premium. We set the elasticity of the spread between domestic and foreign interest rates in line with Schmitt-Grohé and Uribe (2003), $\psi^{rp} = 0.0001$.

Table 1: Parameterization

A.Data/Sim targets		**Value**	**Source**
t^l, t^h	Population weights of households	0.69, 0.31	Eurostat (2021)
γ	EoS (home produced, imported goods)	3.9600	targeting y^{F^*}/y, y^F/y, d/y
ϵ	EoS (l-labor, capital, h-labor)	1.3575	Eurostat data on k/y, y^F/y, y^{F^*}/y, d/y
η	Remittances share	0.6800	Eurostat data
s^c	Consumption (output share)	0.6000	Eurostat data
$s^{g,c}$	Government consumption (output share)	0.1724	Eurostat data
τ^k	Capital tax rate	0.1800	Eurostat data
$\tau^{n,H}$, $\tau^{n,F}$	Domestic and foreign labor income tax rate	0.2900	Eurostat data
κ^h	High-skill vacancy cost	0.0500	total vacancy costs: 5% of GDP
x_2^h, x_2^l	Search abroad cost: high-skilled, low-skilled	0.0470	emigr flows: 0.7% of working-age pop & h-to-l emigr ratio: 2/3
B. S-S equations		**Value**	**Rationale**
β	Discount factor	0.9662	Derived from (S.15), annual interest rate = 0.0350
δ	Depreciation rate	0.0481	Derived from (S.13) and $k/y = 3.95$, $i/y = 0.19$
ζ	Weight on capital	0.6698	System of 26 eqs (Online Appendix G)
ω	Home bias	0.8268	System of 26 eqs (Online Appendix G)
q^h	Effective productivity of mismatched workers	1.1600	System of 26 eqs (Online Appendix G)
κ^l	Low-skill vacancy cost	0.2059	System of 26 eqs (Online Appendix G)
Φ^h	Relative disutility for high-skilled labor	0.0251	System of 20 eqs (Online Appendix G)
Φ^l	Relative disutility for low-skilled labor	0.4090	System of 20 eqs (Online Appendix G)
$\bar{\omega}$	Unemployment benefits	0.2300	System of 20 eqs (Online Appendix G)
μ_1	Matching efficiency	0.4979	Derived from (S.7) and (S.8)
μ_2	Matching elasticity	0.7593	Derived from (S.7) and (S.8)
b_1	On-the-job search cost to end mismatch	0.1316	Derived from (S.23), (S.60), (S.61)
ϕ_2	Efficiency of on-the-job search to end mismatch	1.1888	Derived from (S.23), (S.60), (S.61)
x_1^h	Search abroad cost: high-skilled	0.1441	Derived from (S.62)
x_1^l	Search abroad cost: low-skilled	0.2039	Derived from (S.63)
$\theta^h, \theta^{hl}, \theta^l$	Firms' bargaining power	0.03, 0.49, 0.44	Derived from (S.39), (S.40), (S.41)
C. Literature		**Value**	**Source**
ρ	EoS (h-labor, capital)	0.9260	Krusell et al. (2000)
η^c	Inverse elasticity of intertemporal substitution	1.0100	Pappa et al. (2015)
α	Weight on l-labor	0.4200	Oikonomou (2023)
$\sigma^h = \sigma^{h,F}$	High-skill job destruction rate	0.0600	Close to Hobijn and Şahin (2009)
$\sigma^l = \sigma^{l,F}$	Low-skill job destruction rate	0.0800	Close to Hobijn and Şahin (2009)
$\phi^h = \phi^l$	Inverse Frisch elasticity	1.5000	Pappa et al. (2015)
Ξ	Capital adjustment costs	4.0000	Dolado Juan J. (2021)
ρ_g	Persistence of $s_t^{g,c}$	0.9500	Papageorgiou et al. (2009)
ψ^{rp}	Elasticity of the country's risk premium	0.0001	Close to Schmitt-Grohé and Uribe (2003)
D. Other		**Value**	**Rationale**
ϕ_1	Efficacy of on-the-job search cost to end mismatch	1.0000	Normalization
b_2	On-the-job search cost to end mismatch	2.0000	Normalization

Notes: h and l denote high-skilled and low-skilled, respectively; EoS denotes elasticity of substitution; pop denotes population.

Table 2: Steady-state variables

Variable	Description	Value
y	Output	0.7935
y^{F^*}/y, y^F/y	Exports, imports (output shares)	0.23, 0.26
y^H, y^F, y_i	Demand: domestic good, imported good, intermediate good	0.5916, 0.2063, 0.7741
x_i	Composite input (capital, high-skilled labor)	1.1654
c^h, c^l	Total consumption: high-skilled, low-skilled	0.8947, 0.2881
$c^{h,H}$, $c^{l,H}$	Domestic-good consumption: high-skilled, low-skilled	0.8989, 0.2888
$c^{h,F}$, $c^{l,F}$	Foreign-good consumption: high-skilled, low-skilled	0.0325, 0.0214
i/y, k/y	Investment, capital (output shares)	0.19, 3.95
d/y	Net foreign assets (output share)	0.13
τ	Lump-sum transfers	-0.0344
$n^{h,H}$, $n^{l,H}$, $n^{hl,H}$	Employment rates: high-skill, low-skill, mismatch jobs	0.625, 0.49, 0.185
$n^{h,F}$, $n^{l,F}$	Employment rate abroad: high-skill, low-skill jobs	0.0048, 0.0025
l^h, l^l	Non-participants: high-skilled, low-skilled	0.1202, 0.4275
u^h, u^l	Unemployed: high-skilled, low-skilled	0.065, 0.08
$w_H^{h,H}$, $w_H^{l,H}$, $w_H^{hl,H}$	Wages: high-skill, low-skill, mismatch	1.0030, 0.6479, 0.6522
$w^{h,F}$, $w^{l,F}$	Wages abroad: high-skill, low-skill	1.0823, 0.7143
$m^{h,H}$, $m^{l,H}$, $m^{hl,H}$	Matches: high-skill, low-skill, mismatches	0.0116, 0.0270, 0.0161
v^h, v^l	Vacancies: high-skill, low-skill	0.0166, 0.0923
$\psi_H^{h,H}$, $\psi_H^{l,H}$, $\psi_H^{hl,H}$	Hiring probabilities: high-skill, low-skill, mismatch	0.1700, 0.4914, 0.8500
$\psi_F^{h,H}$, $\psi_F^{l,H}$, $\psi_F^{hl,H}$	Vacancy-filling probabilities: high-skill, low-skill, mismatch	0.7000, 0.5000, 0.4203
$\psi^{h,F}$, $\psi^{l,F}$	High- and low-skill hiring probabilities abroad	0.2550, 0.9000
z, $b(z)$, $\phi(z)$	On-the-job search to end mismatch, cost: effort, cost, efficacy	1.1466, 0.1730, 1.1766
$X^h\left(\tilde{O}^h\tilde{u}^h\right)$, $X^l\left(\tilde{O}^l\tilde{u}^l\right)$	Search abroad costs: high-skilled, low-skilled	0.1047, 0.1373
x	Share of low-skill positions given to high-skilled	0.4140
$1-s$	Share of high-skilled searchers looking for mismatch job	0.9542
O^h, O^l	Shares of searchers looking for jobs abroad: high-skilled, low-skilled	0.0174, 0.0028
p^H, p^F	Prices: Domestic good, foreign good	1.0264, 0.9025
r^k	Return on capital	0.1013
r^d, r^*	Interest rates (gross): domestic, world	1.0350
e	Exchange rate	0.9025

4 Quantitative analysis

In this section, we examine the impulse responses and fiscal multipliers generated by our DSGE model and investigate how international migration and skills mismatch shape the transmission of fiscal policy. We focus on a 1% negative shock to the government-spending-to-GDP ratio. We first present the baseline results and compare them with an alternative model variant that shuts down migration.[20] This comparison allows us to isolate the mechanisms through which migration interacts with production structure and labor-market mismatch to affect fiscal multipliers. We report the full set of impulse responses in Online Appendix H; here, we focus on the key variables of interest.

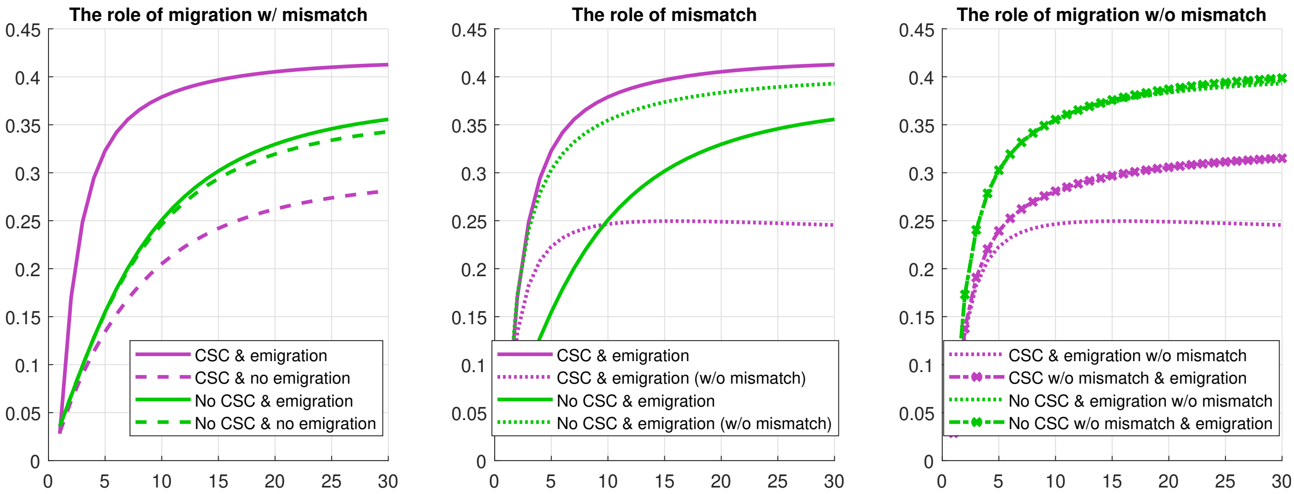
We compute fiscal multipliers at horizon h as the ratio of the present-value cumulative response of output to that of government spending, scaled by the steady-state spending-to-GDP ratio:

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

Therefore, the fiscal multiplier quantifies the effect on economic output of a fiscal expansion or contraction. For $j = 0$, we get the impact multiplier, which describes the immediate impact of a change in government consumption on aggregate output. Typically, the cumulative multiplier exceeds the impact multiplier due to propagation through labor market and migration dynamics.

[20]We shut down migration by holding all migration variables fixed at their steady-state level.

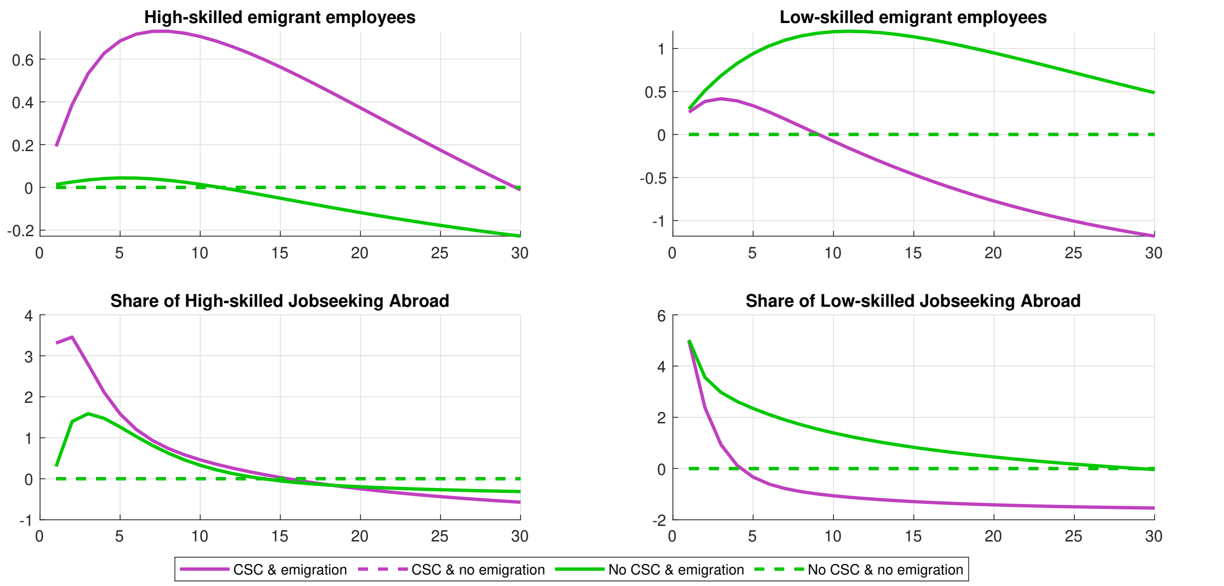
Figure 2: The annualized cumulative fiscal multiplier (government consumption)



Notes: The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

We begin by presenting the fiscal multipliers implied by the baseline model and by an alternative variant without migration. The left graph in Figure 2 depicts the baseline findings. The key finding is that introducing migration decisions into the CSC economy (purple lines) raises the fiscal multiplier. For instance, five years after the shock, the multiplier more than doubles—rising from around 0.13 in the no-migration model to around 0.32 in the migration model. This result suggests that fiscal contractions lead to larger output losses when agents can emigrate from a CSC economy.

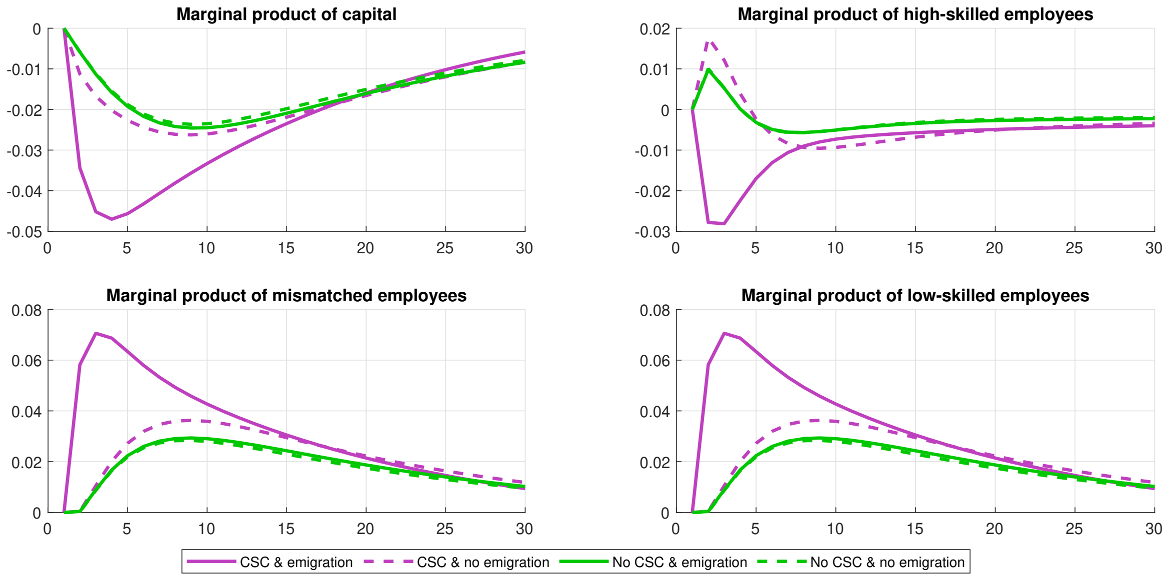
Figure 3: Impulse response functions of high-skilled and low-skilled emigration



Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Let us now examine the migration patterns triggered by the shock. Figure 3 depicts per skill level the impulse response functions of the stocks of emigrants (upper panel) and the share of unemployed searching for jobs abroad (bottom panel). The negative shock to government spending generates a pronounced “brain drain" in the CSC economy. Specifically, we observe a protracted increase in high-skilled emigration and only a modest, rise in low-skilled emigration, the latter eventually reverting to return migration. In what follows, we delve deeper into these results by illustrating the demand-depressing mechanism underlying the "brain drain" outcome.

Figure 4: Impulse response functions of the marginal products

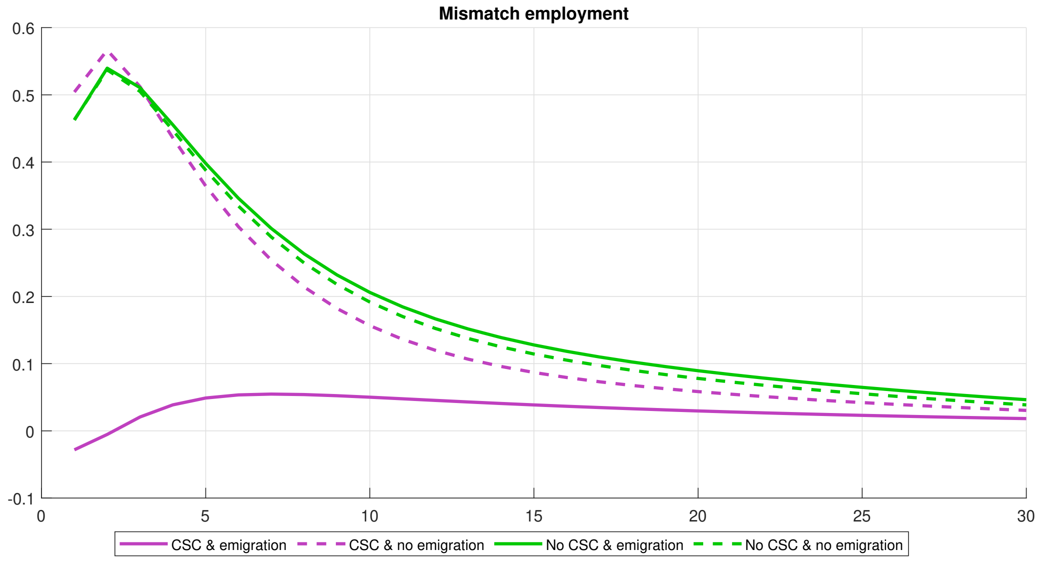


Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure 4 displays impulse responses for the marginal products of capital and domestic labor. In the CSC economy with emigration, the marginal product of capital exhibits a sharper and more persistent decline relative to the same model without emigration. The marginal product of high-skilled labor, in contrast, reverses sign—from a short-lived positive to a negative response—reflecting the "brain drain" induced by fiscal consolidation. This outflow of skilled workers reduces the effective complementarity between capital and high-skilled labor, thereby depressing investment incentives.

The marginal product of mismatched employees rises in the short run, indicating a temporary surge in skill misallocation as firms adjust to the recession and the altered workforce composition. Indeed, Figure 5 shows that the mismatch rate behaves countercyclically, consistent with Mavrigiannakis et al. (2023). This countercyclicality is weaker when agents can emigrate in the economy with CSC as the exodus abroad of high-skilled workers following the adverse demand shock mitigates the increase in mismatch relative to the no-migration case.

Figure 5: The response of the vertical mismatch rate



Notes: The mismatch employment rate refers to the share of mismatched employees in the total number of the high-skilled household's employed members, $n_t^{h,l}/(n_t^{h,l}+n_t^{h,h})$. *Responses are in percent deviations from the steady state. The horizontal axis depicts time periods.*

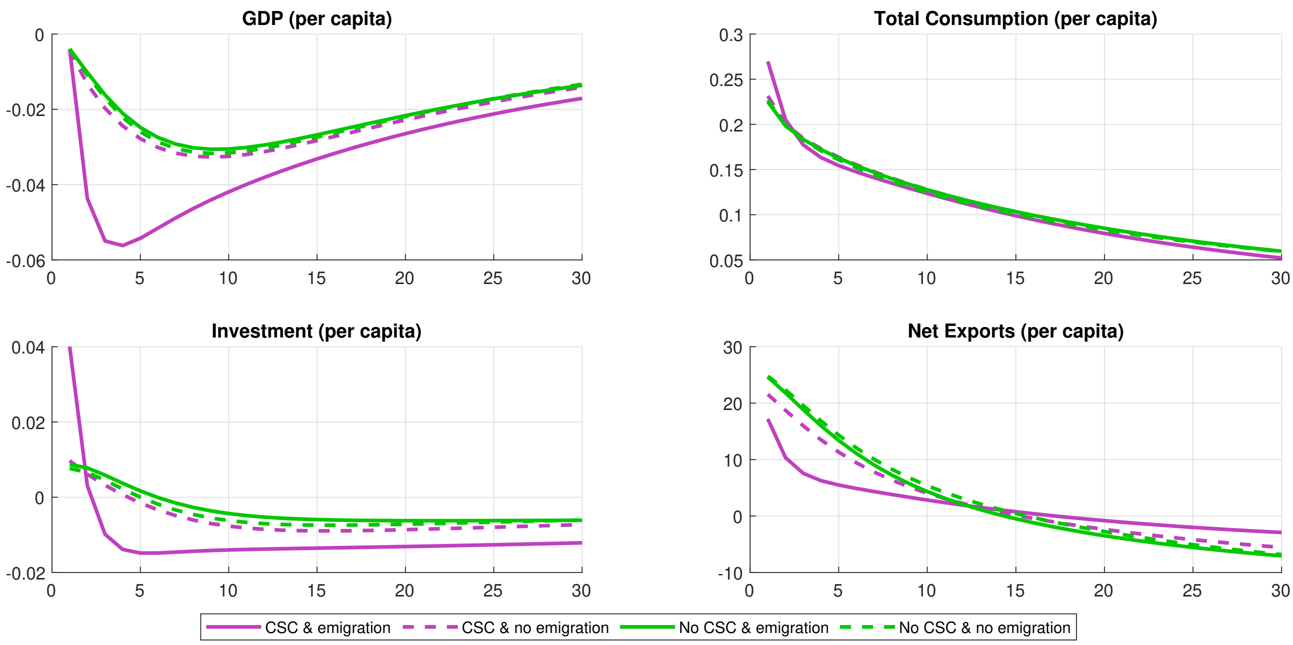
Figure 6 depicts the impulse response functions of key macroeconomic variables. Following the fiscal consolidation shock, we observe a sharp rise in net exports, consistent with the contraction in domestic demand. When CSC and emigration are both present, the increase is noticeably smaller and more short-lived. This muted external adjustment reflects the deeper output contraction in the CSC economy, which limits the capacity of domestic producers to reallocate resources toward exports. In other words, the recessionary effects are markedly amplified: GDP and investment contract more sharply. Through CSC, skilled emigration alters the skill composition of the domestic workforce and reduces the marginal productivity of capital, thereby amplifying the investment contraction beyond the initial impact period. In contrast, total consumption shows more muted differences between scenarios, indicating that amplification operates primarily through the investment and net export channels.

Fiscal consolidation induces high-skilled emigration in the CSC economy. The resulting decline in the domestic skill supply reduces the marginal productivity of capital, weakens investment, and amplifies the recession. At the same time, emigration sustains higher wages, which diminishes the internal devaluation and the increase of per capita net exports. These demand-depressing channels increase the fiscal multiplier.

The search frictions reinforce this effect, as asymmetric emigration generates uneven congestion across skilled and unskilled market segments. The heightened competition among firms for the remaining skilled labor raises the effective cost of posting vacancies, thereby weakening hiring incentives. The ensuing reduction in vacancy postings for skilled workers further worsens the workforce's skill composition and deepens the fall in capital demand. The reversal of the sign in the impulse response of the marginal productivity of high-skilled labor—from positive to negative due to the pronounced contraction in capital—carries through to the corresponding wage response, which similarly switches sign (see Figure A.2).[21]

[21] The positive sign is due to the wealth effect of the fiscal cut, which reduces labor market participation, thereby increase the wage of the high-skilled after the impact period.

Figure 6: Impulse response functions of macroeconomic variables



Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Similarly, recent evidence in Oikonomou (2023) shows that skilled emigration amplifies a recession induced by a risk-premium shock in an advanced economy through a demand-depressing mechanism. Building on this insight, we show how the "brain drain" shapes the transmission of fiscal policy. Since the outflow of high-skilled workers reduces the marginal productivity of capital, weakens private investment, and deepens the downturn, fiscal contractions have larger output effects: the "brain drain" amplifies the recession, thus increasing the fiscal multiplier. Conversely, fiscal expansions become more potent when migration drains skilled labor abroad, as the resulting demand sensitivity strengthens the multiplier channel.

Our findings highlight the importance of accounting for endogenous migration in the design of stabilization tools for advanced economies. In previous DSGE models with labor market frictions and emigration, but without skill heterogeneity and CSC (see Bandeira et al. (2022)), the demand-depressing mechanism is not sufficiently strong to affect the multipliers of wasteful government spending.

5 Counterfactual analysis

This section presents counterfactual analysis to highlight the key drivers of the main results of the model. Sections 5.1 and 5.2 examine the role of CSC and mismatch, respectively, in the responses to the fiscal shock.

5.1 The role of capital-skill complementarity

We examine first a counterfactual economy without CSC. This is implemented by setting $\rho = \epsilon = 1.3575$ so that capital and high-skilled labor are substitutes. In this environment, Figure 2, left graph, shows that the fiscal multiplier remains virtually unchanged when we introduce migration decisions—an outcome that stands in sharp contrast to the results obtained under CSC.

The key mechanism behind this difference lies in the distinct migration patterns triggered by the shock across the two economies. As shown in Figure 3, in the no-CSC economy, emigration is predominantly low-skilled, while high-skilled households exhibit near-zero emigration rates for more than ten periods following the shock, after which they display mild return migration. Low-skilled emigration vacates low-skill positions that high-skilled workers may fill through mismatch employment. Alongside high-skilled return migration, this tends to amplify the increase in the mismatch rate relative to the economy without migration, but the difference is minimal (see Figure 5). On the flip side, increased mismatch—by reducing the number of suitable job matches for low-skilled workers—can intensify low-skilled emigration.

Additionally, the multiplier in Figure 2 takes smaller values after the impact period compared to the CSC economy with emigration. Consistently, Figure 6 shows that the milder recession relative to the CSC economy allows for a more pronounced and persistent improvement in the trade balance and a smaller decline in investment. In a similar vein, the impulse responses for the marginal products of capital and domestic labor are much milder in the model without CSC (see Figure 4), underscoring the amplifying role of CSC-driven high-skilled emigration.

Notice that the no-CSC model produces predominantly low-skilled emigration despite the positive response of the marginal product of low-skilled labor. This outcome reflects the interaction between migration incentives and search frictions: while the marginal product of labor of low-skilled workers rises, the accompanying increase in labor-market congestion and job-seeking among this group weakens their effective employment prospects and induces outward migration. The focus of high-skilled searchers on domestic vacancies—including mismatched positions—intensifies job competition for low-skilled searchers, thereby contributing further to their increased emigration. In Section 5.2, we revisit this finding when we shut down skills mismatch in the model.

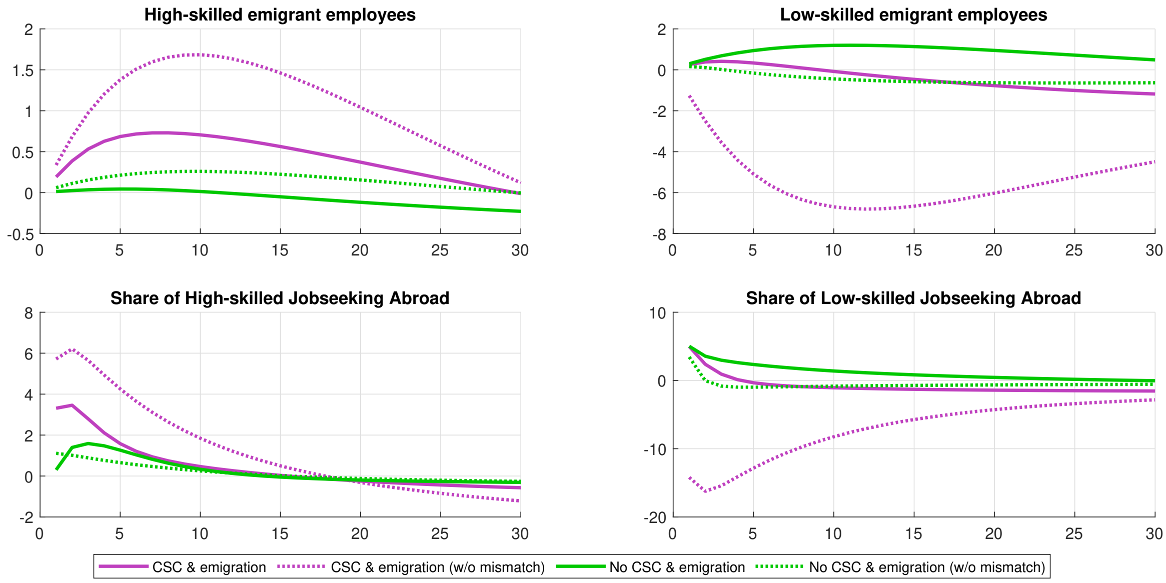
In sum, the analysis suggest that the impact of migration on the fiscal multiplier crucially hinges on the presence of CSC, which governs the skill asymmetry of emigration and thus the post-shock skill composition of the workforce. In economies with CSC, a negative shock to government spending triggers predominantly high-skilled emigration ("brain drain"), amplifying recessionary forces and raising the fiscal multiplier. In the absence of CSC, by contrast, emigration is primarily low-skilled and exerts only muted effects on the multiplier. Taken together, these findings underscore that the CSC–migration interaction is pivotal for understanding the transmission of fiscal shocks in small open economies: CSC fundamentally alters both the direction and composition of migration flows, shaping labor-market dynamics, wage adjustment, and ultimately the output response to fiscal consolidation.

5.2 The role of skill mismatch

Having established the role of migration and CSC, we now examine how skills mismatch interacts with these mechanisms. As noted in Section 5.1, the no-CSC model produces predominantly low-skilled emigration despite the positive response of the marginal product of low-skilled labor to the fiscal shock. Without mismatch, the positive productivity signal would likely dominate and low-skilled emigration would be much less pronounced. In this section, we investigate this hypothesis and assess the overall role of mismatch in our framework. In doing so, we compare impulse responses to the same fiscal shock in a model variant in which mismatch is eliminated, while maintaining the distinction between the CSC and non-CSC economies.[22]

Two main results emerge from this exercise. First, Figure 7 shows that eliminating mismatch induces a predominantly high-skilled emigration pattern—a "brain drain" outcome—in both economies: in the non-CSC case, this reverses the predominantly low-skilled emigration documented in Section 5.1, while in the CSC economy, the "brain drain" becomes even more pronounced when mismatch is muted. These results confirm that mismatch employment acts as a brake on "brain drain" by offering high-skilled workers a domestic buffer during recessions. Without mismatch, the incentive to emigrate increases for high-skilled workers and declines for low-skilled ones, since the latter no longer face competition from high-skilled job seekers willing to accept a mismatch. Consistent with these results, the marginal productivity of high-skilled labor turns negative when mismatch is absent (see Figure 8).

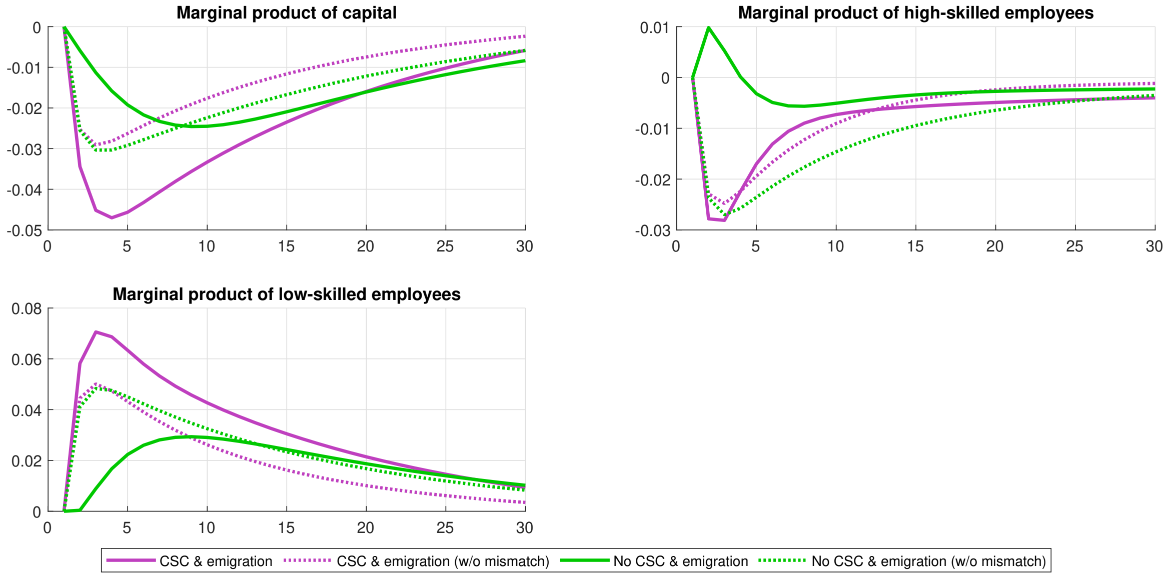
Figure 7: Impulse response functions of high-skilled and low-skilled emigration: Muting mismatch



Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

[22]We hold all mismatch variables fixed at their steady-state values. Online Appendix I includes the full set of impulse responses.

Figure 8: Impulse response functions of the marginal products: Muting mismatch



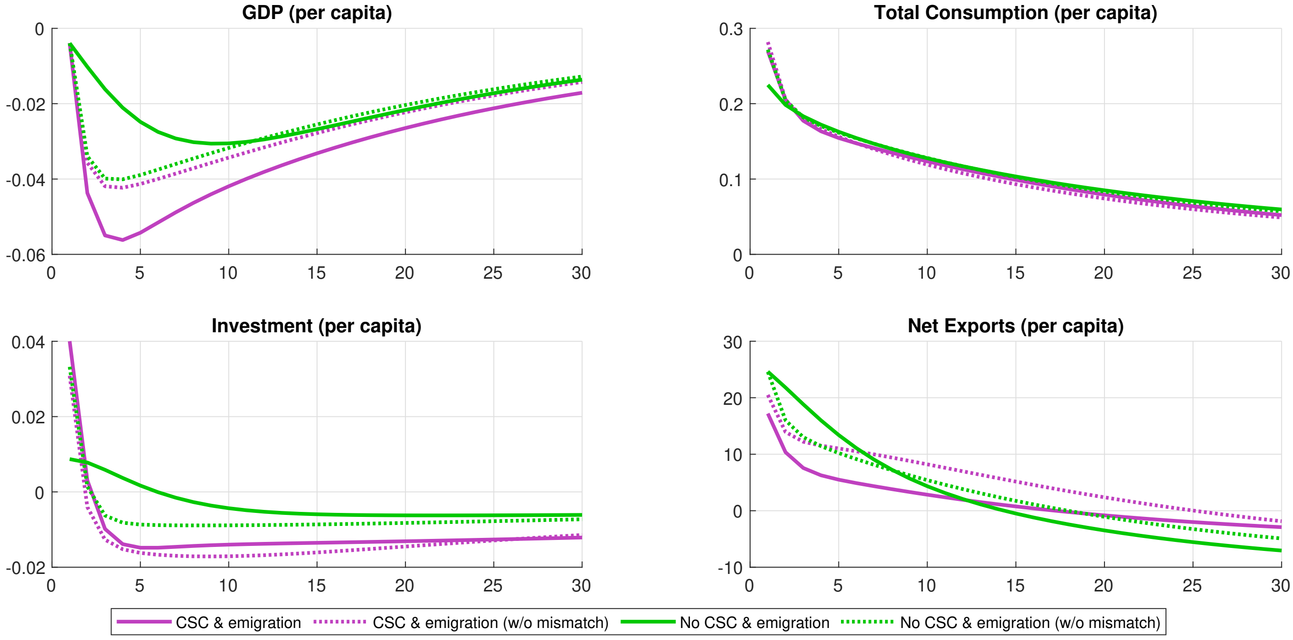
Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

The second main finding shows that mismatch affects the fiscal multiplier in opposite ways across CSC and no-CSC economies (see middle graph in Figure 2). When CSC is present, the mismatch amplifies the downturn: the buffer of mismatch jobs (i) limits high-skilled emigration and (ii) supports domestic labor market participation, both of which dampen wage adjustment. This, in turn, restricts internal devaluation through real exchange rate depreciation and the associated boost to exports *(dominant net-exports channel)* as shown in Figure 9. Consequently, muting mismatch in this environment mitigates output losses, yielding a lower fiscal multiplier, which implies smaller output losses from the fiscal contraction. In contrast, in the absence of CSC, mismatch mitigates the downturn. In this case, Figure 9 illustrates that the main mechanism operates through mitigating the capital losses associated with the reduced "brain drain" following a fiscal contraction *(dominant investment channel)*. Eliminating mismatch under these conditions instead intensifies output losses, leading to a higher fiscal multiplier.

Finally, the model without mismatch confirms our earlier result that introducing migration decisions leaves the fiscal multiplier unchanged in the no-CSC economy, whereas it does affect the multiplier in the CSC economy (see right graph in Figure 2). In the latter, however, migration now reduces—rather than amplifies—the multiplier, the opposite of what we found in the baseline model with mismatch. As a result, the multipliers in the CSC economy become lower than those in the no-CSC economy.

Taken together, the counterfactual exercises in this section highlight that the interaction between migration responses, capital–skill complementarity and skills mismatch is central for understanding the transmission of fiscal shocks in open economies. When fiscal consolidation triggers an outflow of high-skilled workers, the resulting change in the skill composition of the domestic workforce reduces labor income and weakens aggregate demand. This demand-depressing channel amplifies the contractionary effects of fiscal tightening and leads to substantially larger fiscal multipliers compared with an economy where migration is absent. More broadly, the findings underscore the importance of incorporating endogenous labor mobility and skill heterogeneity into macroeconomic models used to evaluate stabilization policies.

Figure 9: Impulse response functions of macroeconomic variables: Muting mismatch



Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

6 Conclusion

This paper has shown that international labor mobility plays a central role in shaping the transmission of fiscal policy in economies characterized by skills mismatch. By developing a small open economy DSGE framework with heterogeneous households, endogenous migration decisions, search-and-matching frictions, overqualification, and capital–skill complementarity (CSC), we uncover a key interaction between migration and production structure. In particular, the effect of migration on the fiscal multiplier hinges critically on the presence of CSC, which governs the skill composition of migrants.

In response to a fiscal contraction, the model predicts predominantly high-skilled emigration. This "brain drain" alleviates congestion in domestic labor markets and thereby tempers the rise in skills mismatch. At the same time, however, it amplifies the recession through a demand-depressing channel, resulting in a larger fiscal multiplier. In contrast, in an economy without CSC, migration is mainly concentrated among low-skilled workers and has only a limited impact on fiscal multipliers.

Overall, these findings highlight the importance of accounting jointly for labor mobility, skills mismatch, and production complementarities when evaluating fiscal stabilization policies. Ignoring the endogenous response of migration—particularly its skill composition—may lead to a systematic misassessment of fiscal policy effectiveness in open economies.

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ONLINE APPENDIX

Brain Drain, Skills Mismatch and the Fiscal Multiplier

George Liontos Konstantinos Mavrigiannakis Eugenia Vella

A Household FOCs

The first-order conditions from the high-skilled household's problem with respect to c_t^h, k_{t+1}^h, d_{t+1}^h, $n_{t+1}^{h,H}$, $n_{t+1}^{hl,H}$, $n_{t+1}^{h,F}$, u_t^h are as follows:

$[c_t^h]$

$$\lambda_{c_t^h} = \left(c_t^h - \chi c_{t-1}^h\right)^{-\eta^c} - \beta\chi\left(c_{t+1}^h - \chi c_t^h\right)^{-\eta^c} \tag{A.1}$$

$[k_{t+1}^h]$

$$\lambda_{c_t^h}\left(1 + \Xi\left(\frac{k_{t+1}^h}{k_t^h} - 1\right)\right) = \beta\mathbb{E}_t\lambda_{c_{t+1}^h}\left(1 + \left(1 - \tau_{t+1}^k\right)r_{t+1}^k - \delta + \frac{\Xi}{2}\left(\left(\frac{k_{t+2}^h}{k_{t+1}^h}\right)^2 - 1\right)\right) \tag{A.2}$$

$[d_{t+1}^h]$

$$\lambda_{c_t^h}e_t = \beta\mathbb{E}_t\lambda_{c_{t+1}^h}e_{t+1}r_{t+1}^d \tag{A.3}$$

$[n_{t+1}^{h,H}]$

$$\lambda_{n_t^{h,H}} = \beta\mathbb{E}_t\left\{-\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_{t+1}^h}\left(1 - \tau_{t+1}^{n,H}\right)w_{t+1}^{h,H} + \lambda_{n_{t+1}^{h,H}}\left(1 - \sigma^h\right)\right\} \tag{A.4}$$

$[n_{t+1}^{h,F}]$

$$\lambda_{n_t^{h,F}} = \beta\mathbb{E}_t\left\{-\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_{t+1}^h}\left(1 - \tau^{n,F}\right)e_{t+1}w^{h,F} + \lambda_{n_{t+1}^{h,F}}\left(1 - \sigma^{h,F}\right)\right\} \tag{A.5}$$

$[n_{t+1}^{hl,H}]$

$$\begin{aligned}\lambda_{n_t^{hl,H}} = \beta\mathbb{E}_t\Big\{-\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_{t+1}^h}\left[\left(1 - \tau_{t+1}^{n,H}\right)w_{t+1}^{hl,H} - b(z_{t+1})\right] + \lambda_{n_{t+1}^{hl,H}}\left(1 - \sigma^l - \phi(z_{t+1})\psi_{H,t+1}^{h,H}\right) \\ + \lambda_{n_{t+1}^{h,H}}\psi_{H,t+1}^{h,H}\phi\left(z_{t+1}\right)\Big\}\end{aligned} \tag{A.6}$$

$[u_t^h]$

$$\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_t^h}\left(X^h\left(\tilde{O}_t^h\tilde{u}_t^h\right)O_t^h - \bar{\omega}\right) = \lambda_{n_t^{h,H}}\psi_{H,t}^{h,H}\left(1 - O_t^h\right)s_t + \lambda_{n_t^{hl,H}}\psi_{H,t}^{hl,H}\left(1 - O_t^h\right)\left(1 - s_t\right) + \lambda_{n_t^{h,F}}\psi^{h,F}O_t^h \tag{A.7}$$

The first-order conditions from the low-skilled household's problem with respect to c_t^l, $n_{t+1}^{l,H}$, $n_{t+1}^{l,F}$, u_t^l are as follows:

$[c_t^l]$

$$\lambda_{c_t^l} = \left(c_t^l - \chi c_{t-1}^l\right)^{-\eta^c} - \beta\chi\left(c_{t+1}^l - \chi c_t^l\right)^{-\eta^c} \tag{A.8}$$

$[n_{t+1}^{l,H}]$

$$\lambda_{n_t^{l,H}} = \beta\mathbb{E}_t\left\{-\Phi^l l_t^{l^{-\phi^l}} + \lambda_{c_{t+1}^l}\left(1-\tau_{t+1}^{n,H}\right)w_{t+1}^{l,H} + \lambda_{n_{t+1}^{l,H}}\left(1-\sigma^l\right)\right\} \tag{A.9}$$

$[n_{t+1}^{l,F}]$

$$\lambda_{n_t^{l,F}} = \beta\mathbb{E}_t\left\{-\Phi^l l_t^{l^{-\phi^l}} + \lambda_{c_{t+1}^l}\left(1-\tau^{n,F}\right)e_{t+1}w^{l,F} + \lambda_{n_{t+1}^{l,F}}\left(1-\sigma^{l,F}\right)\right\} \tag{A.10}$$

$[u_t^l]$

$$\Phi^l l_t^{l^{-\phi^l}} + \lambda_{c_t^l}\left(X^l\left(\tilde{O}_t^l\tilde{u}_t^l\right)O_t^l - \bar{\omega}\right) = \lambda_{n_t^{l,H}}\psi_{H,t}^{l,H}\left(1-O_t^l\right) + \lambda_{n_t^{l,F}}\psi^{l,F}O_t^l \tag{A.11}$$

B The firm's problem: some details

Derivation of equations (37) and (38) Using the vacancy-filling probabilities of equation (12), the employment laws of motion in equations (15)-(16) can be rewritten as follows:

$$N^f n_{t+1}^{hl,f} = \left(1-\sigma^l-\phi\left(z_t\right)\psi_{H,t}^{h,H}\right)n_t^{hl,f}N^f + \psi_{F,t}^{hl,H}x_t v_t^{l,f}N^f \tag{A.12}$$

$$N^f n_{t+1}^{ll,f} = \left(1-\sigma^l\right)n_t^{ll,f}N^f + \psi_{F,t}^{l,H}\left(1-x_t\right)v_t^{l,f}N^f \tag{A.13}$$

$$N^f n_{t+1}^{h,f} = \left(1-\sigma^h\right)n_t^{h,f}N^f + \psi_{F,t}^{h,H}v_t^{h,f}N^f \tag{A.14}$$

Solving for vacancies Using the optimal values for $n_{t+1}^{ll,f}$ and $n_{t+1}^{hl,f}$, we can derive the high-skill vacancies by solving equation (A.12) for x_t and substituting in equation (A.13):

$$v_t^{l,f} = \frac{n_{t+1}^{ll,f} - \left(1-\sigma^l\right)n_t^{ll,f}}{\psi_{F,t}^{l,H}} + \frac{n_{t+1}^{hl,f} - \left(1-\sigma^l-\phi\left(z_t\right)\psi_{H,t}^{h,H}\right)n_t^{hl,f}}{\psi_{F,t}^{hl,H}} \tag{A.15}$$

and low-skill vacancies by solving equation (A.14):

$$v_t^{h,f} = \frac{n_{t+1}^{h,f} - \left(1-\sigma^h\right)n_t^{h,f}}{\psi_{F,t}^{h,H}} \tag{A.16}$$

C The wage-bargaining problem

First, let us define the following that will be used later. The marginal products of k_t^f, $n_t^{ll,f}$, $n_t^{h,f}$ and $n_t^{hl,f}$ are calculated as follows:

$$y_{i,t}^{k,f} \equiv \frac{\partial y_{i,t}^f}{\partial k_t^f} = \zeta\left(1-\alpha\right)A_t^{\frac{\epsilon-1}{\epsilon}}\left(\frac{y_{i,t}^f}{x_{i,t}^f}\right)^{\frac{1}{\epsilon}}\left(\frac{x_{i,t}^f}{k_t^f}\right)^{\frac{1}{\rho}} \tag{A.17}$$

$$y_{i,t}^{ll,f} \equiv \frac{\vartheta y_{i,t}^{f}}{\vartheta n_{t}^{ll,f}} = \alpha A_{t}^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_{i,t}^{f}}{n_{t}^{l,f}} \right)^{\frac{1}{\epsilon}} \tag{A.18}$$

$$y_{i,t}^{h,f} \equiv \frac{\vartheta y_{i,t}^{f}}{\vartheta n_{t}^{h,f}} = (1-\zeta)(1-\alpha) A_{t}^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_{i,t}^{f}}{x_{i,t}^{f}} \right)^{\frac{1}{\epsilon}} \left(\frac{x_{i,t}^{f}}{n_{t}^{h,f}} \right)^{\frac{1}{\rho}} \tag{A.19}$$

$$y_{i,t}^{hl,f} \equiv \frac{\vartheta y_{i,t}^{f}}{\vartheta n_{t}^{hl,f}} = q_h \alpha A_{t}^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_{i,t}^{f}}{n_{t}^{l,f}} \right)^{\frac{1}{\epsilon}} \tag{A.20}$$

The Nash bargaining problem is to maximize the weighted sum of log surpluses for each employment status. The wages are given as the optimal solution of the following three problems:

$$\max_{w_t^{h,H}} \left\{ \left(1-\theta^h\right) \ln V_{n_t^h}^h + \theta^h \ln V_{n_t^h}^f \right\} \tag{A.21}$$

$$\max_{w_t^{hl,H}} \left\{ \left(1-\theta^{hl}\right) \ln V_{n_t^{hl}}^h + \theta^{hl} \ln V_{n_t^{hl}}^f \right\} \tag{A.22}$$

$$\max_{w_t^{l,H}} \left\{ \left(1-\theta^{l}\right) \ln V_{n_t^{l}}^h + \theta^{l} \ln V_{n_t^{l}}^f \right\} \tag{A.23}$$

where θ_l^f and θ_h^f denote the bargaining power on wage setting of firms for low and high skill positions, $V_{n_t^h}^f$, $V_{n_t^{hl}}^f$ and $V_{n_t^l}^f$ are the respective value functions of an additional unit of high skill, low skill and mismatched employment to each firm, and $V_{n_t^h}^h$ and $V_{n_t^{hl}}^h$ are the respective marginal values of a high skill household having an additional member employed in a high skill or mismatched position and $V_{n_t^l}^h$ is the respective marginal value of a low skill household having an additional member employed in a low skill position.

a) Derivation of the high-skill wage, $w_t^{h,H}$:

$$\max_{w_t^{h,H}} \left\{ \left(1-\theta^h\right) \ln V_{n_t^h}^h + \theta^h \ln V_{n_t^h}^f \right\}, \text{ subject to} \tag{A.24}$$

$$V_{n_t^h}^h = -\Phi^h l_t^{h^{-\phi^h}} + \lambda_{c_t^h} \left(1-\tau_t^{n,H}\right) w_t^{h,H} + \lambda_{n_t^{h,H}} \left(1-\sigma^h\right) \tag{A.25}$$

$$V_{n_t^h}^f = p_t^H y_{i,t}^{h,f} - w_t^{h,H} + \kappa^h \frac{\left(1-\sigma^h\right)}{\psi_{F,t}^{h,H}} \tag{A.26}$$

Substituting the constraints yields:

$$\max_{w_t^{h,H}} \left\{ \left(1-\theta^h\right) \ln \left(-\Phi^h l_t^{h^{-\phi^h}} + \lambda_{c_t^h} \left(1-\tau_t^{n,H}\right) w_t^{h,H} + \lambda_{n_t^{h,H}} \left(1-\sigma^h\right) \right) + \theta^h \ln \left(p_t^H y_{i,t}^{h,f} - w_t^{h,H} + \kappa^h \frac{\left(1-\sigma^h\right)}{\psi_{F,t}^{h,H}} \right) \right\} \tag{A.27}$$

Thus, the wage rate $w_t^{h,H}$ is given by:

$$w_t^{h,H} = \left(1-\theta^h\right)\left(p_t^H y_{i,t}^{h,f} + \kappa^h \frac{\left(1-\sigma^h\right)}{\psi_{F,t}^{h,H}}\right) - \frac{\theta^h}{\lambda_{c_t^h}\left(1-\tau_t^{n,H}\right)}\left(-\Phi^h {l_t^h}^{-\phi^h} + \lambda_{n_t^{h,H}}\left(1-\sigma^h\right)\right) \tag{A.28}$$

b) Derivation of the mismatched wage, $w_t^{hl,H}$:

$$\max_{w_t^{hl,H}} \left\{\left(1-\theta^{hl}\right)\ln V_{n_t^{hl}}^h + \theta^{hl}\ln V_{n_t^{hl}}^f\right\}, \text{ subject to} \tag{A.29}$$

$$V_{n_t^{hl}}^h = -\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_t^h}\left[\left(1-\tau_t^{n,H}\right)w_t^{hl,H} - b(z_t)\right] + \lambda_{n_t^{hl,H}}\left(1-\sigma^l - \phi(z_t)\psi_{H,t}^{h,H}\right) + \lambda_{n_t^{h,H}}\psi_{H,t}^{h,H}\phi\left(z_t\right) \tag{A.30}$$

$$V_{n_t^{hl}}^f = p_t^H y_{i,t}^{hl,f} - w_t^{hl,H} + \kappa^l \frac{\left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right)}{\psi_{F,t}^{hl,H}} \tag{A.31}$$

Substituting the constraints yields:

$$\begin{aligned}\max_{w_t^{hl,H}} \Bigg\{ &\left(1-\theta^{hl}\right)\ln\Bigg(-\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_t^h}\left[\left(1-\tau_t^{n,H}\right)w_t^{hl,H} - b(z_t)\right] + \lambda_{n_t^{hl,H}}\left(1-\sigma^l - \phi(z_t)\psi_{H,t}^{h,H}\right) \\ &+ \lambda_{n_t^{h,H}}\psi_{H,t}^{h,H}\phi\left(z_t\right)\Bigg) + \theta^{hl}\ln\left(p_t^H y_{i,t}^{hl,f} - w_t^{hl,H} + \kappa^l \frac{\left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right)}{\psi_{F,t}^{hl,H}}\right)\Bigg\}\end{aligned} \tag{A.32}$$

Thus, the wage rate $w_t^{hl,H}$ is given by:

$$\begin{aligned}w_t^{hl,H} = &\left(1-\theta^{hl}\right)\left(p_t^H y_{i,t}^{hl,f} + \kappa^l \frac{\left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right)}{\psi_{F,t}^{hl,H}}\right) \\ &- \frac{\theta^{hl}}{\lambda_{c_t^h}\left(1-\tau_t^{n,H}\right)}\left(-\Phi^h {l_t^h}^{-\phi^h} - \lambda_{c_t^h} b\left(z_t\right) + \lambda_{n_t^{hl,H}}\left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right) + \lambda_{n_t^{h,H}}\psi_{H,t}^{h,H}\phi\left(z_t\right)\right)\end{aligned} \tag{A.33}$$

c) Derivation of the low-skill wage, $w_t^{l,H}$:

$$\max_{w_t^{l,H}} \left\{\left(1-\theta^l\right)\ln V_{n_t^l}^h + \theta^l \ln V_{n_t^l}^f\right\}, \text{ subject to} \tag{A.34}$$

$$V_{n_t^l}^h = -\Phi^l {l_t^l}^{-\phi^l} + \lambda_{c_t^l}\left(1-\tau_t^{n,H}\right)w_t^{l,H} + \lambda_{n_t^{l,H}}\left(1-\sigma^l\right) \tag{A.35}$$

$$V_{n_t^l}^f = p_t^H y_{i,t}^{ll,f} - w_t^{l,H} + \kappa^l \frac{\left(1-\sigma^l\right)}{\psi_{F,t}^{l,H}} \tag{A.36}$$

Substituting the constraints yields:

$$\max_{w_t^{l,H}} \left\{ \left(1-\theta^l\right) \ln \left(-\Phi^l {l_t^l}^{-\phi^l} + \lambda_{c_t^l} \left(1-\tau_t^{n,H}\right) w_t^{l,H} + \lambda_{n_t^{l,H}} \left(1-\sigma^l\right) \right) + \theta^l \ln \left(p_t^H y_{i,t}^{ll,f} - w_t^{l,H} + \kappa^l \frac{\left(1-\sigma^l\right)}{\psi_{F,t}^{l,H}} \right) \right\} \tag{A.37}$$

Thus, the wage rate $w_t^{l,H}$ is given by:

$$w_t^{l,H} = \left(1-\theta^l\right) \left(p_t^H y_{i,t}^{ll,f} + \kappa^l \frac{\left(1-\sigma^l\right)}{\psi_{F,t}^{l,H}} \right) - \frac{\theta^l}{\lambda_{c_t^l} \left(1-\tau_t^{n,H}\right)} \left(-\Phi^l {l_t^l}^{-\phi^l} + \lambda_{n_t^{l,H}} \left(1-\sigma^l\right) \right) \tag{A.38}$$

D Market-clearing conditions

D.1 Transformations

Total population is given by:

$$N = N^h + N^l \tag{A.39}$$

we define t^h and t^l to be the shares of high and low-skilled households in the population respectively:

$$t^h = \frac{N^h}{N^h + N^l}, \qquad t^l = \frac{N^l}{N^h + N^l} \tag{A.40}$$

Since the high-skilled households own the firms, it must hold:

$$N^h = N^f \tag{A.41}$$

High-skilled labor, $n_t^{h,H}$

Supply

$$\sum_{h=1}^{N^h} n_t^{h,H} = N^h n_t^{h,H} \tag{A.42}$$

Demand

$$\sum_{f=1}^{N^f} n_t^{h,f} = N^f n_t^{h,f} \tag{A.43}$$

Supply=Demand

$$N^h n_t^{h,H} = N^f n_t^{h,f} \Rightarrow n_t^{h,f} = n_t^{h,H} \tag{A.44}$$

Low-skilled labor, $n_t^{l,H}$

Supply

$$\sum_{l=1}^{N^l} n_t^{l,H} = N^l n_t^{l,H} \tag{A.45}$$

Demand

$$\sum_{f=1}^{N^f} n_t^{ll,f} = N^f n_t^{ll,f} \tag{A.46}$$

Supply=Demand

$$N^l n_t^{l,H} = N^f n_t^{ll,f} \Rightarrow n_t^{ll,f} = \frac{N^l}{N^f} n_t^{l,H} \Rightarrow n_t^{ll,f} = \frac{t^l}{t^h} n_t^{l,H} \tag{A.47}$$

Mismatched labor, $n_t^{hl,H}$

Supply

$$\sum_{h=1}^{N^h} n_t^{hl,H} = N^h n_t^{hl,H} \tag{A.48}$$

Demand

$$\sum_{f=1}^{N^f} n_t^{hl,f} = N^f n_t^{hl,f} \tag{A.49}$$

Supply=Demand

$$N^h n_t^{hl,H} = N^f n_t^{hl,f} \Rightarrow n_t^{hl,f} = n_t^{hl,H} \tag{A.50}$$

Aggregate low-skilled labor, n_t^l

Supply

$$\sum_{l=1}^{N^l} n_t^{l,H} + \sum_{h=1}^{N^h} n_t^{hl,H} = N^l n_t^{l,H} + N^h n_t^{hl,H} \tag{A.51}$$

Demand

$$\sum_{f=1}^{N^f} n_t^{ll,f} + q^h \sum_{f=1}^{N^f} n_t^{hl,f} = N^f n_t^{ll,f} + q^h N^f n_t^{hl,f} \tag{A.52}$$

The aggregate low-skilled labor n_t^l is defined by firms taking into account equations (A.44), (A.47) and (A.50).

$$N^f n_t^{l,f} = N^f \frac{t^l}{t^h} n_t^{l,H} + q^h N^f n_t^{hl,H} \Rightarrow n_t^l = \frac{t^l}{t^h} n_t^{l,H} + q^h n_t^{hl,H} \tag{A.53}$$

D.2 Profits

a) Intermediate good

Taking into account equations (A.67), (A.69), (A.73), (A.44), (A.47), (A.50), the profits of the intermediate good firm are zero and the profit function of intermediate good firm is now given by:

$$p_t^H y_{i,t} = w_t^{l,H} t^l n_t^{l,H} + w_t^{hl,H} t^h n_t^{hl,H} + w_t^{h,H} t^h n_t^{h,H} + r_t^k k_t + \kappa^l t^h v_t^{l,f} + \kappa^h t^h v_t^{h,f} \tag{A.54}$$

b) Economy-wide final good

The profits of the economy-wide final good firm are zero. Hence, the profit function is now given by:

$$Y_t = p_t^H Y_t^H + p_t^F Y_t^F \Rightarrow \frac{1}{N} Y_t = p_t^H \frac{1}{N} Y_t^H + p_t^F \frac{1}{N} Y_t^F \Rightarrow y_t = p_t^H y_t^H + p_t^F y_t^F \tag{A.55}$$

Net foreign assets law of motion

$$e_t \left(r_t^d d_t - d_{t+1}\right) = p_t^H y_t^{F^*} - p_t^F y_t^F + e_t \underbrace{\left(\left(1-\tau^{n,F}\right) w^{h,F} - c_t^{h,F}\right) n_t^{h,F}}_{\Xi_t^h:\ remittances\ of\ high\text{-}skilled} t^h + e_t \underbrace{\left(\left(1-\tau^{n,F}\right) w^{l,F} - c_t^{l,F}\right) n_t^{l,F}}_{\Xi_t^l:\ remittances\ of\ low\text{-}skilled} t^l \tag{A.56}$$

Intermediate good distribution

$$\begin{aligned} Y_{i,t} = Y_t^H + Y_t^{F^*} &\Leftrightarrow \sum_{f=1}^{N^f} y_{i,t}^f = \sum_{f=1}^{N^f} y_t^H + \sum_{f=1}^{N^f} y_t^{F^*} \\ &\Leftrightarrow N^f y_{i,t}^f = N^f y_t^H + N^f y_t^{F^*} \\ &\Rightarrow y_{i,t}^f = y_t^H + y_t^{F^*} \xrightarrow{p_t^H} p_t^H y_{i,t}^f = p_t^H y_t^H + p_t^H y_t^{F^*} \end{aligned} \tag{A.57}$$

D.3 Law of motion of net foreign assets

High-skilled household budget constraint (in per capita terms)

$$\begin{aligned} &\left(1-n_t^{h,F}\right) c_t^{h,H} t^h + e_t n_t^{h,F} c_t^{h,F} t^h + i_t + X^h \left(\tilde{O}_t^h \tilde{u}_t^h\right) O_t^h u_t^h t^h + e_t r_t^d d_t + b\left(z_t\right) n_t^{hl,H} t^h \\ &= \left(1-\tau_t^{n,H}\right) \left(w_t^{h,H} n_t^{h,H} + w_t^{hl,H} n_t^{hl,H}\right) t^h + \left(1-\tau^{n,F}\right) e_t w^{h,F} n_t^{h,F} t^h + \left(1-\tau_t^k\right) r_t^k k_t - \tau_t^h t^h + e_t d_{t+1} + \bar{\omega} u_t^h t^h \end{aligned} \tag{A.58}$$

Low-skilled household budget constraint (in per capita terms)

$$\left(1-n_t^{l,F}\right) c_t^{l,H} t^l + e_t n_t^{l,F} c_t^{l,F} t^l + X^l \left(\tilde{O}_t^l \tilde{u}_t^l\right) O_t^l u_t^l t^l = \left(1-\tau_t^{n,H}\right) w_t^{l,H} n_t^{l,H} t^l + \left(1-\tau^{n,F}\right) e_t w^{l,F} n_t^{l,F} t^l - \tau_t^l t^l + \bar{\omega} u_t^l t^l \tag{A.59}$$

Government budget constraint (in per capita terms)

$$\bar{\omega}t^h u_t^h + \bar{\omega}t^l u_t^l + g_t^c = \tau_t + \tau_t^k r_t^k k_t + \tau_t^{n,H}\left(w_t^{h,H} n_t^{h,H} t^h + w_t^{hl,H} n_t^{hl,H} t^h + w_t^{l,H} n_t^{l,H} t^l\right) \tag{A.60}$$

Step 1: Add the budget constraints of the high-skilled and the low-skilled households, equations (A.58) and (A.59):

$$\left(1-n_t^{h,F}\right) c_t^{h,H} t^h + e_t n_t^{h,F} c_t^{h,F} t^h + i_t + X^h\left(\tilde{O}_t^h \tilde{u}_t^h\right) O_t^h u_t^h t^h + e_t r_t^d d_t + b\left(z_t\right) n_t^{hl,H} t^h + \left(1-n_t^{l,F}\right) c_t^{l,H} t^l + e_t n_t^{l,F} c_t^{l,F} t^l + X^l\left(\tilde{O}_t^l \tilde{u}_t^l\right) O_t^l u_t^l t^l = \left(1-\tau_t^{n,H}\right)\left(w_t^{h,H} n_t^{h,H} + w_t^{hl,H} n_t^{hl,H}\right) t^h + \left(1-\tau^{n,F}\right) e_t w^{h,F} n_t^{h,F} t^h + \left(1-\tau_t^k\right) r_t^k k_t - \tau_t^h t^h + e_t d_{t+1} + \bar{\omega} u_t^h t^h + \left(1-\tau_t^{n,H}\right) w_t^{l,H} n_t^{l,H} t^l + \left(1-\tau^{n,F}\right) e_t w^{l,F} n_t^{l,F} t^l - \tau_t^l t^l + \bar{\omega} u_t^l t^l + \tau_t^k r_t^k k_t \tag{A.61}$$

Step 2: Use the government budget constraint, equation (A.60), and substitute out $\bar{\omega}t^h u_t^h + \bar{\omega}t^l u_t^l + g_t^c$ in equation (A.61):

$$\begin{aligned}&\left(1-n_t^{h,F}\right) c_t^{h,H} t^h + e_t n_t^{h,F} c_t^{h,F} t^h + i_t + X^h\left(\tilde{O}_t^h \tilde{u}_t^h\right) O_t^h u_t^h t^h + e_t r_t^d d_t + b\left(z_t\right) n_t^{hl,H} t^h \\ &+ \left(1-n_t^{l,F}\right) c_t^{l,H} t^l + e_t n_t^{l,F} c_t^{l,F} t^l + X^l\left(\tilde{O}_t^l \tilde{u}_t^l\right) O_t^l u_t^l t^l + g_t^c = \left(w_t^{h,H} n_t^{h,H} + w_t^{hl,H} n_t^{hl,H}\right) t^h \\ &+ w_t^{l,H} n_t^{l,H} t^l + r_t^k k_t + e_t d_{t+1} + \left(1-\tau^{n,F}\right) e_t w^{h,F} n_t^{h,F} t^h + \left(1-\tau^{n,F}\right) e_t w^{l,F} n_t^{l,F} t^l\end{aligned} \tag{A.62}$$

Step 3: Use the intermediate good firms profits, equation (A.54), and substitute out $w_t^{l,H} t^l n_t^{l,H} + w_t^{hl,H} t^h n_t^{hl,H} + w_t^{h,H} t^h n_t^{h,H} + r_t^k k_t$ in equation (A.62):

$$\begin{aligned}&\left(1-n_t^{h,F}\right) c_t^{h,H} t^h + e_t n_t^{h,F} c_t^{h,F} t^h + i_t + X^h\left(\tilde{O}_t^h \tilde{u}_t^h\right) O_t^h u_t^h t^h + e_t r_t^d d_t + b\left(z_t\right) n_t^{hl,H} t^h \\ &+ \left(1-n_t^{l,F}\right) c_t^{l,H} t^l + e_t n_t^{l,F} c_t^{l,F} t^l + X^l\left(\tilde{O}_t^l \tilde{u}_t^l\right) O_t^l u_t^l t^l + g_t^c = p_t^H y_{i,t} - \kappa^l v_t^l \\ &- \kappa^h v_t^h + e_t d_{t+1} + \left(1-\tau^{n,F}\right) e_t w^{h,F} n_t^{h,F} t^h + \left(1-\tau^{n,F}\right) e_t w^{l,F} n_t^{l,F} t^l\end{aligned} \tag{A.63}$$

Step 4: Use the definition of remittances, Ξ_t^h, Ξ_t^l, equations (7):

$$\begin{aligned}&\left(1-n_t^{h,F}\right) c_t^{h,H} t^h + \left(1-n_t^{l,F}\right) c_t^{l,H} t^l + i_t + X^h\left(\tilde{O}_t^h \tilde{u}_t^h\right) O_t^h u_t^h t^h + X^l\left(\tilde{O}_t^l \tilde{u}_t^l\right) O_t^l u_t^l t^l \\ &+ b\left(z_t\right) n_t^{hl,H} t^h + g_t^c + \kappa^h v_t^h + \kappa^l v_t^l = p_t^H y_{i,t} + e_t\left(d_{t+1} - r_t^d d_t\right) + e_t n_t^{h,F} \Xi_t^h t^h + e_t n_t^{l,F} \Xi_t^l t^l\end{aligned} \tag{A.64}$$

Step 5: Use the economy-wide final good equation (54):

$$y_t = p_t^H y_{i,t} + e_t\left(d_{t+1} - r_t^d d_t\right) + e_t n_t^{h,F} \Xi_t^h t^h + e_t n_t^{l,F} \Xi_t^l t^l \tag{A.65}$$

Step 6: Use the economy-wide final good profit function, equation (A.55), and intermediate good distribution, equation (A.57), and substitute out y_t and $p_t^H y_{i,t}$ respectively:

$$e_t\left(r_t^d d_t - d_{t+1}\right) = p_t^H y_t^{F^*} - p_t^F y_t^F + e_t\left(n_t^{h,F} \Xi_t^h t^h + n_t^{l,F} \Xi_t^l t^l\right) \tag{A.66}$$

D.4 Market clearing conditions

Intermediate good

$$y_{i,t} = \frac{1}{N} \sum_{f=1}^{N^f} y_{i,t}^f = \frac{1}{N} N^f y_{i,t}^f = t^h y_{i,t}^f \tag{A.67}$$

$$x_{i,t} = \frac{1}{N} \sum_{f=1}^{N^f} x_{i,t}^f = \frac{1}{N} N^f = t^h x_{i,t}^f \tag{A.68}$$

Capital, investment and foreign assets

$$k_t = \frac{1}{N} \sum_{h=1}^{N^h} k_t^h = \frac{1}{N} \sum_{f=1}^{N^f} k_t^f \Leftrightarrow k_t = \frac{1}{N} N^h k_t^h = \frac{1}{N} N^f k_t^f \Leftrightarrow k_t = t^h k_t^h = t^h k_t^f \tag{A.69}$$

$$i_t = \frac{1}{N} \sum_{h=1}^{N^h} i_t^h = \frac{1}{N} N^h i_t^h = t^h i_t^h \tag{A.70}$$

$$d_t = \frac{1}{N} \sum_{h=1}^{N^h} d_t^h = \frac{1}{N} N^h d_t^h = t^h d_t^h \tag{A.71}$$

Unemployed

$$\frac{U_t^j}{N} = \frac{1}{N} \sum_{j=1}^{N^j} u_t^j = t^j u_t^j, \quad j \in \{h, l\} \tag{A.72}$$

Vacancies

$$v_t^j = \frac{V_t^j}{N} = \frac{1}{N} \sum_{f=1}^{N^f} v_t^{j,f} = t^h v_t^{j,f}, \quad j \in \{h, l\} \tag{A.73}$$

E Decentralized Competitive Equilibrium

Given market prices $w_t^{h,H}$, $w_t^{hl,H}$, $w_t^{l,H}$, $w^{h,F}$, $w^{l,F}$, r_t^k, r_t^d, e_t, p_t^H, p_t^F, government policy τ_t^h, τ_t^l and economy-wide variables (A_t), each individual household of high-skilled households, $h = 1, 2, \ldots, N^h$, solves its problem as defined in Section 2.4, each individual household of low-skilled households, $l = 1, 2, \ldots, N^l$, solves its problem as defined in Section 2.4, each individual firm in the intermediate sector, $f = 1, 2, \ldots, N^f$, solves its problem as defined in Section 2.5, all markets clear and all constraints are satisfied. Thus the DCE, expressed in per capita terms, is given by equations (D.1)-(D.62):

Probabilities of a job seeker to be hired $\left\{\psi_{H,t}^{h,H}, \psi_{H,t}^{l,H}, \psi_{H,t}^{hl,H}\right\}$

$$\psi_{H,t}^{h,H} = \frac{m_t^{h,H}}{\left(1 - O_t^h\right) s_t u_t^h t^h + \phi\left(z_t\right) n_t^{hl,H} t^h} \tag{D.1}$$

$$\psi_{H,t}^{l,H} = \frac{m_t^{l,H}}{\left(1 - O_t^l\right) u_t^l t^l} \tag{D.2}$$

$$\psi_{H,t}^{hl,H} = \frac{m_t^{hl,H}}{\left(1 - O_t^h\right) \left(1 - s_t\right) u_t^h t^h} \tag{D.3}$$

Probabilities of a vacancy to be filled $\left\{\psi_{F,t}^{h,H}, \psi_{F,t}^{l,H}, \psi_{F,t}^{hl,H}\right\}$

$$\psi_{F,t}^{h,H} = \frac{m_t^{h,H}}{v_t^h} \tag{D.4}$$

$$\psi_{F,t}^{l,H} = \frac{m_t^{l,H}}{\left(1 - x_t\right) v_t^l} \tag{D.5}$$

$$\psi_{F,t}^{hl,H} = \frac{m_t^{hl,H}}{x_t v_t^l} \tag{D.6}$$

Matches $\left\{m_t^{h,H}, m_t^{l,H}, m_t^{hl,H}\right\}$

$$m_t^{h,H} = \mu_1 \left(v_t^h\right)^{\mu_2} \left(\left(1 - O_t^h\right) s_t u_t^h t^h + \phi\left(z_t\right) n_t^{hl,H} t^h\right)^{1-\mu_2} \tag{D.7}$$

$$m_t^{l,H} = \mu_1 \left(\left(1 - x_t\right) v_t^l\right)^{\mu_2} \left(\left(1 - O_t^l\right) u_t^l t^l\right)^{1-\mu_2} \tag{D.8}$$

$$m_t^{hl,H} = \mu_1 \left(x_t v_t^l\right)^{\mu_2} \left(\left(1 - O_t^h\right) \left(1 - s_t\right) u_t^h t^h\right)^{1-\mu_2} \tag{D.9}$$

High-skilled h/h $\left\{c_t^h, c_t^{h,H}, c_t^{h,F}, i_t, k_{t+1}, d_{t+1}, n_{t+1}^{h,H}, n_{t+1}^{hl,H}, n_{t+1}^{h,F}, l_t^h, u_t^h, s_t, O_t^h, z_t, \lambda_{c_t^h}, \lambda_{n_t^{h,H}}, \lambda_{n_t^{hl,H}}, \lambda_{n_t^{h,F}}\right\}$

$$\begin{aligned} &c_t^h t^h + i_t + X^h\left(\tilde{O}_t^h \tilde{u}_t^h\right) O_t^h u_t^h t^h + e_t r_t^d d_t + b\left(z_t\right) n_t^{hl,H} t^h \\ &= \left(1 - \tau_t^{n,H}\right)\left(w_t^{h,H} n_t^{h,H} + w_t^{hl,H} n_t^{hl,H}\right) t^h + \left(1 - \tau^{n,F}\right) e_t w^{h,F} n_t^{h,F} t^h + \left(1 - \tau_t^k\right) r_t^k k_t - \tau_t^h t^h + e_t d_{t+1} + \bar{\omega} u_t^h t^h \end{aligned} \tag{D.10}$$

$$c_t^h = \left(1 - n_t^{h,F}\right) c_t^{h,H} + e_t n_t^{h,F} c_t^{h,F} \tag{D.11}$$

$$n_t^{h,F} c_t^{h,F} = \left(1 - \tau^{n,F} - \eta\right) w^{h,F} n_t^{h,F} \tag{D.12}$$

$$i_t = k_{t+1} - \left(1 - \delta\right) k_t + \frac{\Xi}{2}\left(\frac{k_{t+1}}{k_t} - 1\right)^2 k_t \tag{D.13}$$

$$\lambda_{c_t^h}\left(1 + \Xi\left(\frac{k_{t+1}}{k_t} - 1\right)\right) = \beta \mathbb{E}_t \lambda_{c_{t+1}^h}\left(1 + \left(1 - \tau_{t+1}^k\right) r_{t+1}^k - \delta + \frac{\Xi}{2}\left(\left(\frac{k_{t+2}}{k_{t+1}}\right)^2 - 1\right)\right) \tag{D.14}$$

$$\lambda_{c_t^h} e_t = \beta \mathbb{E}_t \lambda_{c_{t+1}^h} e_{t+1} r_{t+1}^d \tag{D.15}$$

$$n_{t+1}^{h,H} = \left(1 - \sigma^h\right) n_t^{h,H} + \frac{m_t^{h,H}}{t^h} \tag{D.16}$$

$$n_{t+1}^{hl,H} = \left(1 - \sigma^l - \phi\left(z_t\right) \psi_{H,t}^{h,H}\right) n_t^{hl,H} + \frac{m_t^{hl,H}}{t^h} \tag{D.17}$$

$$n_{t+1}^{h,F} = \left(1 - \sigma^{h,F}\right) n_t^{h,F} + \psi^{h,F} O_t^h u_t^h \tag{D.18}$$

$$n_t^{h,H} + n_t^{hl,H} + u_t^h + l_t^h + n_t^{h,F} = 1 \tag{D.19}$$

$$\Phi^h {l_t^h}^{-\phi^h} = \lambda_{c_t^h} \bar{\omega} + \lambda_{n_t^{h,H}} \psi_{H,t}^{h,H} \tag{D.20}$$

$$\lambda_{n_t^{h,H}} \psi_{H,t}^{h,H} = \lambda_{n_t^{hl,H}} \psi_{H,t}^{hl,H} \tag{D.21}$$

$$\lambda_{n_t^{h,H}} \psi_{H,t}^{h,H} = \lambda_{n_t^{h,F}} \psi^{h,F} - \lambda_{c_t^h} X^h \left(\tilde{O}_t^h \tilde{u}_t^h\right) \tag{D.22}$$

$$\lambda_{c_t^h} \frac{b'\left(z_t\right)}{\phi'\left(z_t\right)} = \psi_{H,t}^{h,H} \left(\lambda_{n_t^{h,H}} - \lambda_{n_t^{hl,H}}\right) \tag{D.23}$$

$$\lambda_{c_t^h} = \left(c_t^h - \chi c_{t-1}^h\right)^{-\eta^c} - \beta \chi \left(c_{t+1}^h - \chi c_t^h\right)^{-\eta^c} \tag{D.24}$$

$$\lambda_{n_t^{h,H}} = \beta \mathbb{E}_t \left\{-\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_{t+1}^h} \left(1 - \tau_{t+1}^{n,H}\right) w_{t+1}^{h,H} + \lambda_{n_{t+1}^{h,H}} \left(1 - \sigma^h\right)\right\} \tag{D.25}$$

$$\begin{aligned}\lambda_{n_t^{hl,H}} = \beta \mathbb{E}_t \Big\{ -\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_{t+1}^h} \left[\left(1 - \tau_{t+1}^{n,H}\right) w_{t+1}^{hl,H} - b(z_{t+1})\right] + \lambda_{n_{t+1}^{hl,H}} \left(1 - \sigma^l - \phi(z_{t+1}) \psi_{H,t+1}^{h,H}\right) \\ + \lambda_{n_{t+1}^{h,H}} \psi_{H,t+1}^{h,H} \phi\left(z_{t+1}\right) \Big\}\end{aligned} \tag{D.26}$$

$$\lambda_{n_t^{h,F}} = \beta \mathbb{E}_t \left\{-\Phi^h {l_t^h}^{-\phi^h} + \lambda_{c_{t+1}^h} \left(1 - \tau^{n,F}\right) e_{t+1} w^{h,F} + \lambda_{n_{t+1}^{h,F}} \left(1 - \sigma^{h,F}\right)\right\} \tag{D.27}$$

Low-skilled h/h $\left\{c_t^l, c_t^{l,H}, c_t^{l,F}, n_{t+1}^{l,H}, n_{t+1}^{l,F}, l_t^l, u_t^l, O_t^l, \lambda_{c_t^l}, \lambda_{n_t^{l,H}}, \lambda_{n_t^{l,F}}\right\}$

$$c_t^l t^l + X^l \left(\tilde{O}_t^l \tilde{u}_t^l\right) O_t^l u_t^l t^l = \left(1 - \tau_t^{n,H}\right) w_t^{l,H} n_t^{l,H} t^l + \left(1 - \tau^{n,F}\right) e_t w^{l,F} n_t^{l,F} t^l - \tau_t^l t^l + \bar{\omega} u_t^l t^l \tag{D.28}$$

$$c_t^l = \left(1 - n_t^{l,F}\right) c_t^{l,H} + e_t n_t^{l,F} c_t^{l,F} \tag{D.29}$$

$$n_t^{l,F} c_t^{l,F} = \left(1 - \tau^{n,F} - \eta\right) w^{l,F} n_t^{l,F} \tag{D.30}$$

$$n_{t+1}^{l,H} = \left(1 - \sigma^l\right) n_t^{l,H} + \frac{m_t^{l,H}}{t^l} \tag{D.31}$$

$$n_{t+1}^{l,F} = \left(1 - \sigma^{l,F}\right) n_t^{l,F} + \psi^{l,F} O_t^l u_t^l \tag{D.32}$$

$$n_t^{l,H} + u_t^l + l_t^l + n_t^{l,F} = 1 \tag{D.33}$$

$$\Phi^l l_t^{l^{-\phi^l}} = \lambda_{c_t^l} \bar{\omega} + \lambda_{n_t^{l,H}} \psi_{H,t}^{l,H} \tag{D.34}$$

$$\lambda_{n_t^{l,H}} \psi_{H,t}^{l,H} = \lambda_{n_t^{l,F}} \psi^{l,F} - \lambda_{c_t^l} X^l \left(\tilde{O}_t^l \tilde{u}_t^l\right) \tag{D.35}$$

$$\lambda_{c_t^l} = \left(c_t^l - \chi c_{t-1}^l\right)^{-\eta^c} - \beta\chi \left(c_{t+1}^l - \chi c_t^l\right)^{-\eta^c} \tag{D.36}$$

$$\lambda_{n_t^{l,H}} = \beta \mathbb{E}_t \left\{ -\Phi^l l_t^{l^{-\phi^l}} + \lambda_{c_{t+1}^l} \left(1 - \tau_{t+1}^{n,H}\right) w_{t+1}^{l,H} + \lambda_{n_{t+1}^{l,H}} \left(1 - \sigma^l\right) \right\} \tag{D.37}$$

$$\lambda_{n_t^{l,F}} = \beta \mathbb{E}_t \left\{ -\Phi^l l_t^{l^{-\phi^l}} + \lambda_{c_{t+1}^l} \left(1 - \tau^{n,F}\right) e_{t+1} w^{l,F} + \lambda_{n_{t+1}^{l,F}} \left(1 - \sigma^{l,F}\right) \right\} \tag{D.38}$$

Wages $\left\{w_t^{h,H}, w_t^{l,H}, w_t^{hl,H}\right\}$

$$w_t^{h,H} = \left(1 - \theta^h\right) \left(p_t^H y_{i,t}^{h,f} + \kappa^h \frac{\left(1 - \sigma^h\right)}{\psi_{F,t}^{h,H}} \right) - \frac{\theta^h}{\lambda_{c_t^h} \left(1 - \tau_t^{n,H}\right)} \left(-\Phi^h l_t^{h^{-\phi^h}} + \lambda_{n_t^{h,H}} \left(1 - \sigma^h\right) \right) \tag{D.39}$$

$$w_t^{l,H} = \left(1 - \theta^l\right) \left(p_t^H y_{i,t}^{ll,f} + \kappa^l \frac{\left(1 - \sigma^l\right)}{\psi_{F,t}^{l,H}} \right) - \frac{\theta^l}{\lambda_{c_t^l} \left(1 - \tau_t^{n,H}\right)} \left(-\Phi^l l_t^{l^{-\phi^l}} + \lambda_{n_t^{l,H}} \left(1 - \sigma^l\right) \right) \tag{D.40}$$

$$\begin{aligned} w_t^{hl,H} = {} & \left(1 - \theta^{hl}\right) \left(p_t^H y_{i,t}^{hl,f} + \kappa^l \frac{\left(1 - \sigma^l - \phi\left(z_t\right) \psi_{H,t}^{h,H}\right)}{\psi_{F,t}^{hl,H}} \right) \\ & - \frac{\theta^{hl}}{\lambda_{c_t^h} \left(1 - \tau_t^{n,H}\right)} \left(-\Phi^h l_t^{h^{-\phi^h}} - \lambda_{c_t^h} b\left(z_t\right) + \lambda_{n_t^{hl,H}} \left(1 - \sigma^l - \phi\left(z_t\right) \psi_{H,t}^{h,H}\right) + \lambda_{n_t^{h,H}} \psi_{H,t}^{h,H} \phi\left(z_t\right) \right) \end{aligned} \tag{D.41}$$

Intermediate-good firm focs $\left\{y_{i,t}, x_{i,t}, x_t, y_t^{F^*}, r_t^k, p_t^H, v_t^l, v_t^h\right\}$

$$y_{i,t} = A_t \left(\alpha \left(t^l n_t^{l,H} + q^h t^h n_t^{hl,H} \right)^{\frac{\epsilon-1}{\epsilon}} + (1 - \alpha) \left(x_{i,t}\right)^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \tag{D.42}$$

$$x_{i,t} = \left(\zeta(k_t)^{\frac{\rho-1}{\rho}} + (1-\zeta)(t^h n_t^{h,H})^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}} \tag{D.43}$$

$$x_t = \frac{t^h \left(n_{t+1}^{hl,H} - \left(1-\sigma^l - \phi\left(z_t\right)\psi_{H,t}^{h,H}\right) n_t^{hl,H}\right)}{v_t^l \psi_{F,t}^{hl,H}} \tag{D.44}$$

$$\frac{\kappa^h}{\psi_{F,t}^{h,H}} = \mathbb{E}_t \Lambda_{t,t+1} \left\{ p_{t+1}^H y_{i,t+1}^h - w_{t+1}^{h,H} + \kappa^h \frac{\left(1-\sigma^h\right)}{\psi_{F,t+1}^{h,H}} \right\} \tag{D.45}$$

$$\frac{\frac{\kappa^l}{\psi_{F,t}^{hl,H}}}{\frac{\kappa^l}{\psi_{F,t}^{l,H}}} = \frac{\left\{ p_{t+1}^H y_{i,t+1}^{hl} - w_{t+1}^{hl,H} + \kappa^l \frac{\left(1-\sigma^l - \phi(z_{t+1})\psi_{H,t+1}^{h,H}\right)}{\psi_{F,t+1}^{hl,H}} \right\}}{\left\{ p_{t+1}^H y_{i,t+1}^{l} - w_{t+1}^{l,H} + \kappa^l \frac{(1-\sigma^l)}{\psi_{F,t+1}^{l,H}} \right\}} \tag{D.46}$$

$$y_{i,t} = y_t^H + y_t^{F^*} \tag{D.47}$$

$$r_t^k = p_t^H y_{i,t}^k \tag{D.48}$$

$$y_t^{F^*} = (1-\omega^*)\left(\frac{p_t^H}{e_t}\right)^{-\gamma^*} y_t^* \tag{D.49}$$

Economy-wide final good $\left\{y_t, y_t^H, y_t^F\right\}$

$$y_t = \left(\omega^{\frac{1}{\gamma}}\left(y_t^H\right)^{\frac{\gamma-1}{\gamma}} + (1-\omega)^{\frac{1}{\gamma}}\left(y_t^F\right)^{\frac{\gamma-1}{\gamma}}\right)^{\frac{\gamma}{\gamma-1}} \tag{D.50}$$

$$y_t^F = (1-\omega)\left(\frac{p_t^F}{P_t}\right)^{-\gamma} y_t \tag{D.51}$$

$$y_t^H = \frac{\omega}{1-\omega}\left(\frac{p_t^H}{p_t^F}\right)^{-\gamma} y_t^F \tag{D.52}$$

Government $\left\{\tau_t\right\}$

$$\bar{\omega} t^h u_t^h + \bar{\omega} t^l u_t^l + g_t^c = \tau_t + \tau_t^k r_t^k k_t + \tau_t^{n,H}\left(w_t^{h,H} n_t^{h,H} t^h + w_t^{hl,H} n_t^{hl,H} t^h + w_t^{l,H} n_t^{l,H} t^l\right) \tag{D.53}$$

Closing the SOE model $\left\{r_t^d, rp_t, nx_t, gdp_t, p_t^F, e_t\right\}$

$$r_t^d = r_t^* + rp_t \tag{D.54}$$

$$rp_t = \psi^{rp}\left(exp\left(\frac{e_t d_{t+1}}{gdp_t} - \frac{ed}{gdp}\right) - 1\right) + \log\left(RP_t\right) \tag{D.55}$$

$$e_t\left(r^d_t d_t - d_{t+1}\right) = nx_t + e_t\left(n^{h,F}_t \Xi^h_t t^h + n^{l,F}_t \Xi^l_t t^l\right) \tag{D.56}$$

$$nx_t = p^H_t y^{F^*}_t - p^F_t y^F_t \tag{D.57}$$

$$gdp_t = y_t + nx_t \tag{D.58}$$

$$e_t = \frac{p^F_t}{P} \tag{D.59}$$

We thus have a system of 59 equations in the paths of 59 unknown endogenous variables: $\psi^{h,H}_{H,t}$, $\psi^{l,H}_{H,t}$, $\psi^{hl,H}_{H,t}$, $\psi^{h,H}_{F,t}$, $\psi^{l,H}_{F,t}$, $\psi^{hl,H}_{F,t}$, $m^{h,H}_t$, $m^{l,H}_t$, $m^{hl,H}_t$, c^h_t, $c^{h,H}_t$, $c^{h,F}_t$, i_t, k_{t+1}, d_{t+1}, $n^{h,H}_{t+1}$, $n^{hl,H}_{t+1}$, $n^{h,F}_{t+1}$, l^h_t, u^h_t, s_t, O^h_t, z_t, $\lambda_{c^h_t}$, $\lambda_{n^{h,H}_t}$, $\lambda_{n^{hl,H}_t}$, $\lambda_{n^{h,F}_t}$, c^l_t, $c^{l,H}_t$, $c^{l,F}_t$, $n^{l,H}_{t+1}$, $n^{l,F}_{t+1}$, l^l_t, u^l_t, O^l_t, $\lambda_{c^l_t}$, $\lambda_{n^{l,H}_t}$, $\lambda_{n^{l,F}_t}$, $w^{h,H}_t$, $w^{l,H}_t$, $w^{hl,H}_t$, $y_{i,t}$, $x_{i,t}$, x_t, $y^{F^*}_t$, r^k_t, p^H_t, v^l_t, v^h_t, r^d_t, y_t, y^H_t, y^F_t, τ_t, e_t, rp_t, nx_t, gdp_t, p^F_t.

$$y^k_{i,t} = \zeta\left(1-\alpha\right) A_t^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_{i,t}}{x_{i,t}}\right)^{\frac{1}{\epsilon}} \left(\frac{x_{i,t}}{k_t}\right)^{\frac{1}{\rho}} \tag{D.60}$$

$$y^h_{i,t} = \left(1-\zeta\right)\left(1-\alpha\right) A_t^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_{i,t}}{x_{i,t}}\right)^{\frac{1}{\epsilon}} \left(\frac{x_{i,t}}{t^h n^{h,H}_t}\right)^{\frac{1}{\rho}} \tag{D.61}$$

$$y^l_{i,t} = \alpha A_t^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_{i,t}}{t^l n^{l,H}_t + q^h t^h n^{hl,H}_t}\right)^{\frac{1}{\epsilon}} \tag{D.62}$$

$$y^{hl}_{i,t} = q_h \alpha A_t^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_{i,t}}{t^l n^{l,H}_t + q^h t^h n^{hl,H}_t}\right)^{\frac{1}{\epsilon}} \tag{D.63}$$

We choose the following functional forms $\left\{b(z), \phi\left(z\right), X^h\left(\tilde{O}^h_t \tilde{u}^h_t\right), X^l\left(\tilde{O}^l_t \tilde{u}^l_t\right)\right\}$

$$b\left(z_t\right) = b_1\left(z_t\right)^{b_2} \tag{D.64}$$

$$\phi\left(z_t\right) = \phi_1\left(z_t\right)^{\phi_2} \tag{D.65}$$

$$X^h\left(\tilde{O}^h_t \tilde{u}^h_t\right) = x^h_1\left(\tilde{O}^h_t \tilde{u}^h_t\right)^{x^h_2} \tag{D.66}$$

$$X^l\left(\tilde{O}^l_t \tilde{u}^l_t\right) = x^l_1\left(\tilde{O}^l_t \tilde{u}^l_t\right)^{x^l_2} \tag{D.67}$$

Finally, $s^c_t = \frac{G^c_t}{Y_t}$ and RP_t follow AR(1) processes:

$$\ln s^c_{t+1} = \rho_g \ln s^c_t + \left(1-\rho_g\right)\ln s^c_0 + \epsilon^g_{t+1} \tag{D.68}$$

$$\ln RP_{t+1} = \rho_{RP} \ln RP_t + (1-\rho_{RP}) \ln RP_0 + \epsilon_{t+1}^{RP} \tag{D.69}$$

F Steady-state equilibrium

In the long-run, our economy reaches an equilibrium where no shocks exist and variables remain constant. To find the steady state equilibrium, we remove time subscripts and solve for the equilibrium. Thus, all variables satisfy that $x_{t+1} = x_t = x_{t-1} = x$. The steady-state equilibrium is given by equations (S.1) - (S.64):

Probabilities of a job seeker to be hired $\left\{\psi_H^{h,H}, \psi_H^{l,H}, \psi_H^{hl,H}\right\}$

$$\psi_H^{h,H} = \frac{m^{h,H}}{(1-O^h)\, s u^h t^h + \phi(z)\, n^{hl,H} t^h} \tag{S.1}$$

$$\psi_H^{l,H} = \frac{m^{l,H}}{(1-O^l)\, u^l t^l} \tag{S.2}$$

$$\psi_H^{hl,H} = \frac{m^{hl,H}}{(1-O^h)(1-s)\, u^h t^h} \tag{S.3}$$

Probabilities of a vacancy to be filled $\left\{\psi_F^{h,H}, \psi_F^{l,H}, \psi_F^{hl,H}\right\}$

$$\psi_F^{h,H} = \frac{m^{h,H}}{v^h} \tag{S.4}$$

$$\psi_F^{l,H} = \frac{m^{l,H}}{(1-x)\, v^l} \tag{S.5}$$

$$\psi_F^{hl,H} = \frac{m^{hl,H}}{x v^l} \tag{S.6}$$

Matches $\left\{m^{h,H}, m^{l,H}, m^{hl,H}\right\}$

$$m^{h,H} = \mu_1 \left(v^h\right)^{\mu_2} \left((1-O^h)\, s u^h t^h + \phi(z)\, n^{hl,H} t^h\right)^{1-\mu_2} \tag{S.7}$$

$$m^{l,H} = \mu_1 \left((1-x)\, v^l\right)^{\mu_2} \left((1-O^l)\, u^l t^l\right)^{1-\mu_2} \tag{S.8}$$

$$m^{hl,H} = \mu_1 \left(x v^l\right)^{\mu_2} \left((1-O^h)(1-s)\, u^h t^h\right)^{1-\mu_2} \tag{S.9}$$

High-skilled h/h $\{c^h, c^{h,H}, c^{h,F}, i, k, d, n^{h,H}, n^{hl,H}, n^{h,F}, l^h, u^h, s, O^h, z, \lambda_{c^h}, \lambda_{n^{h,H}}, \lambda_{n^{hl,H}}, \lambda_{n^{h,F}}\}$

$$\begin{aligned} c^h t^h + i + X^h\left(\tilde{O}^h \tilde{u}^h\right) O^h u^h t^h + e r^d d + b(z)\, n^{hl,H} t^h = &\left(1-\tau^{n,H}\right)\left(w^{h,H} n^{h,H} + w^{hl,H} n^{hl,H}\right) t^h \\ &+ \left(1-\tau^{n,F}\right) e w^{h,F} n^{h,F} t^h \\ &+ \left(1-\tau^k\right) r^k k - \tau^h t^h + ed + \bar{\omega} u^h t^h \end{aligned} \tag{S.10}$$

$$c^h = \left(1 - n^{h,F}\right) c^{h,H} + e n^{h,F} c^{h,F} \tag{S.11}$$

$$n^{h,F} c^{h,F} = (1 - \eta)\, w^{h,F} n^{h,F} \tag{S.12}$$

$$i = \delta k \tag{S.13}$$

$$1 = \beta \left(1 + \left(1 - \tau^k\right) r^k - \delta\right) \tag{S.14}$$

$$1 = \beta r^d \tag{S.15}$$

$$n^{h,H} = \frac{m^{h,H}}{\sigma^h t^h} \tag{S.16}$$

$$n^{hl,H} = \frac{m^{hl,H}}{\left(\sigma^l + \phi\left(z\right) \psi_H^{h,H}\right) t^h} \tag{S.17}$$

$$n^{h,F} = \frac{\psi^{h,F} O^h u^h}{\sigma^{h,F}} \tag{S.18}$$

$$n^{h,H} + n^{hl,H} + u^h + l^h + n^{h,F} = 1 \tag{S.19}$$

$$\Phi^h l^{h^{-\phi^h}} - \lambda_{c^h} \bar{\omega} = \lambda_{n^{h,H}} \psi_H^{h,H} \tag{S.20}$$

$$\lambda_{n^{h,H}} \psi_H^{h,H} = \lambda_{n^{hl,H}} \psi_H^{hl,H} \tag{S.21}$$

$$\lambda_{n^{h,H}} \psi_H^{h,H} s + \lambda_{n^{hl,H}} \psi_H^{hl,H} \left(1 - s\right) = \lambda_{n^{h,F}} \psi^{h,F} - \lambda_{c^h} X^h \left(\tilde{O}^h \tilde{u}^h\right) \tag{S.22}$$

$$\lambda_{c^h} \frac{b'\left(z\right)}{\phi'\left(z\right)} = \psi_H^{h,H} \left(\lambda_{n^{h,H}} - \lambda_{n^{hl,H}}\right) \tag{S.23}$$

$$\lambda_{c^h} = (1 - \beta\chi) \left(\left(1 - \chi\right) c^h\right)^{-\eta^c} \tag{S.24}$$

$$\lambda_{n^{h,H}} = \beta \left\{ -\Phi^h l^{h^{-\phi^h}} + \lambda_{c^h} \left(1 - \tau^{n,H}\right) w^{h,H} + \lambda_{n^{h,H}} \left(1 - \sigma^h\right) \right\} \tag{S.25}$$

$$\lambda_{n^{hl,H}} = \beta \left\{ -\Phi^h l^{h^{-\phi^h}} + \lambda_{c^h} \left[\left(1 - \tau^{n,H}\right) w^{hl,H} - b(z)\right] + \lambda_{n^{hl,H}} \left(1 - \sigma^l - \phi(z) \psi_H^{h,H}\right) + \lambda_{n^{h,H}} \psi_H^{h,H} \phi\left(z\right) \right\} \tag{S.26}$$

$$\lambda_{n^{h,F}} = \beta\left\{-\Phi^h l^{h^{-\phi^h}} + \lambda_{c^h}\left(1-\tau^{n,F}\right) e w^{h,F} + \lambda_{n^{h,F}}\left(1-\sigma^{h,F}\right)\right\} \tag{S.27}$$

Low-skilled h/h $\left\{c^l, c^{l,H}, c^{l,F}, n^{l,H}, n^{l,F}, l^l, u^l, O^l, \lambda_{c^l}, \lambda_{n^{l,H}}, \lambda_{n^{l,F}}\right\}$

$$\begin{aligned} y = {} & \left(1-n^{h,F}\right) c^{h,H} t^h + \left(1-n^{l,F}\right) c^{l,H} t^l + i + g^c + X^h\left(\tilde{O}^h \tilde{u}^h\right) O^h u^h t^h \\ & + X^l\left(\tilde{O}^l \tilde{u}^l\right) O^l u^l t^l + b(z)\, n^{hl,H} t^h + \kappa^h v^h + \kappa^l v^l \end{aligned} \tag{S.28}$$

$$c^l = \left(1-n^{l,F}\right) c^{l,H} + e n^{l,F} c^{l,F} \tag{S.29}$$

$$n^{l,F} c^{l,F} = (1-\eta)\, w^{l,F} n^{l,F} \tag{S.30}$$

$$n^{l,H} = \frac{m^{l,H}}{\sigma^l t^l} \tag{S.31}$$

$$n^{l,F} = \frac{\psi^{l,F} O^l u^l}{\sigma^{l,F}} \tag{S.32}$$

$$n^{l,H} + u^l + l^l + n^{l,F} = 1 \tag{S.33}$$

$$\Phi^l l^{l^{-\phi^l}} - \lambda_{c^l}\bar{\omega} = \lambda_{n^{l,H}} \psi_H^{l,H} \tag{S.34}$$

$$\lambda_{n^{l,H}} \psi_H^{l,H} = \lambda_{n^{l,F}} \psi^{l,F} - \lambda_{c^l} X^l\left(\tilde{O}^l \tilde{u}^l\right) \tag{S.35}$$

$$\lambda_{c^l} = (1-\beta\chi)\left((1-\chi)\, c^l\right)^{-\eta^c} \tag{S.36}$$

$$\lambda_{n^{l,H}} = \beta\left\{-\Phi^l l^{l^{-\phi^l}} + \lambda_{c^l}\left(1-\tau^{n,H}\right) w^{l,H} + \lambda_{n^{l,H}}\left(1-\sigma^l\right)\right\} \tag{S.37}$$

$$\lambda_{n^{l,F}} = \beta\left\{-\Phi^l l^{l^{-\phi^l}} + \lambda_{c^l}\left(1-\tau^{n,F}\right) e w^{l,F} + \lambda_{n^{l,F}}\left(1-\sigma^{l,F}\right)\right\} \tag{S.38}$$

Wages $\left\{w^{h,H}, w^{l,H}, w^{hl,H}\right\}$

$$w^{h,H} = \left(1-\theta^h\right)\left(p^H y_i^h + \kappa^h \frac{\left(1-\sigma^h\right)}{\psi_F^{h,H}}\right) - \frac{\theta^h}{\lambda_{c^h}\left(1-\tau^{n,H}\right)}\left(-\Phi^h l^{h^{-\phi^h}} + \lambda_{n^{h,H}}\left(1-\sigma^h\right)\right) \tag{S.39}$$

$$w^{l,H} = \left(1-\theta^l\right)\left(p^H y_i^l + \kappa^l \frac{\left(1-\sigma^l\right)}{\psi_F^{l,H}}\right) - \frac{\theta^l}{\lambda_{c^l}\left(1-\tau^{n,H}\right)}\left(-\Phi^l l^{l^{-\phi^l}} + \lambda_{n^{l,H}}\left(1-\sigma^l\right)\right) \tag{S.40}$$

$$\begin{aligned} w^{hl,H} = {} & \left(1-\theta^{hl}\right)\left(p^H y_i^{hl} + \kappa^l \frac{\left(1-\sigma^l-\phi(z)\,\psi_H^{h,H}\right)}{\psi_F^{hl,H}}\right) \\ & - \frac{\theta^{hl}}{\lambda_{c^h}\left(1-\tau^{n,H}\right)}\left(-\Phi^h l^{h^{-\phi^h}} - \lambda_{c^h} b(z) + \lambda_{n^{hl,H}}\left(1-\sigma^l-\phi(z)\,\psi_H^{h,H}\right) + \lambda_{n^{h,H}}\psi_H^{h,H}\phi(z)\right) \end{aligned} \tag{S.41}$$

Intermediate good firm $\left\{y_i, x_i, x, y^{F^*}, r^k, p^H, v^l, v^h\right\}$

$$y_i = A\left(\alpha\left(t^l n^{l,H} + q^h t^h n^{hl,H}\right)^{\frac{\epsilon-1}{\epsilon}} + (1-\alpha)\left(x_i\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}} \tag{S.42}$$

$$x_i = \left(\zeta(k)^{\frac{\rho-1}{\rho}} + (1-\zeta)(t^h n^{h,H})^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}} \tag{S.43}$$

$$x = \frac{t^h\left(\sigma^l + \phi\left(z\right)\psi_H^{h,H}\right)n^{hl,H}}{v^l \psi_F^{hl,H}} \tag{S.44}$$

$$\frac{\kappa^h}{\psi_F^{h,H}} = \beta\left\{p^H y_i^h - w^{h,H} + \kappa^h \frac{\left(1-\sigma^h\right)}{\psi_F^{h,H}}\right\} \tag{S.45}$$

$$\frac{\frac{\kappa^l}{\psi_F^{hl,H}}}{\frac{\kappa^l}{\psi_F^{l,H}}} = \frac{\left\{p^H y_i^{hl} - w^{hl,H} + \kappa^l \frac{\left(1-\sigma^l-\phi(z)\psi_H^{h,H}\right)}{\psi_F^{hl,H}}\right\}}{\left\{p^H y_i^l - w^{l,H} + \kappa^l \frac{\left(1-\sigma^l\right)}{\psi_F^{l,H}}\right\}} \tag{S.46}$$

$$y_i = y^H + y^{F^*} \tag{S.47}$$

$$r^k = p^H y_i^k \tag{S.48}$$

$$y^{F^*} = (1-\omega^*)\left(\frac{p^H}{e}\right)^{-\gamma^*} y^* \tag{S.49}$$

Economy-wide final good $\left\{y, y^H, y^F\right\}$

$$y = \left(\omega^{\frac{1}{\gamma}}\left(y^H\right)^{\frac{\gamma-1}{\gamma}} + (1-\omega)^{\frac{1}{\gamma}}\left(y^F\right)^{\frac{\gamma-1}{\gamma}}\right)^{\frac{\gamma}{\gamma-1}} \tag{S.50}$$

$$y^F = (1-\omega)\left(\frac{p^F}{P}\right)^{-\gamma} y \tag{S.51}$$

$$y^H = \frac{\omega}{1-\omega}\left(\frac{p^H}{p^F}\right)^{-\gamma} y^F \tag{S.52}$$

Government $\left\{g^c\right\}$

$$\bar{\omega} t^h u^h + \bar{\omega} t^l u^l + g^c = \tau + \tau^k r^k k + \tau^{n,H}\left(w^{h,H} n^{h,H} t^h + w^{hl,H} n^{hl,H} t^h + w^{l,H} n^{l,H} t^l\right) \tag{S.53}$$

Closing the SOE model $\left\{r^d, rp, nx, gdp, p^F, e\right\}$

$$r^d = r^* \tag{S.54}$$

$$rp = 0 \tag{S.55}$$

$$ed(r^d - 1) = p^H y^{F^*} - p^F y^F + e\left(n^{h,F}\Xi^h t^h + n^{l,F}\Xi^l t^l\right) \tag{S.56}$$

$$nx = p^H y^{F^*} - p^F y^F \tag{S.57}$$

$$gdp = y + nx \tag{S.58}$$

$$e = \frac{p^F}{P} \tag{S.59}$$

$\{b_1, \phi_2\}$

$$b(z) = b_1 (z)^{b_2} \tag{S.60}$$

$$\phi(z) = \phi_1 (z)^{\phi_2} \tag{S.61}$$

$\left\{x_2^h, x_2^l\right\}$

$$X^h\left(\tilde{O}^h \tilde{u}^h\right) = x_1^h \left(O^h u^h\right)^{x_2^h} \tag{S.62}$$

$$X^l\left(\tilde{O}^l \tilde{u}^l\right) = x_1^l \left(O^l u^l\right)^{x_2^l} \tag{S.63}$$

G Calibration strategy

We set employment and unemployment rates per household type using data from the Labor Force Survey (Hellenic Statistical authority). Then, l^l and l^h are obtained residually from:

$$n^{l,H} + u^l + l^l + n^{l,F} = 1 \tag{S.33}$$

$$n^{h,H} + n^{hl,H} + u^h + l^h + n^{h,F} = 1 \tag{S.19}$$

Setting $\psi^{h,F}/\psi_H^{h,H} = 1.5$ and $\psi_H^{h,H} = 0.17$, we find $\psi^{h,F} = 0.2550$. We compute $m^{h,H} = 0.0116$ and $m^{l,H} = 0.0270$ from:

$$n^{h,H} = \frac{m^{h,H}}{\sigma^h t^h} \tag{S.16}$$

$$n^{l,H} = \frac{m^{l,H}}{\sigma^l t^l} \tag{S.31}$$

Setting $\psi^{l,F} = 0.9$, we find $O^l = 0.0028$ from:

$$n^{l,F} = \frac{\psi^{l,F} O^l u^l}{\sigma^{l,F}} \tag{S.32}$$

We find $\psi_H^{l,H} = 0.4914$ from:

$$\psi_H^{l,H} = \frac{m^{l,H}}{(1 - O^l)\, u^l t^l} \tag{S.2}$$

We find $O^h = 0.0174$ from:

$$n^{h,F} = \frac{\psi^{h,F} O^h u^h}{\sigma^{h,F}} \tag{S.18}$$

We solve a system of two equations in two unknowns and obtain $s = 0.0458$ and $\phi(z) = 1.1766$ from:

$$\psi_H^{h,H} = \frac{m^{h,H}}{(1 - O^h)\, s u^h t^h + \phi(z)\, n^{hl,H} t^h} \tag{S.1}$$

$$\psi_H^{hl,H} = \frac{m^{hl,H}}{(1 - O^h)(1 - s)\, u^h t^h} \tag{S.3}$$

We calculate $m^{hl,H} = 0.0161$ and $v^h = 0.0166$ from:

$$n^{hl,H} = \frac{m^{hl,H}}{\left(\sigma^l + \phi(z)\, \psi_H^{h,H}\right) t^h} \tag{S.17}$$

$$\psi_F^{h,H} = \frac{m^{h,H}}{v^h} \tag{S.4}$$

To find $\mu_1 = 0.4979$ and $\mu_2 = 0.7593$, we solve the following system of equations:

$$m^{h,H} = \mu_1 \left(v^h\right)^{\mu_2} \left((1 - O^h)\, s u^h t^h + \phi(z)\, n^{hl,H} t^h\right)^{1-\mu_2} \tag{S.7}$$

$$m^{l,H} = \mu_1 \left(m^{l,H} / \psi_F^{l,H}\right)^{\mu_2} \left((1 - O^l)\, u^l t^l\right)^{1-\mu_2} \tag{S.8}$$

where $(1 - x)\, v^l = 0.0541$ and $x v^l = 0.0382$ are obtained from:

$$\psi_F^{l,H} = \frac{m^{l,H}}{(1 - x)\, v^l} \tag{S.5}$$

$$m^{hl,H} = \mu_1 \left(x v^l\right)^{\mu_2} \left((1 - O^h)(1 - s)\, u^h t^h\right)^{1-\mu_2} \tag{S.9}$$

Then, $v^l = 0.0923$ and $x = 0.4140$. Finally, $\psi_F^{hl,H} = 0.4203$ is obtained from:

$$\psi_F^{hl,H} = \frac{m^{hl,H}}{xv^l} \tag{S.6}$$

We control for the elasticity of substitution between physical capital and skilled labor ($\rho = 0.9260$), the elasticity substitution between unskilled labor and capital-skilled labor ($\epsilon = 1.3575$), the share of unskilled labor ($\alpha = 0.42$), the elasticity of substitution between home produced and imported goods ($\gamma = 3.96$), and total vacancy costs, $\kappa^h v^h + \kappa^l v^l$, to be 5.0% of GDP. Furthermore, by setting the price levels P, p^{F^*} equal to 1, and in order to match k/y, y^F/y, y^{F^*}/y, d/y, $w^{h,H}/w^{l,H}$, $w^{hl,H}/w^{l,H}$, c/y from the data, the following equations form a system of 26 equations in 26 unknowns: β, δ, ζ, ω, κ^l, r^k, k, i, d, y, y^H, y^F, y_i, x_i, y^H/y, y^{F^*}, y^*, $w^{h,H}$, $w^{hl,H}$, $w^{l,H}$, p^H, p^F, e, q^h, nx, gdp.

$$\frac{y^H}{y} = \omega \left(\frac{p^H}{P}\right)^{-\gamma} \tag{S.55}$$

$$\frac{y^F}{y} = (1-\omega) \left(\frac{p^F}{P}\right)^{-\gamma} \tag{S.54}$$

$$1 = \left(\omega^{\frac{1}{\gamma}} \left(y^H/y\right)^{\frac{\gamma-1}{\gamma}} + (1-\omega)^{\frac{1}{\gamma}} \left(y^F/y\right)^{\frac{\gamma-1}{\gamma}}\right)^{\frac{\gamma}{\gamma-1}} \tag{S.53}$$

$$\frac{y_i}{y} = \frac{y^H}{y} + \frac{y^{F^*}}{y} \tag{S.50}$$

$$y^H = \left(y^H/y\right) y \tag{SS.2}$$

$$y^{F^*} = \left(y^{F^*}/y\right) y \tag{SS.3}$$

$$k = \left(\frac{k}{y}\right) y \tag{SS.4}$$

$$i = \left(\frac{i}{y}\right) y \tag{SS.5}$$

$$p^H y_i = w^{l,H} t^l n^{l,H} + w^{hl,H} t^h n^{hl,H} + w^{h,H} t^h n^{h,H} + r^k k + \kappa^l v^l + \kappa^h v^h \tag{S.57}$$

$$y_i = A\left(\alpha \left(t^h n^l\right)^{\frac{\epsilon-1}{\epsilon}} + (1-\alpha)\left(x_i\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}} \tag{S.42}$$

$$x_i = \left(\zeta(k)^{\frac{\rho-1}{\rho}} + (1-\zeta)(t^h n^{h,H})^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}} \tag{S.43}$$

$$\frac{\kappa^h}{\psi_F^{h,H}} = \beta \left\{ p^H (1-\zeta)(1-\alpha) A^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_i}{x_i}\right)^{\frac{1}{\epsilon}} \left(\frac{x_i}{t^h n^{h,H}}\right)^{\frac{1}{\rho}} - w^{h,H} + \kappa^h \frac{(1-\sigma^h)}{\psi_F^{h,H}} \right\} \tag{S.46}$$

$$\frac{w^{hl,H}}{w^{l,H}} = \frac{\beta p^H \alpha q^h A^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_i}{n^{l,H} t^l + q^h n^{hl,H} t^h}\right)^{\frac{1}{\epsilon}} + \frac{\kappa^l}{\psi_F^{hl,H}} \left(\beta \left(1-\sigma^l - \phi(z)\psi_H^{h,H}\right) - 1\right)}{\beta p^H \alpha A^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_i}{n^{l,H} t^l + q^h n^{hl,H} t^h}\right)^{\frac{1}{\epsilon}} + \frac{\kappa^l}{\psi_F^{l,H}} \left(\beta (1-\sigma^l) - 1\right)} \tag{S.47}$$

$$r^k = p^H \zeta (1-\alpha) A^{\frac{\epsilon-1}{\epsilon}} \left(\frac{y_i}{x_i}\right)^{\frac{1}{\epsilon}} \left(\frac{x_i}{k}\right)^{\frac{1}{\rho}} \tag{S.51}$$

$$p^F = e p^{F^*} \tag{SS.6}$$

$$w^{l,H} = \frac{w^{h,H}}{(w^{h,H}/w^{l,H})} \tag{SS.7}$$

$$w^{hl,H} = w^{l,H} \left(\frac{w^{hl,H}}{w^{l,H}}\right) \tag{SS.8}$$

$$d = \left(\frac{d}{y}\right) y \tag{SS.9}$$

$$\frac{y^{F^*}}{y} = (1-\omega) \left(\frac{p^H}{e}\right)^{-\gamma} \frac{y^*}{y} \tag{S.52}$$

$$ed(r^d - 1) = p^H y^{F^*} - p^F y^F + e\left(n^{h,F} \Xi^h t^h + n^{l,F} \Xi^l t^l\right) \tag{S.57}$$

$$1 = \beta r^d \tag{S.15}$$

$$r^d = 1 + \left(1-\tau^k\right) r^k - \delta \tag{S.14}$$

$$\frac{i}{y} = \delta \frac{k}{y} \tag{S.13}$$

$$y^{F^*} = \left(\frac{y^{F^*}}{y}\right) y \tag{SS.11}$$

$$nx = p^H y^{F^*} - p^F y^F \tag{S.58}$$

$$gdp = y + nx \tag{S.59}$$

Next, we control for the inverse elasticity of intertemporal substitution ($\eta^c = 1.0$), the inverse Frisch elasticity ($\phi^h = \phi^l = 1.5$), the share of consumption to output ($c/y = 0.60$), the share of government spending to output ($g^c/y = 0.17$), the capital tax rate $\left(\tau^k = 0.18\right)$ and the labor tax rates ($\tau^{n,H} = \tau^{n,F} = 0.29$) at home and abroad respectively. The following equations form a system of 20 equations in 20 unknowns: c^h, $c^{h,H}$, $c^{h,F}$, c^l, $c^{l,H}$, $c^{l,F}$, τ, Φ^h, Φ^l, X^h, X^l, $b(z)$, $\bar{\omega}$, λ_{c^h}, λ_{n^h}, $\lambda_{n^{hl}}$, $\lambda_{n^{h,F}}$, λ_{c^l}, λ_{n^l}, $\lambda_{n^{l,F}}$.

rest equations

$$1 = \frac{c}{y} + \frac{i}{y} + \frac{g^c}{y} + \frac{\kappa^l v^l + \kappa^h v^h}{y} + \frac{X^h\left(\bar{O}^h \bar{u}^h\right) O^h u^h t^h}{y} + \frac{X^l\left(\bar{O}^l \bar{u}^l\right) O^l u^l t^l}{y} + \frac{b\left(z\right) n^{hl,H} t^h}{y} \tag{S.28}$$

$$\lambda_{c^h} = c^{h^{-\eta^c}} \tag{S.24}$$

$$n^{h,F} c^{h,F} = \left(1 - \tau^{n,F} - \eta\right) w^{h,F} n^{h,F} \tag{S.12}$$

$$c^h = \left(1 - n^{h,F}\right) c^{h,H} + e n^{h,F} c^{h,F} \tag{S.11}$$

$$\Phi^h l^{h^{-\phi^h}} - \lambda_{c^h}\bar{\omega} = \lambda_{n^{h,H}} \psi_H^{h,H} \tag{S.20}$$

$$\lambda_{n^{h,F}} = \beta\left\{-\Phi^h l^{h^{-\phi^h}} + \lambda_{c^h}\left(1 - \tau^{n,F}\right) e w^{h,F} + \lambda_{n^{h,F}}\left(1 - \sigma^{h,F}\right)\right\} \tag{S.27}$$

$$\lambda_{n^{h,H}} \psi_H^{h,H} = \lambda_{n^{hl,H}} \psi_H^{hl,H} \tag{S.21}$$

$$\lambda_{n^{h,H}} \psi_H^{h,H} = \lambda_{n^{h,F}} \psi^{h,F} - \lambda_{c^h} X^h \left(\tilde{O}^h \tilde{u}^h\right) \tag{S.22}$$

$$\lambda_{n^{h,H}} = \beta\left\{-\Phi^h l^{h^{-\phi^h}} + \lambda_{c^h}\left(1 - \tau^{n,H}\right) w^{h,H} + \lambda_{n^{h,H}}\left(1 - \sigma^h\right)\right\} \tag{S.25}$$

$$\lambda_{n^{hl,H}} = \beta\left\{-\Phi^h l^{h^{-\phi^h}} + \lambda_{c^h}\left[\left(1 - \tau^{n,H}\right) w^{hl,H} - b(z)\right] + \lambda_{n^{hl,H}}\left(1 - \sigma^l - \phi(z)\psi_H^{h,H}\right) + \lambda_{n^{h,H}}\psi_H^{h,H}\phi\left(z\right)\right\} \tag{S.26}$$

$$\begin{aligned} & c^h t^h + i + X^h\left(\tilde{O}^h \tilde{u}^h\right) O^h u^h t^h + e r^d d + b\left(z\right) n^{hl,H} t^h \\ & = \left(1 - \tau^{n,H}\right)\left(w^{h,H} n^{h,H} + w^{hl,H} n^{hl,H}\right) t^h + \left(1 - \tau^{n,F}\right) e w^{h,F} n^{h,F} t^h + \left(1 - \tau^k\right) r^k k - \tau^h t^h + ed + \bar{\omega} u^h t^h \end{aligned} \tag{S.10}$$

$$\frac{c}{y} = \frac{\left(1 - n^{h,F}\right) c^{h,H} t^h + \left(1 - n^{l,F}\right) c^{l,H} t^l}{y} \tag{SS.12}$$

$$\bar{\omega} t^h u^h + \bar{\omega} t^l u^l + g_t^c = \tau + \tau^k r^k k + \tau^{n,H} \left(w^{h,H} n^{h,H} t^h + w^{hl,H} n^{hl,H} t^h + w^{l,H} n^{l,H} t^l\right) \tag{S.56}$$

$$\lambda_{c^l} = c^{l^{-\eta^c}} \tag{S.36}$$

$$n^{l,F} c^{l,F} = \left(1 - \tau^{n,F} - \eta\right) w^{l,F} n^{l,F} \tag{S.30}$$

$$c^l = \left(1 - n^{l,F}\right) c^{l,H} + e n^{l,F} c^{l,F} \tag{S.29}$$

$$\Phi^l l^{-\phi^l} - \lambda_{c^l} \bar{\omega} = \lambda_{n^{l,H}} \psi_H^{l,H} \tag{S.34}$$

$$\lambda_{n^{l,H}} \psi_H^{l,H} = \lambda_{n^{l,F}} \psi^{l,F} - \lambda_{c^l} X^l \left(\tilde{O}^l \tilde{u}^l\right) \tag{S.35}$$

$$\lambda_{n^{l,H}} = \beta \left\{-\Phi^l l^{-\phi^l} + \lambda_{c^l} \left(1 - \tau^{n,H}\right) w^{l,H} + \lambda_{n^{l,H}} \left(1 - \sigma^l\right)\right\} \tag{S.37}$$

$$\lambda_{n^{l,F}} = \beta \left\{-\Phi^l l^{-\phi^l} + \lambda_{c^l} \left(1 - \tau^{n,F}\right) e w^{l,F} + \lambda_{n^{l,F}} \left(1 - \sigma^{l,F}\right)\right\} \tag{S.38}$$

Then, we obtain the bargaining power of firms, θ^h, θ^l and θ^{hl}, from equations:

$$w^{h,H} = \left(1 - \theta^h\right) \left(p^H y_i^h + \kappa^h \frac{\left(1 - \sigma^h\right)}{\psi_F^{h,H}}\right) - \frac{\theta^h}{\lambda_{c^h} \left(1 - \tau^{n,H}\right)} \left(-\Phi^h l^{h^{-\phi^h}} + \lambda_{n^{h,H}} \left(1 - \sigma^h\right)\right) \tag{S.39}$$

$$w^{l,H} = \left(1 - \theta^l\right) \left(p^H y_i^l + \kappa^l \frac{\left(1 - \sigma^l\right)}{\psi_F^{l,H}}\right) - \frac{\theta^l}{\lambda_{c^l} \left(1 - \tau^{n,H}\right)} \left(-\Phi^l l^{l^{-\phi^l}} + \lambda_{n^{l,H}} \left(1 - \sigma^l\right)\right) \tag{S.40}$$

$$\begin{aligned} w^{hl,H} &= \left(1 - \theta^{hl}\right) \left(p^H y_i^{hl} + \kappa^l \frac{\left(1 - \sigma^l - \phi(z) \psi_H^{h,H}\right)}{\psi_F^{hl,H}}\right) \\ &- \frac{\theta^{hl}}{\lambda_{c^h} \left(1 - \tau^{n,H}\right)} \left(-\Phi^h l^{h^{-\phi^h}} - \lambda_{c^h} b(z) + \lambda_{n^{hl,H}} \left(1 - \sigma^l - \phi(z) \psi_H^{h,H}\right) + \lambda_{n^{h,H}} \psi_H^{h,H} \phi(z)\right) \end{aligned} \tag{S.41}$$

Regarding the parameters of the on-the-job search cost, b_1, b_2, the efficacy of this search ϕ_1 ϕ_2, and the search effort to end mismatch z, we use the following procedure: first, we set $\phi_1 = 1$ and we set the cost of search, b_2, equal to 2. Then, by using the following equations, we solve for ϕ_2, b_1, z:

$$b(z) = b_1(z)^{b_2} \tag{S.61}$$

$$\phi(z) = \phi_1(z)^{\phi_2} \tag{S.62}$$

$$\lambda_{c^h} \frac{b'(z)}{\phi'(z)} = \psi_H^{h,h}(\lambda_{n^{h,H}} - \lambda_{n^{hl,H}}) \tag{S.22}$$

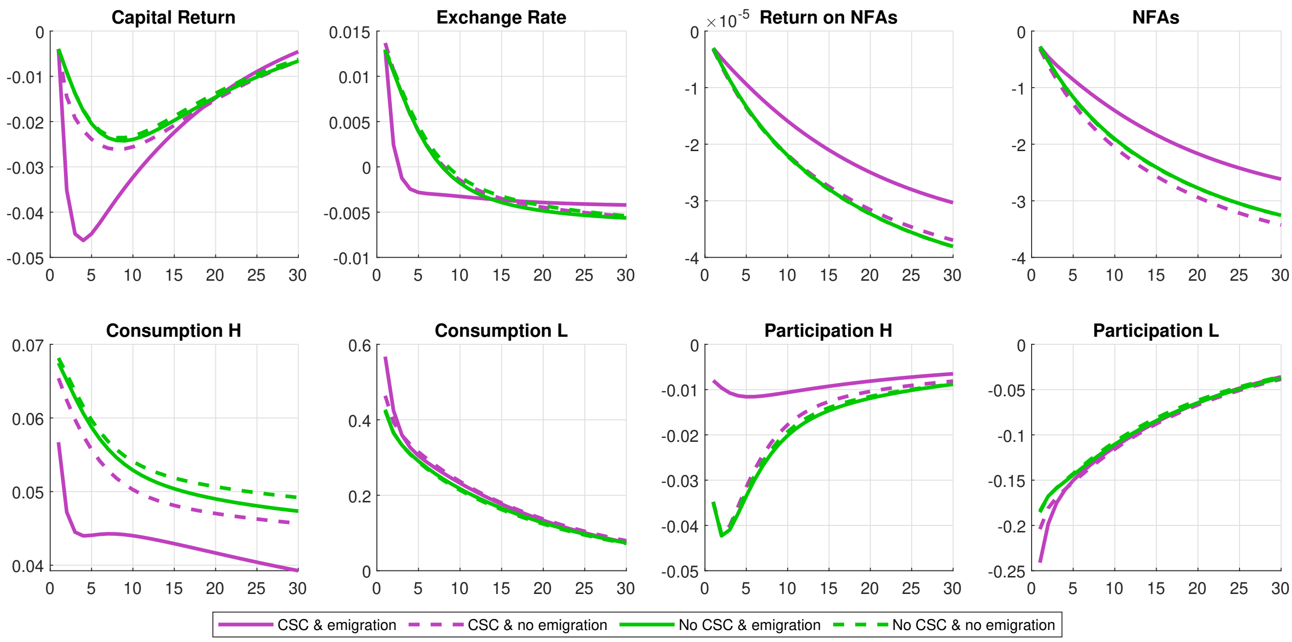
Finally, we set x_2^h, x_2^l by jointly targeting (a) the share of emigration flows in the working age population around 2010 (0.7%) and (b) an average skilled to unskilled emigrants ratio of 2/3 (see also Bandeira et al. (2022)). This is in line with survey evidence from Labrianidis et al. (2016) who report that more than 65% of Greek emigrants post 2010 were highly educated graduates (as measured by ISCED levels of 5 and above). Hence, given that in equilibrium $\tilde{O}^h \tilde{u}^h = O^h u^h$ and $\tilde{O}^l \tilde{u}^l = O^l u^l$, we obtain x_1^h, x_1^l from the following equations:

$$X^h\left(O^h u^h\right) = x_1^h \left(O^h u^h\right)^{x_2^h} \tag{S.63}$$

$$X^l\left(O^l u^l\right) = x_1^l \left(O^l u^l\right)^{x_2^l} \tag{S.64}$$

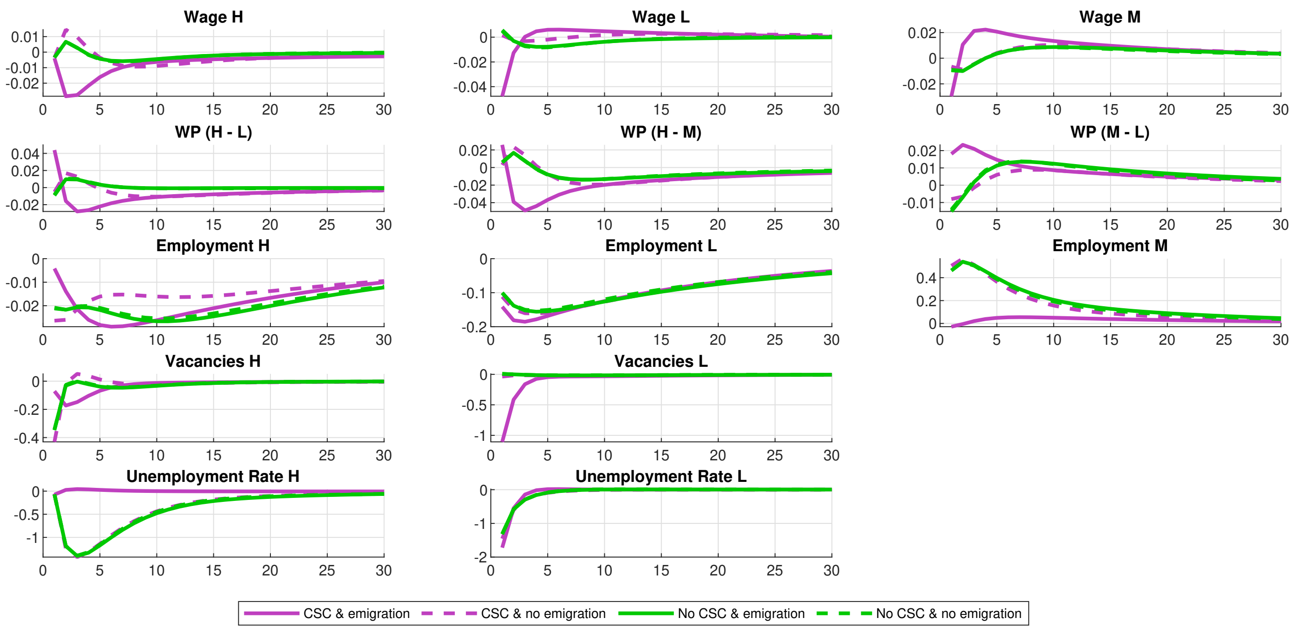
H More impulse responses: Baseline results

Figure A.1: Selected variables



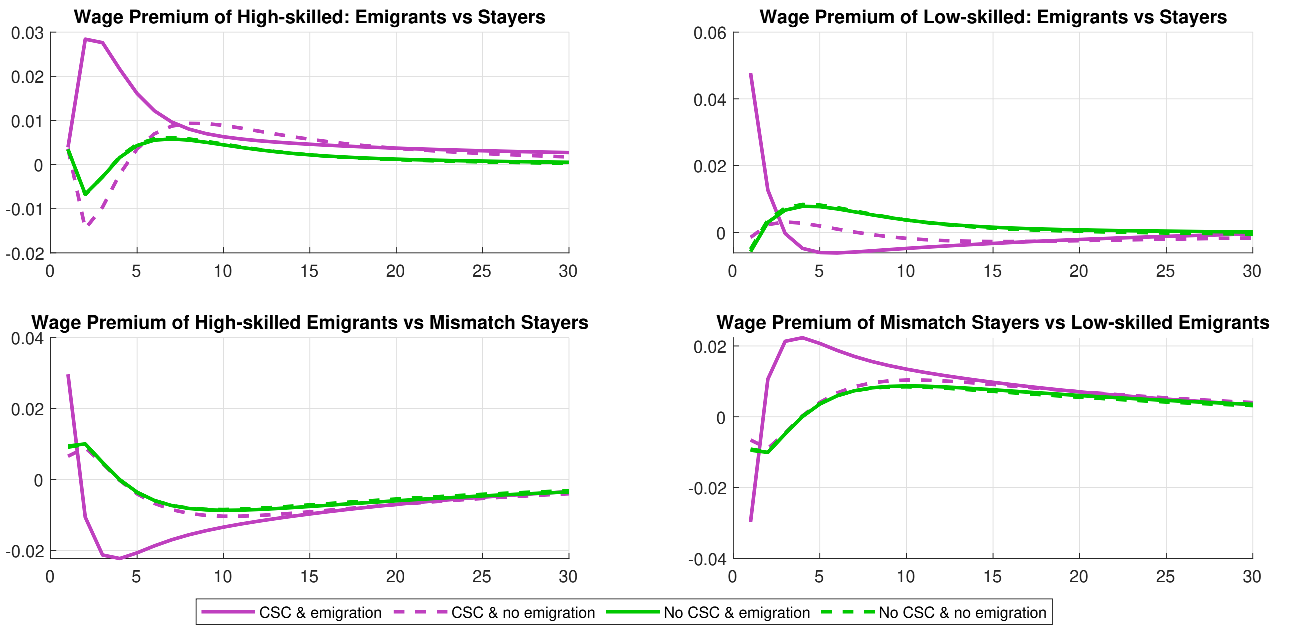
Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.2: Labor market variables



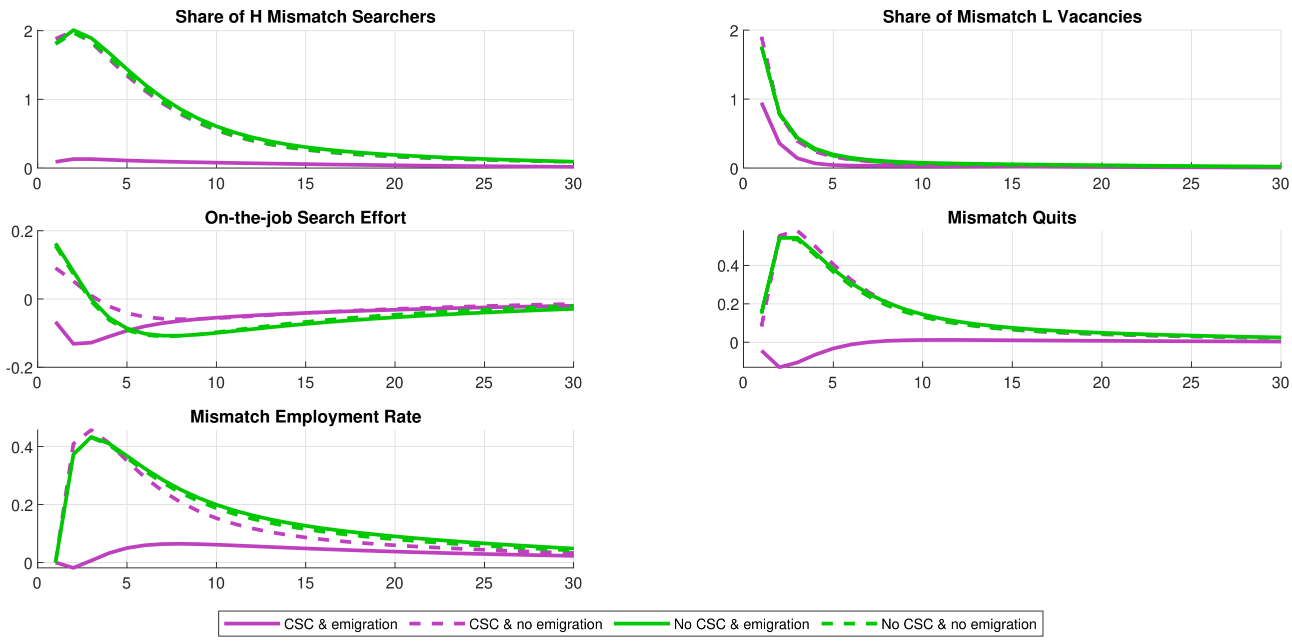
Notes: H and L denote high-skilled and low-skilled, respectively. M denotes mismatch. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.3: More migration and mismatch variables



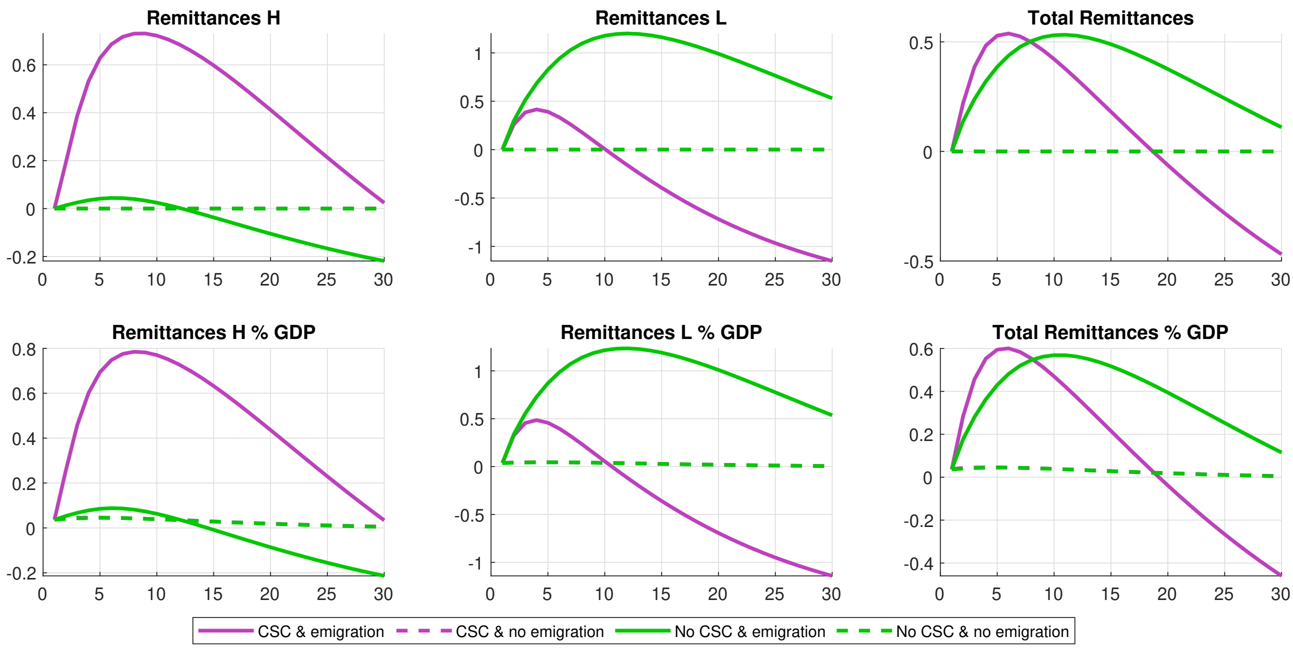
Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.4: Understanding the mismatch response



Notes: H and L denote high-skilled and low-skilled, respectively. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

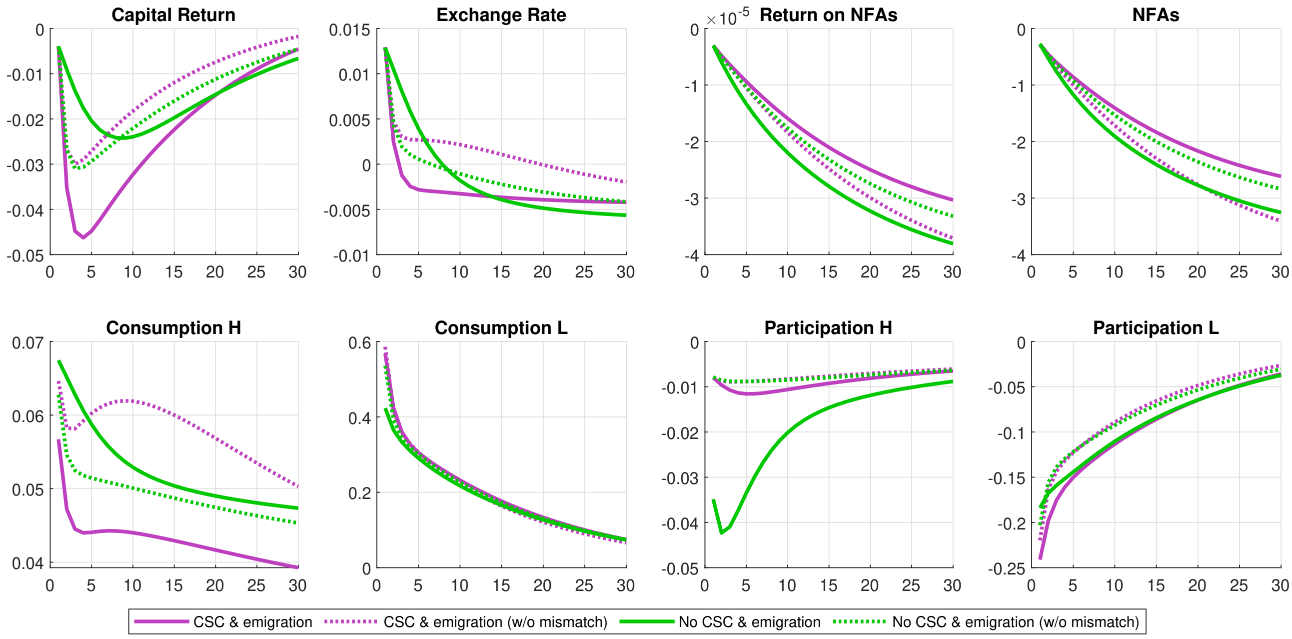
Figure A.5: Remittances



Notes: H and L denote high-skilled and low-skilled, respectively. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

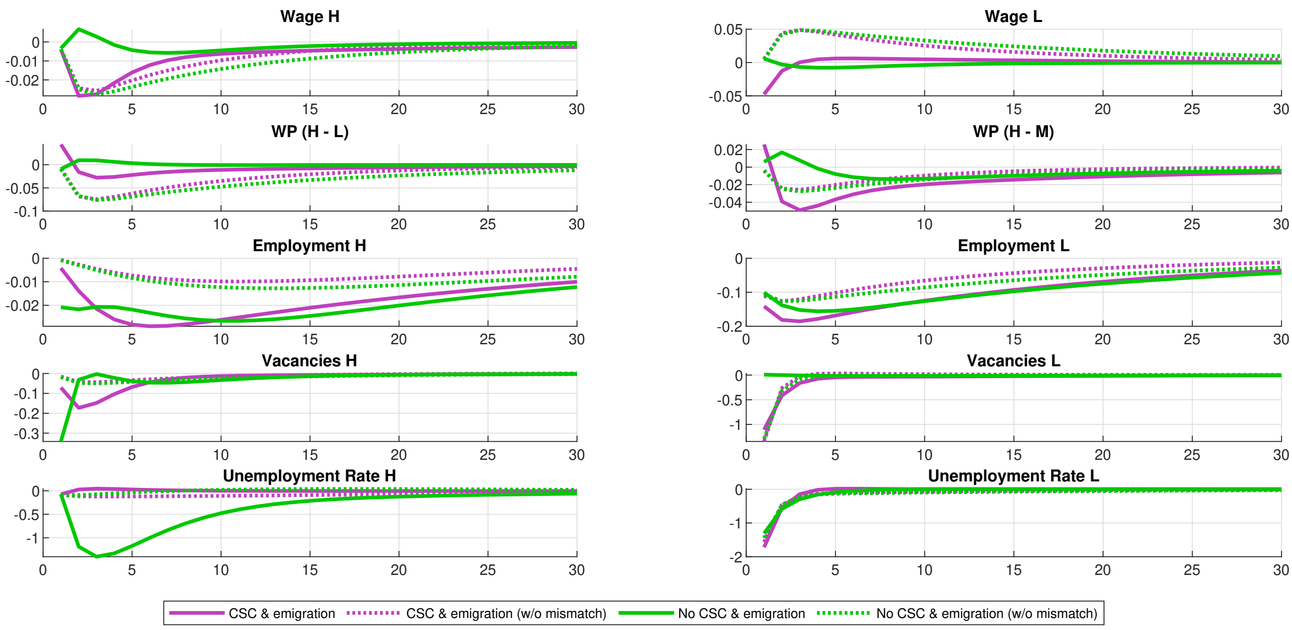
I More impulse responses: Shutting down mismatch

Figure A.6: Selected macroeconomic variables: Muting mismatch



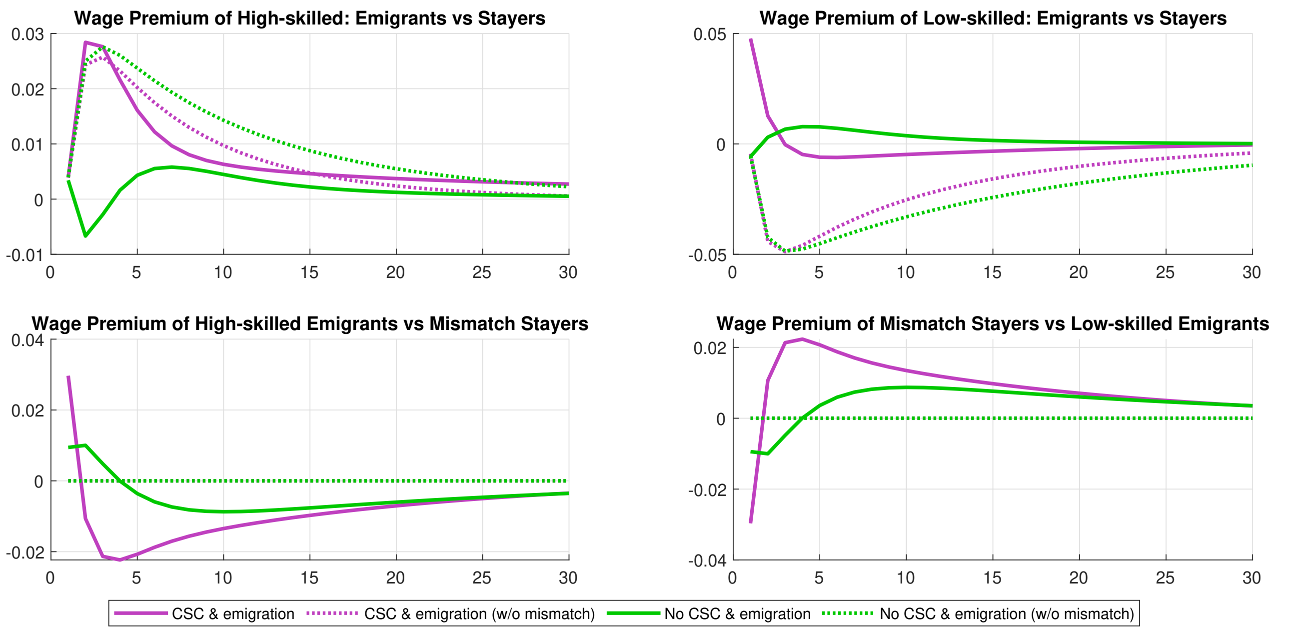
Notes: H and L denote high-skilled and low-skilled, respectively. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.7: Labor market variables: Muting mismatch



Notes: H and L denote high-skilled and low-skilled, respectively. M denotes mismatch. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

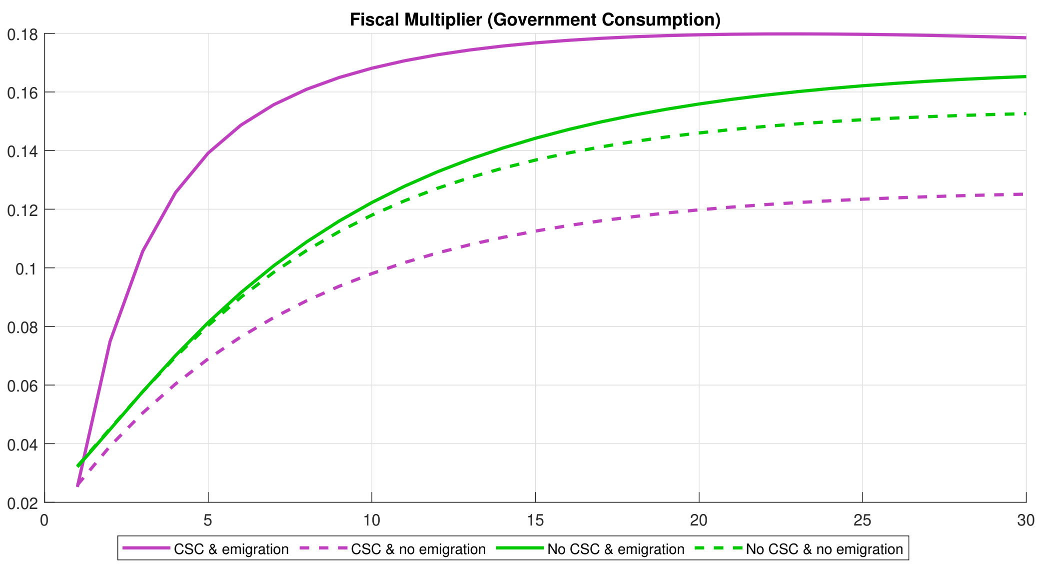
Figure A.8: More migration and mismatch variables: Muting mismatch



Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

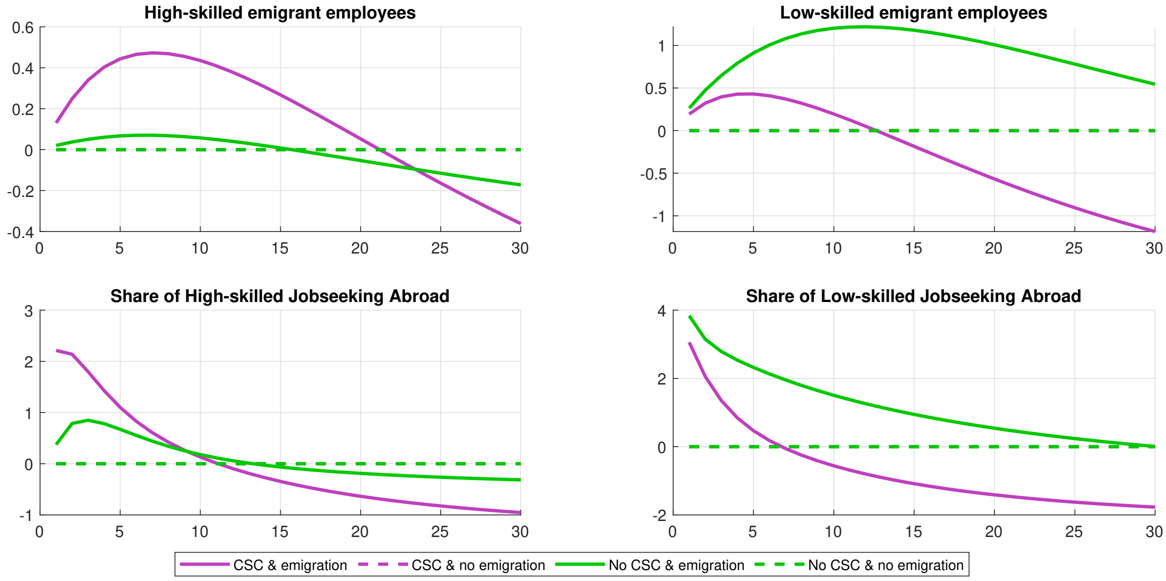
J More impulse responses: Less elastic labor supply, $\phi^h = \phi^l = 4.0$

Figure A.9: Annualized cumulative fiscal multipliers



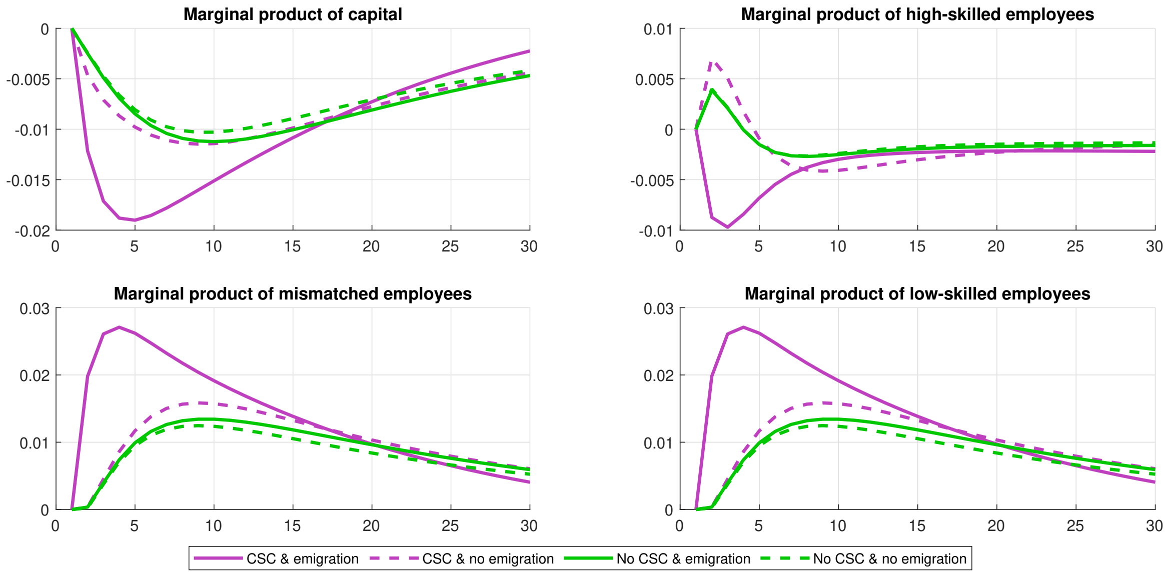
Notes: The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.10: High-skilled and low-skilled emigration after the fiscal shock



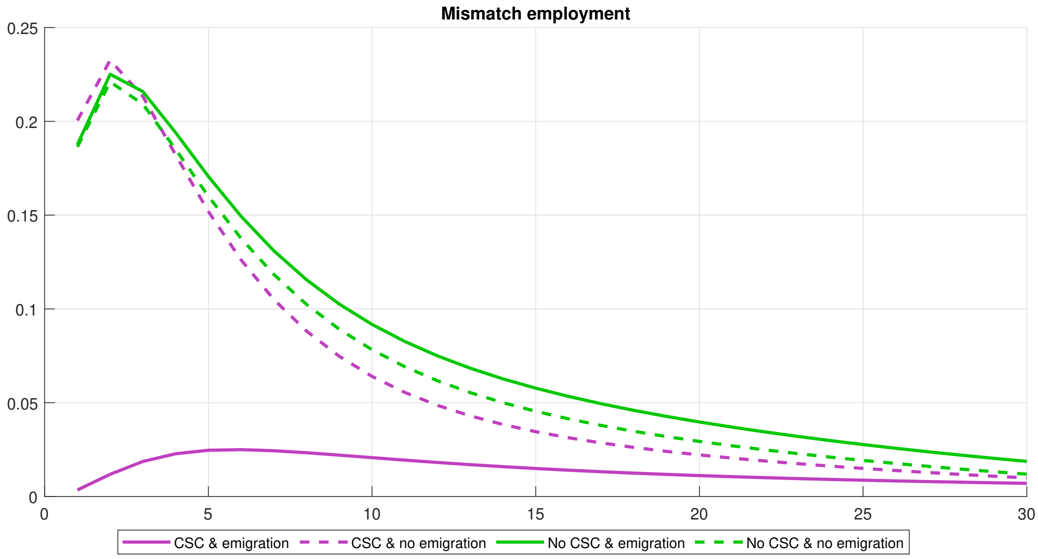
Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.11: Marginal products of capital and labor



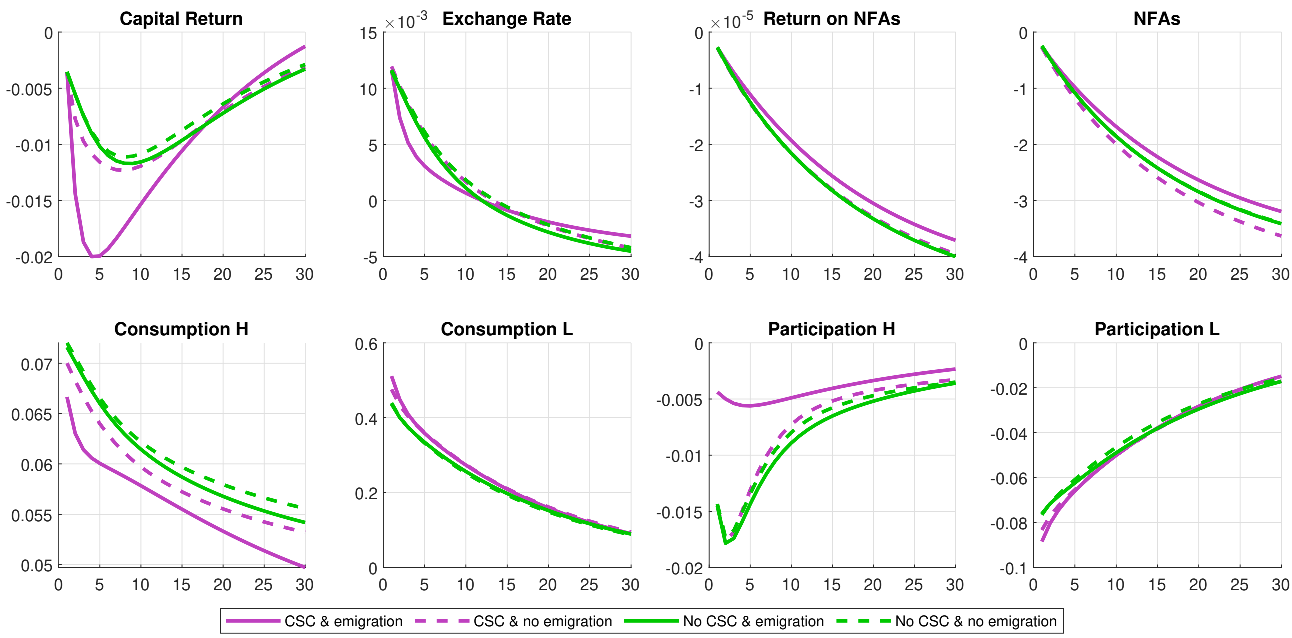
Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.12: The response of the vertical mismatch rate



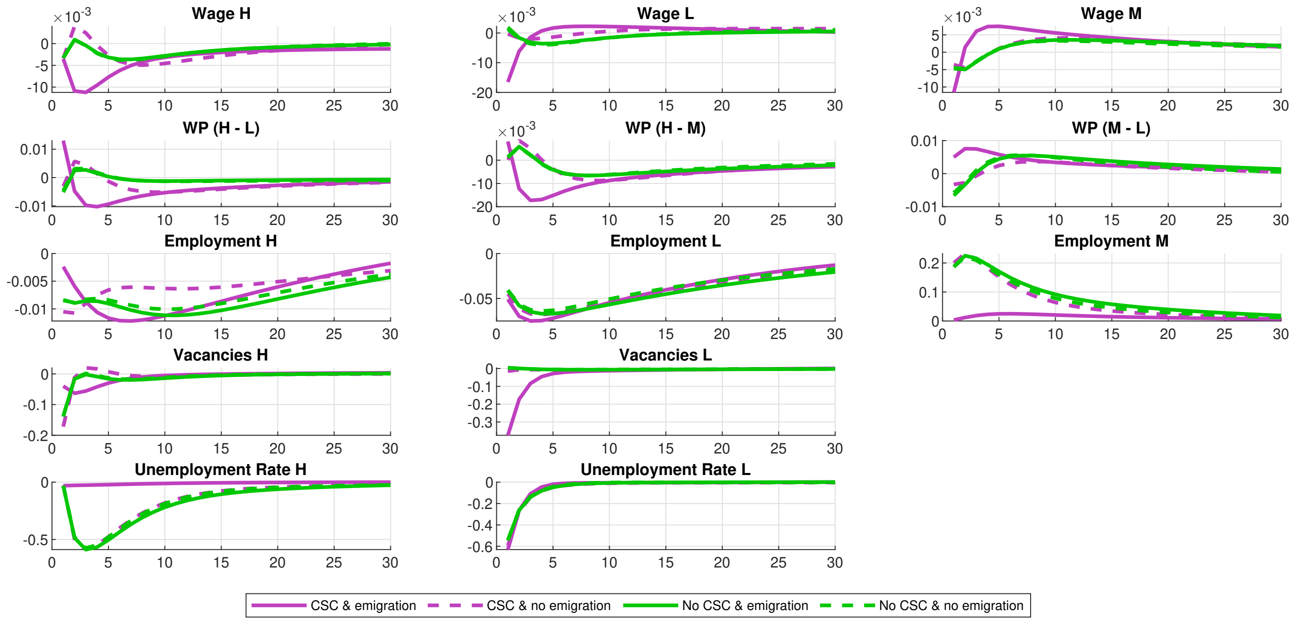
Notes: The mismatch employment rate refers to the share of mismatched employees in the total number of the high-skilled household's employed members, $n_t^{h,l}/(n_t^{h,l}+n_t^{h,h})$. *Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.*

Figure A.13: Selected macroeconomic variables



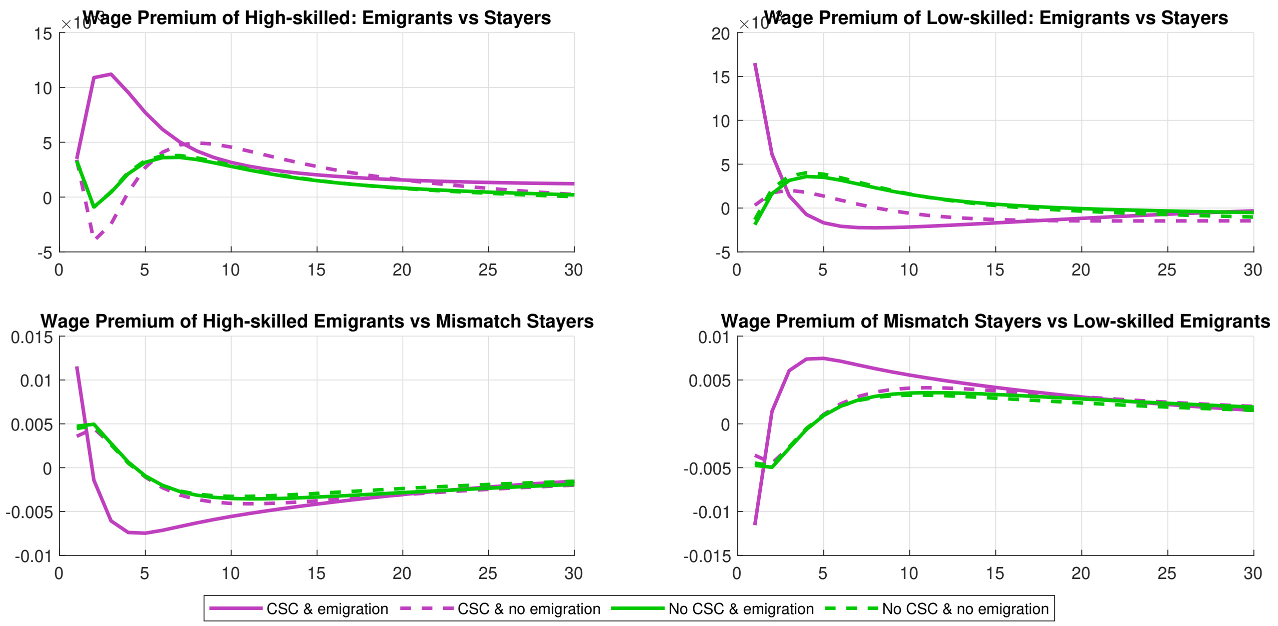
Notes: H and L denote high-skilled and low-skilled, respectively. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.14: Labor market variables



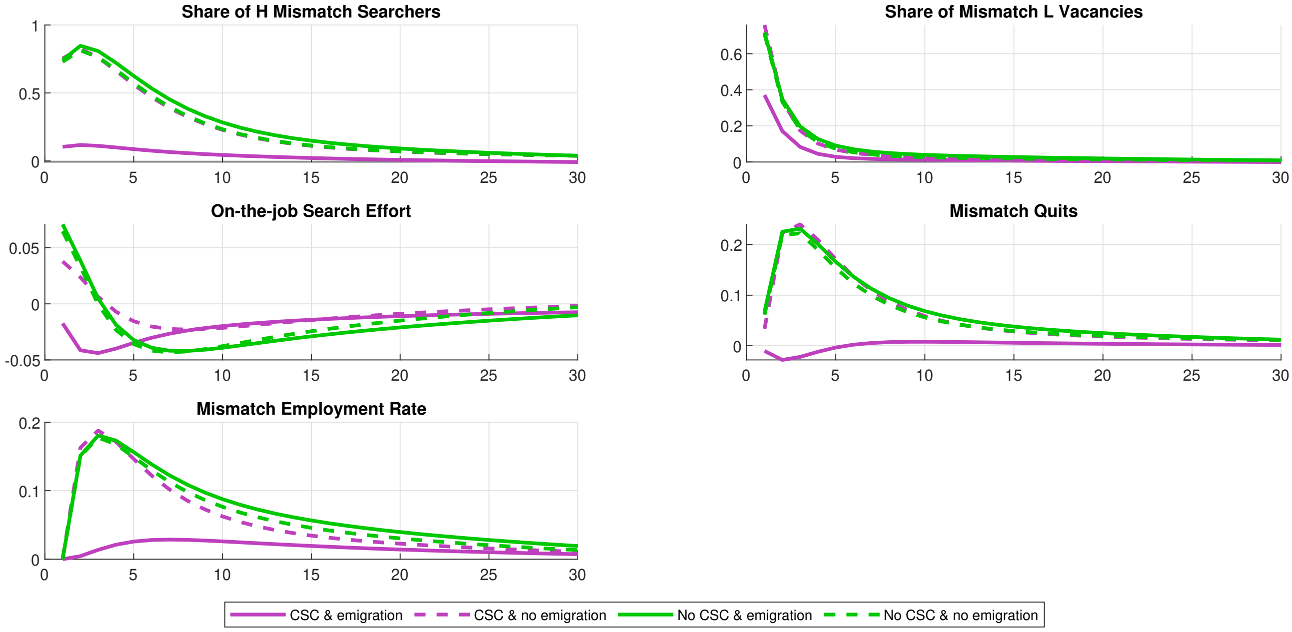
Notes: H and L denote high-skilled and low-skilled, respectively. M denotes mismatch. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.15: More migration and mismatch variables



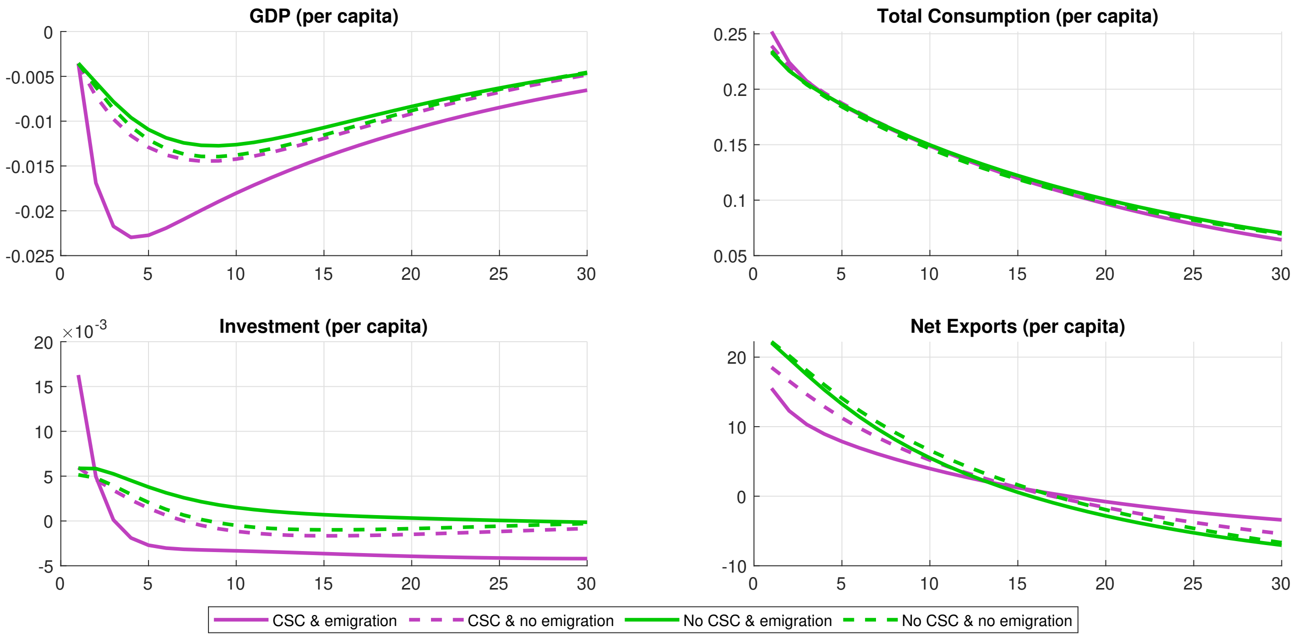
Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.16: Understanding the mismatch response



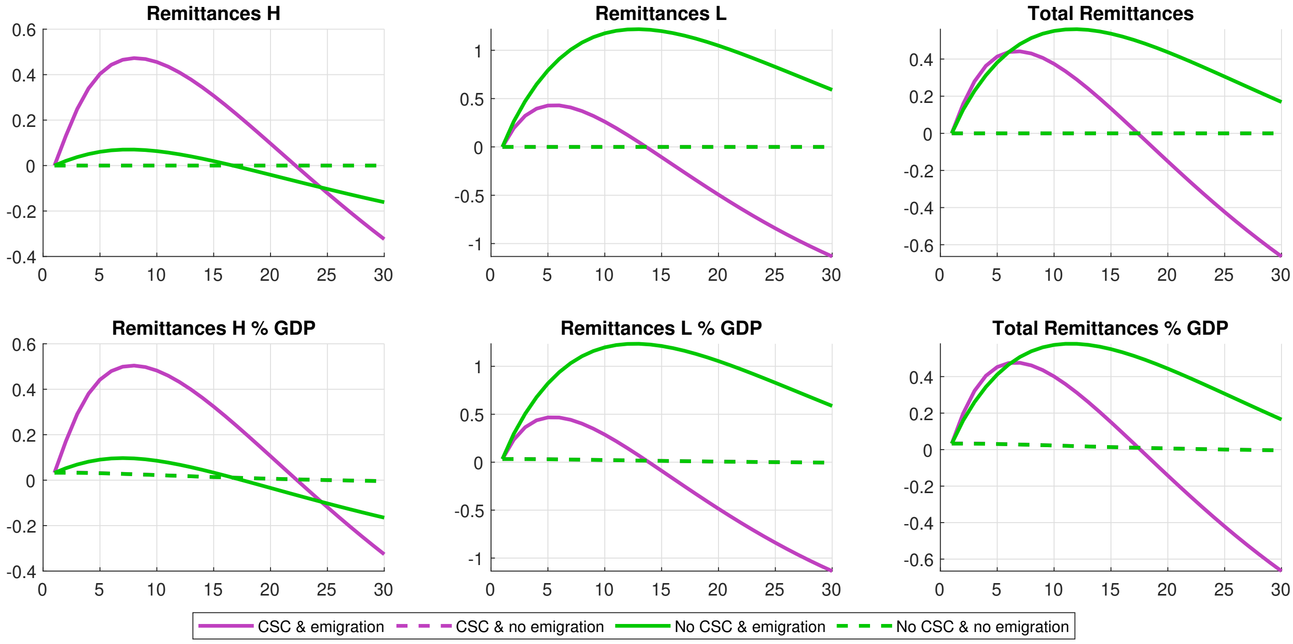
Notes: H and L denote high-skilled and low-skilled, respectively. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.17: Per capita variables



Notes: Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.

Figure A.18: Remittances



Notes: H and L denote high-skilled and low-skilled, respectively. Impulse responses to a 1% negative shock in the ratio of government spending to GDP are in percent deviations from the steady state. The horizontal axis depicts time periods. CSC denotes capital-skill complementarity.