EUROPEAN CENTRAL BANK

EUROSYSTEM

Working Paper Series

Katarzyna Budnik

European temporary migration in a two country DSGE model

No 3226

Abstract

Free movement of labour across borders can influence business cycle dynamics in the affected countries. This paper studies the macroeconomic implications of temporary migration using a two-country dynamic stochastic general equilibrium model calibrated to represent the "old" EU Member States (EU15) and the "new" Member States (NMS12). The model introduces fully endogenous temporary migration and combines it with search-and-matching frictions in labour markets. Workers migrate temporarily in response to differences in labour market conditions and wages, allowing productivity shocks to affect local labour supply. The results show that productivity shocks in the host economy attract temporary migrants and increase labour supply. This migration response amplifies output fluctuations while leaving inflation dynamics largely unaffected. Migration also smooths wage responses but increases the volatility of employment. At the same time, temporary migration dampens the macroeconomic effects of productivity shocks in the sending economy by redistributing labour across regions. These findings highlight the role of labour mobility as an adjustment mechanism within an integrated economic area and suggest that cross-border migration can significantly shape business cycle dynamics in Europe.

JEL Classification: E20, E32, F16, F22, F41

Keywords: labour migration, business cycle, dynamic stochastic general equilibrium model, integration, labour market, EU enlargement

Non-technical summary

Labour mobility has become an increasingly important feature of the European economy, particularly following the enlargement of the European Union and the gradual removal of restrictions on cross-border labour movements. Since the mid-2000s, migration flows from the Central and Eastern European Member States to the older EU economies have increased substantially. These developments have influenced labour market conditions, wage dynamics and macroeconomic developments across Europe. Despite their importance, cross-border labour movements are rarely incorporated explicitly into the macroeconomic models commonly used to analyse business cycle dynamics and policy transmission in Europe.

This paper contributes to addressing this gap by developing a macroeconomic framework in which temporary migration arises endogenously as part of the economic adjustment process. The analysis is conducted in a stylised two-region model representing the "old" EU Member States (EU15) and the "new" Member States from Central and Eastern Europe (NMS12). In the model, workers may temporarily move between countries in response to differences in labour market conditions, wages, and employment prospects. Migration decisions therefore reflect economic incentives rather than being imposed exogenously. At the same time, migrants maintain economic links with their home country through remittances and investment decisions, capturing the temporary character of many migration flows observed in Europe.

The framework allows the interaction between labour mobility and macroeconomic developments to be analysed in a coherent setting. In particular, the model highlights how migration can affect the business cycle dynamics and the adjustment of labour markets, output and domestic demand in both sending and receiving economies. The model is calibrated to reflect key structural features of European economies, including differences in productivity levels, labour market conditions and institutional arrangements between the EU15 and the NMS12.

The results suggest that temporary migration can significantly influence the macroeconomic adjustment of both receiving and sending economies. When economic conditions improve in a receiving economy, stronger labour demand attracts workers from abroad. The resulting inflow of migrants increases labour supply and enables firms to expand production more rapidly. As a consequence, economic expansions in receiving economies can become more pronounced. At the same time, migration tends to moderate wage pressures, as firms have access to a larger pool of workers. Through this mechanism, labour mobility can affect both labour market outcomes and inflation dynamics.

In sending economies, migration can act as an adjustment mechanism that alleviates labour market pressures. When economic opportunities improve abroad, some workers leave the domestic labour market, reducing unemployment and increasing wages for remaining workers. Migration therefore allows part of the economic adjustment to occur through labour flows rather than through large changes in wages or employment levels. As a result, migration can smooth macroeconomic fluctuations in sending economies.

The analysis also shows that labour mobility can alter the volatility and persistence of macroeconomic fluctuations. In receiving economies, migration tends to amplify fluctuations in output and domestic demand by strengthening the response of employment and labour supply to economic shocks. In contrast, in sending economies migration may dampen fluctuations in output by easing labour market adjustment. At the same time, stronger cross-border labour mobility increases the degree of economic interdependence between countries, making domestic developments more sensitive to shocks originating abroad.

These findings have implications for the analysis of macroeconomic developments and policy transmission in the European Union. Even when migration flows are relatively small compared with the overall population, they can play an important role in shaping labour market dynamics and the cross-border transmission of economic shocks. In particular, labour mobility may influence the way in which economies respond to productivity shocks, financial disturbances and other macroeconomic developments. Migration flows may amplify economic expansions in receiving economies while helping to stabilise labour markets in sending economies. At the same time, stronger labour mobility increases the extent to which shocks in one country may spill over to others.

1 Introduction

Interest in international migration and its consequences for labour markets has often been stimulated by large migration waves. Examples include migration between Mexico and the United States (U.S.) throughout the twentieth century, movements from Russia to Israel in the 1970s and 1990s, the arrival of guest workers in Western Germany between the 1950s and the 1970s, and migration between Eastern and Western Germany following reunification in 1989. The topic re-emerged prominently in the economic debate around the 2004 enlargement of the European Union (EU), which triggered a surge in cross-border labour mobility within Europe. And yet, more often than not, this interest fades thereafter. Despite its potential importance for macroeconomic adjustment, however, labour mobility remains largely absent from the macroeconomic frameworks commonly used to analyse business cycle dynamics and policy transmission.

This paper studies the macroeconomic role of temporary labour migration between economically integrated regions. In particular, it examines how migration between countries with substantial income differentials but open labour markets affects business cycle dynamics in both sending and receiving economies. The analysis is motivated by the experience of the European Union following the 2004 enlargement, which led to a substantial increase in cross-border labour mobility as immigration restrictions for citizens of the accession countries (NMS12) were gradually relaxed.

The paper develops a two-country dynamic stochastic general equilibrium (DSGE) model with endogenous temporary migration between regions. The framework explicitly incorporates labour mobility, remittance flows, and search-and-matching frictions in labour markets, allowing migration decisions to respond endogenously to macroeconomic conditions. This makes it possible to analyse how migration interacts with productivity shocks, labour market conditions, and capital accumulation in both host and source economies.

The main findings are threefold. First, even relatively small migration flows can significantly affect macroeconomic fluctuations when labour mobility responds endogenously to economic conditions. Second, temporary migration amplifies business cycle fluctuations in receiving economies while dampening them in sending economies. In particular, following productivity shocks in the host region, immigration increases labour supply and strengthens labour demand, thereby amplifying output and employment responses while moderating wage pressures. Third, migration substantially strengthens macroeconomic interdependence between the two regions, altering the transmission of shocks across economies. Labour mobility should therefore be viewed not only as a structural feature of integrated economies, but also as an important propagation mechanism of macroeconomic shocks.

Modern post-enlargement migration differs from earlier European migration waves along several dimensions. It coincides with increasingly favourable conditions for intra-EU mobility, as transport and communication costs declined substantially (Brücker et al., 2009). Moreover, migrants from the NMS12 are generally well educated, exhibit high employment rates - often exceeding those of natives - and are less dependent on welfare programmes than earlier immigrant cohorts in EU15 countries (Heinz and Ward-Warmedinger, 2006; Saleheen and Shadforth, 2006; Blanchflower et al., 2007; Barrett and Duffy, 2008; Lemos and Portes, 2008; Zaiceva and Zimmermann, 2008; Brücker et al., 2009; Blanchflower and Lawton, 2010; Kahanec et al., 2010; Dustmann et al., 2010a).

An important feature of this migration is its predominantly temporary character. Temporary migrants are workers who, at the time of moving, intend to return to their home country and occasionally do so. They are therefore more likely than permanent migrants to maintain consumption and investment patterns similar to those of stayers and, motivated by concern for household welfare at home, to send remittances (Budnik, 2011). This distinction matters for macroeconomic analysis.When migration is permanent, its effects can be approximated - albeit imperfectly - by population shocks in macroeconomic models. By contrast, temporary migration involves distinct settlement plans, consumption patterns, and labour market behaviour, and cannot easily be reduced to simple changes in population.

The value added of this paper lies precisely in its explicit focus on temporary migration in a business-cycle framework. Earlier attempts to incorporate labour migration into DSGE models - such as Canova and Ravn (1998), Chortareas et al. (2008), Binyamini and Razin (2008), and Engler (2009) - typically treat migration as an exogenous shock affecting population growth or composition, or assume that migration is driven by exogenous factors such as foreign wages.[1] In related DSGE frameworks that incorporate remittances, including Chami et al. (2006) and

[1] In addition, Canova and Ravn (1998) and Chortareas et al. (2008) consider economies that are closed to both trade and capital flows.

Acosta et al. (2009), remittance flows are introduced in an ad hoc manner to replicate their assumed cyclical properties. By contrast, this paper models labour mobility and remittances jointly, from both the sending and receiving country perspective, in a framework with endogenous migration decisions.

The analysis is also distinct from the international trade literature on labour mobility. Standard trade models, such as Ramaswami (1968) and the Heckscher-Ohlin framework, allow labour migration to arise endogenously but focus on long-run adjustment and typically abstract from financial markets, frictions, and transition costs.[2] They also rely on homothetic preferences across workers, which effectively gives migration a permanent character and underpins the substitutability between capital mobility, international trade, and labour mobility.[3] In such settings, migrants have no incentive to send remittances. By contrast, the framework developed here incorporates unemployment, price stickiness, habit formation, capital adjustment costs, and endogenous temporary migration.[4] Differences in consumption patterns across countries also reduce the substitutability between imports and immigration that characterises standard trade models.[5]

Labour markets are modelled following Mortensen and Pissarides (1994). Job search is costly and, together with matching frictions, generates equilibrium unemployment.[6] The search-and-matching framework accommodates institutional differences across labour markets, as unemployment in equilibrium can reflect differences in labour market institutions across countries. Here, unlike in the standard search-and-matching model, unemployed workers can search for employment both domestically and abroad.

[2] Ramaswami (1968) and the Heckscher-Ohlin model capture only the long-run consequences of labour mobility. In particular, factor price equalization - or even convergence - is unlikely to arise in the short run (Leamer and Levinsohn, 1995; Hanson and Slaughter, 1999).

[3] This result holds as long as there are no persistent differences in technology, business environment, labour market institutions, or infrastructure across regions (Saavedra-Rivano and Wooton, 1983; Kuhn and Wooton, 1987).

[4] Price stickiness allows for non-trivial responses of output to monetary policy. Capital adjustment costs increase the persistence of responses to shocks, particularly in the presence of labour market frictions (den Haan et al., 2000) and may also affect wage responses to migration shocks (Ottaviano and Peri, 2006). Other frictions play a secondary role and primarily facilitate calibration without qualitatively altering the main results.

[5] Empirical evidence suggests some complementarity between migration and trade, with migration tending to increase trade flows - particularly imports into host countries (Gould, 1994; Head and Ries, 1998; Rauch and Trindade, 2002; Dunlevy and Hutchinson, 1999; Blanes, 2005; White, 2007; Foad, 2009).

[6] Yashiv (2006) shows that search-and-matching models replicate well the volatility and persistence of labour market variables such as unemployment, employment, hires, and job-finding rates in the U.S. Early attempts to integrate search and matching frictions into otherwise standard RBC models include Merz (1995) and Andolfatto (1996); examples within one-country DSGE models include Trigari (2009), Walsh (2005), Krause and Lubik (2007), and Gertler et al. (2008).

In the model, firms may employ either natives or immigrants. These workers are close substitutes in production but may differ in productivity. They fallback positions may also differ because of differences in consumption patterns or access to unemployment benefits. To model labour demand in the presence of these two types of workers, the analysis builds on the partial equilibrium approaches of Pissarides (1992) and Ortega (2000). Firms post vacancies that may be filled by either natives or immigrants, but they cannot distinguish between them ex ante. New employees are drawn randomly from the pool of unemployed workers in the local labour market,[7] and only during wage bargaining do firms observe the worker's nationality and determine the wage accordingly. Consequently, the presence of immigrants in the labour market may either encourage or discourage vacancy creation depending on the relative value of jobs filled by immigrants versus natives.

The additional externality introduced through this specification of labour demand[8] can mitigate or even reverse the negative effects of immigration on the wages and employment of natives, even when firms can easily substitute between workers and cannot adjust along the production frontier. The model is therefore consistent with evidence showing no adverse effects of immigration from the NMS12 on wages or unemployment among EU15 natives (Brücker et al., 2009; Blanchflower et al., 2007; Lemos and Portes, 2008; Dustmann et al., 2010b) and with earlier findings for other migration waves summarized by Longhi et al. (2006), Longhi et al. (2008), and Longhi et al. (2009).[9] The externality plays a similar role as the "greasing the wheels" mechanism of Borjas (2001) and the argument in Dustmann et al. (2013) that immigration may improve labour market outcomes for natives when it raises firms' surplus. Unlike in those frameworks, however, labour markets here always clear and all workers are paid their marginal product.

Immigration is defined as the presence of natives of one country in the labour market of another country, while emigration corresponds to workers belonging to a household in one country who seek employment abroad. In the long run, a positive migration rate may persist due to

[7]Hence, the model assumes identical matching probabilities and employment rates of immigrants and natives.

[8]The two externalities present in the standard model and in this framework are trade and congestion externalities. The trade externality makes it easier for workers and firms to find appropriate matches as more agents search on the opposite side of the market. The congestion externality makes it more difficult for a marginal worker or firm to find a job or an employee, respectively, when more agents compete for the same opportunities.

[9]The mechanism is also supported by the findings of Bodvarsson et al. (2008), who revisit the Mariel Boatlift episode originally analysed by Card (1990) and show that the decline in wages in Miami following the inflow of Cuban workers was moderated by a positive effect of immigration on labour demand.

earnings differentials driven by differences in productivity levels and labour market institutions across countries. At the same time, migration costs prevent excessive labour movements. First, the limited transferability of country-specific skills and job experience places immigrants at a disadvantage relative to natives. Second, workers face one-off costs associated with relocation, such as transportation and accommodation expenses. Finally, emigrants experience the psychological and social costs of separation from family and friends, which are captured in the model through a home-attachment term in the utility function.

Three additional features deserve note. First, labour mobility and capital accumulation are subject to different adjustment costs, implying distinct short- and long-run dynamics. Capital accumulation mainly involves set-up costs, so capital supply is highly inelastic in the short run but perfectly elastic in the long run. Labour migration, by contrast, involves both one-off relocation costs and permanent costs associated with living away from home, making local labour supply relatively elastic in the short run while nearly fixed in the long run. This feature allows the model to capture the argument of Sinn (2000) that adjustment through labour migration may occur faster than adjustment through capital accumulation, and is consistent with evidence on the importance of labour mobility for regional adjustment and convergence (Blanchard et al., 1992; Barro and Sala-i-Martin, 1992).

Second, the population in the model is homogeneous, so migration selectivity is not considered. This choice contrasts with frameworks such as Baldwin and Venables (1994), where only skilled workers migrate, and treat low-skilled immigrants and high-skilled natives as separate factors of production.

Finally, the model is sufficiently general to analyse migration flows between any two regions, but its structure is particularly well suited to capturing the dynamics of European economies. First, the model assumes no significant differences in the skill composition of populations in sending and receiving regions.[10] Then, for illustrative purposes the model is calibrated to represent the NMS12 (as the sending region) and the EU15 (as the receiving region).[11] Given these features, the results of the analysis directly inform the discussion of two key EU policies:

[10]The relatively high education level of recent European migrants raises doubts about modelling immigrants and natives as distinct factors of production with systematically different skill levels.

[11]The model is calibrated rather than estimated due to the scarcity and generally poor quality of data on migration flows between the EU15 and NMS12. In addition, sufficiently long time series for key macroeconomic variables for the NMS12 (in aggregate) are limited. For these reasons, the performance of the calibrated model cannot be directly compared with the data ex post.

the free movement of labour and the enlargement of the Union to less developed economies.

The study also fills a gap in the literature on post-enlargement migration, where comparatively little attention has been devoted to business cycle dynamics in sending and receiving economies. Barrell et al. (2010) analyse the macroeconomic impact of post-accession immigration in recipient countries up to 2007, while Blanchflower et al. (2007) and Barwell (2007) draw related implications for monetary policy. These contributions, however, focus primarily on immigration during economic expansions, emphasising its role in alleviating labour shortages or moderating inflationary pressures. Only the global financial crisis shifted attention toward the role of migration in absorbing recessionary shocks. In this context, studies such as Blanchflower and Lawton (2010) and Ahearne et al. (2009) examine the experience of the United Kingdom (UK) and other EU15 economies during the downturn. The framework developed here provides a broader account of how temporary migration shapes macroeconomic adjustment over the business cycle.

The remainder of the paper is structured as follows. Section 2 presents the structure of the model. Section 3 describes the calibration strategy. Section 4 analyses the steady-state solution of the model and relates it to existing evidence on the long-run effects of migration. This section also clarifies the difference between a migration-preference shock in the model with endogenous temporary migration and a population shock. The following section presents the dynamic responses of the economies to productivity shocks under both open- and closed-border regimes. Section 6 reports robustness checks. The final section concludes.

2 Model

The population of the two economies is normalized to one. A fraction ι of individuals are born in the home country (denoted by H), and $1-\iota$ in the foreign country (denoted by F). For brevity, the model description is presented primarily from the perspective of the home country H; the full set of equations is provided in Annex A.

Individuals may work or search for employment in either economy, but only in one location at a time. At the beginning of each period there are u^H unemployed natives and u^F unemployed immigrants in country H. These workers respond to job offers posted by local firms, and a fraction of them find employment during the period. Those who fail to obtain a job, $\bar{u}^H$ and $\bar{u}^F$, respectively, may remain in the local labour market and continue their search in the next period, or relocate to country F and search for work there. Symmetrically, unemployed workers in F face the same options. At the end of each period, a fraction of existing jobs is destroyed, and workers who lose their jobs enter the pool of unemployed workers in their country of residence.

2.1 Workers

The instantaneous utility of worker j depends on consumption c_j, labour supply, and the location of residence. Workers compare their consumption to the average consumption of their compatriots $\bar{c}$. Consequently, temporary migrants evaluate their consumption relative to stayers rather than relative to residents of the host country, consistent with the framework proposed by Stark and Taylor (1991).

Labour supply is inelastic: workers either work or remain unemployed. The disutility associated with working is normalized to $\chi \geq 0$ for natives of country H and $\chi^\star \geq 0$ for natives of country F. In addition, workers experience a welfare loss when residing abroad. The disutility of living abroad in a given period is denoted by $\upsilon \geq 0$ for workers born in H and $\upsilon^\star \geq 0$ for workers born in F. The disutility evolves according to:

$$\upsilon_t = (1 - h_\upsilon)\upsilon + h_\upsilon \upsilon_{t-1} + \epsilon_{\upsilon,t} \tag{1}$$

where $\epsilon_{\upsilon,t}$ is an i.i.d. shock to migration preferences with standard deviation σ^υ, and h_υ governs the persistence of these shocks. The home-attachment term captures the social and potentially financial costs associated with separation from family and friends or with difficulties in integrating into a new cultural environment. This assumption is important because it limits the scale of labour migration even when income differentials between countries are substantial.

The utility of worker j is therefore given by

$$U_{j,t} = \frac{(c_{j,t} - h\bar{c}_{t-1})^{1-\sigma}}{1-\sigma} - \chi(n_{j,t}^H + n_{j,t}^{H\star}) - \upsilon_t(n_{j,t}^{H\star} + \bar{u}_{j,t}^{H\star}) \tag{2}$$

where $\sigma \geq 1$ is the inverse of the intertemporal elasticity of substitution and h denotes the degree of external habit formation.

The variables n_j^H, $n_j^{H\star}$, and $\bar{u}_j^{H\star}$ are indicator functions that take the value one if a worker born in H is employed at home, employed abroad, or unemployed abroad, respectively. If the worker is employed, then $n_j^H + n_j^{H\star} = 1$, and the worker experiences the disutility of labour χ regardless of the job location. Similarly, if a worker resides abroad - either employed or unemployed - then $n_j^{H\star} + \bar{u}_j^{H\star} = 1$, and the worker incurs the disutility υ.

Worker j maximizes expected lifetime utility:

$$V_{j,t} = \sum_{t=0}^{\infty} \beta^t U(c_{j,t}, n_{j,t}^H, n_{j,t}^{H\star}, \bar{u}_{j,t}^H, \bar{u}_{j,t}^{H\star} | \sigma, \chi, \upsilon_t, \bar{c}_{t-1}) \tag{3}$$

where β is the individual discount factor.

The utility function for a worker born in country F is analogous. The only difference is that the consumption basket $c^\star$ may differ from c, whereas the intertemporal elasticity of substitution and the discount factor are assumed to be identical across workers from the two countries.

Workers pool their income with other members of their native household,[12] Together with the separability of consumption, labour effort, and home attachment in the utility function, income pooling implies that all members of a household share the same marginal utility of wealth and therefore choose identical consumption levels, regardless of their employment status.

Importantly, workers are assumed to enter this insurance arrangement with members of their native household rather than with workers residing in the host country. This assumption introduces remittances into the model. In this framework, remittances reflect the constrained altruism motive described by Stark (1995).

Emigrants reside and supply labour abroad but invest and consume only in their home country. The resulting home bias in investment is attributed to the temporary nature of migration.[13] This assumption is consistent with empirical evidence of a home bias in the asset holdings of

[12]This corresponds to the existence of state-contingent securities that insure workers against fluctuations in individual income. It is a common assumption in models with labour market frictions, e.g. Merz (1995), and simplifies the aggregation of individual decisions.

[13]Binyamini and Razin (2008) and Engler (2009) similarly assume that emigrants transfer all their earnings to their home country. By contrast, Canova and Ravn (1998), and later Chortareas et al. (2008), assume that immigrants spend their earnings in the host economy but, being liquidity constrained, do not invest.

temporary migrants (Dustmann and Mestres, 2010).

The assumption that migrants purchase consumption goods exclusively in their home country is a modelling simplification, which is relaxed in the robustness analysis.[14]

The representative household in country H owns capital k and rents it to domestic firms, earning the return r^K. The household also owns domestic firms and receives their profits. In addition, it holds domestic government bonds that yield a nominal return r. These bonds are risk-free: they are paid at the beginning of period t, while their yield is known at time $t-1$.

The per capita budget constraint of the representative household in country H is given by:

$$c_t + i_t + \frac{b_t}{p_t} \leq \frac{W_t}{p_t} + r_t^K k_t + (1 + r_{t-1})\frac{b_{t-1}}{p_t} + \frac{\Theta_t}{p_t} - \frac{\tau_t}{p_t} - \frac{X_t}{p_t} + e_t^r \frac{X_t^\star}{p_t^\star} \tag{4}$$

where c denotes per capita consumption, i per capita investment, b per capita holdings of government bonds, and k the per capita capital stock. Θ denotes per capita firm profits, e^r is the real exchange rate, p the consumer price level in country H, and $p^\star$ the consumer price level in country F. The variables t and $t^\star$ represent the labour income tax rates in countries H and F, respectively, while τ denotes the per capita lump-sum tax levied on domestic households by the government.[15]

The variable X represents the per capita cost of migration incurred by workers born in H when moving between regions. These costs are assumed to be transferred to foreign households.[16] Similarly, $X^\star$ denotes the total migration costs incurred by workers born in country F, which are transferred to households in H. Finally, the representative household is subject to a standard non-Ponzi constraint on its bond holdings.

Employed workers born in H earn the wage w^H when working in their home country and $w^{H\star}$ when employed in country F. Unemployed workers born in H receive unemployment benefits

[14]This simplification may overstate the supply-side effects of immigration relative to its impact on aggregate demand, shift part of the home-bias effect from trade flows to remittances (while leaving the current account broadly unchanged), and imply that migration decisions are independent of price level differences between host and home economies.

[15]The labour income tax should be interpreted as the total tax wedge, including both taxes and social security contributions paid by employers and employees. This tax is included to allow increases in labour supply to raise government revenues in a setting where lump-sum taxes are paid only by natives.

[16]This transfer can approximate the presence of foreign ownership in sectors providing services to migrants, such as recruitment agencies, housing intermediaries, or transportation companies.

equal to ν^H when searching for work in the domestic labour market and $\nu^{H\star}$ when searching abroad. The labour income of the representative household in country H is therefore given by:

$$\frac{W_t}{p_t} = (1-t)\frac{w_t^H}{p_t}n_t^H + e_t^r(1-t^\star)\frac{w_t^{H\star}}{p^\star}n_t^{H\star} + \frac{\nu_t^H}{p_t}\bar{u}_t^H + e_t^r\frac{\nu_t^{H\star}}{p_t^\star}\bar{u}_t^{H\star} \tag{5}$$

Migration in the model is defined as the presence of natives of one country in the labour market of another country. It can be measured either by the emigration rate in the source country or by the immigration rate in the host country. The emigration rate in country H is defined as the share of temporary emigrants from H in the total population of that country:

$$\frac{n_t^{H\star} + u_t^{H\star}}{n_t^H + u_t^H + n_t^{H\star} + u_t^{H\star}} \tag{6}$$

The immigration rate in country H is defined as the ratio of temporary immigrants to the total number of residents in that country:

$$\frac{n_t^F + \bar{u}_t^F}{n_t^H + \bar{u}_t^H + n_t^F + \bar{u}_t^F} \tag{7}$$

When migration occurs, income transfers arise between the two economies. These transfers are interpreted as remittances and are defined as:

$$T_t = e_t^r(1-t^\star)\frac{w_t^{H\star}}{p_t^\star}n_t^{H\star} + e_t^r\frac{\nu_t^{H\star}}{p_t^\star}\bar{u}_t^{H\star} - (1-t)\frac{w_t^F}{p_t}n_t^F + \frac{\nu_t^F}{p_t}\bar{u}_t^F \tag{8}$$

2.2 International Financial Markets

Households in the home and foreign economies trade a complete set of state-contingent securities that deliver one unit of the home or foreign currency in each state of nature. Under this market structure, the marginal utility of consumption of households from country H is proportional to that of households from country F in every state of nature and at every point in time. The proportionality factor includes a wedge $\bar{\xi}$ reflecting differences in the initial distribution of wealth.

Under perfect risk sharing, the real exchange rate e^r is therefore given by

$$e_t^r = \bar{\xi}\frac{\lambda_t^\star}{\lambda_t} \tag{9}$$

where λ_t denotes the shadow value of consumption for households from H (the Lagrange multiplier associated with the household budget constraint (4)) and $\lambda_t^\star$ is the corresponding shadow value for households from F.[17]

2.3 The Cost of Adjusting Capital

The law of motion for the capital stock owned by the representative household in country H is given by:

$$k_{t+1} = (1-\delta)k_t + \big(1 - S(\frac{i_t}{i_{t-1}})\big)i_t \tag{10}$$

where δ denotes the depreciation rate of capital. The function $S(\cdot)$ describes the technology through which current and past investment are transformed into installed capital.

The function $S(\cdot)$ captures capital adjustment costs and takes the form:

$$S(\frac{i_t}{i_{t-1}} - 1) = \frac{\bar{S}}{2}(\frac{i_t}{i_{t-1}} - 1)^2 \tag{11}$$

When $\bar{S} > 0$, this specification satisfies the conditions proposed by Christiano et al. (2005), namely $S(1) = S'(1) = 0$ and $S''(1) > 0$.

2.4 Production Sector

2.4.1 Final Goods Firms

The final good Y is produced by perfectly competitive firms that aggregate intermediate goods produced domestically, y^H, and imported goods, y^F, according to:

[17] Perfect risk sharing guarantees the stationarity of the real exchange rate and simplifies the solution of the bargaining problem between firms and immigrant workers. Schmitt-Grohe and Uribe (2003) show that models with perfect risk sharing display business-cycle properties similar to those obtained under alternative mechanisms such as foreign-debt elastic risk premia, discount factors that depend on consumption, or convex portfolio adjustment costs.

$$Y_t = \left(a^{\frac{1}{\phi}}(y_t^H)^{\frac{\phi-1}{\phi}} + (1-a)^{\frac{1}{\phi}}(y_t^F)^{\frac{\phi-1}{\phi}}\right)^{\frac{\phi}{\phi-1}} \tag{12}$$

Domestic and imported goods are imperfect substitutes with elasticity of substitution ϕ. When $a > 0.5$, consumer preferences exhibit home bias toward domestically produced goods.

The final good is used for private consumption c, investment i, and government consumption g:

$$Y_t = c_t + i_t + g_t \tag{13}$$

Cost minimization by final goods producers implies the following demand functions for domestic and imported goods. Demand for domestic goods is given by:

$$a(\frac{p_t^H}{p_t})^{-\phi}Y_t \tag{14}$$

while demand for foreign goods is:

$$(1-a)(\frac{p_t^F}{p_t})^{-\phi}Y_t \tag{15}$$

Intermediate goods consist of differentiated varieties produced by monopolistically competitive firms. The composite domestic and foreign intermediate goods are defined as:

$$y_t^H = ((\frac{1}{\iota})^{\frac{1}{\epsilon}}\int_0^{\iota}(y_{i,t}^H)^{\frac{\epsilon-1}{\epsilon}}di)^{\frac{\epsilon}{\epsilon-1}} \tag{16}$$

$$y_t^F = ((\frac{1}{1-\iota})^{\frac{1}{\epsilon^\star}}\int_{\iota}^{1}(y_{i,t}^F)^{\frac{\epsilon^\star-1}{\epsilon^\star}}di)^{\frac{\epsilon^\star}{\epsilon^\star-1}} \tag{17}$$

The number of monopolistically competitive firms is normalized to ι in country H and $1-\iota$ in country F. The parameter ϵ denotes the elasticity of substitution between varieties produced in H, while $\epsilon^\star$ denotes the elasticity of substitution between varieties produced in F. Following Corsetti et al. (2008), it is assumed that ϕ is relatively low and, in particular, smaller than the elasticity of substitution between varieties produced within each country. This assumption captures the product specialization observed across economies.

The price of the domestic intermediate goods bundle in country H, denoted by p^H, is defined as the minimum expenditure required to purchase one unit of the composite good y^H:

$$p_t^H = \left((\frac{1}{\iota}) \int_0^{\iota} (p_{i,t}^H)^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}} \tag{18}$$

Similarly, the price index for imported intermediate goods in H, denoted by p^F, is:

$$p_t^F = \left((\frac{1}{1-\iota}) \int_{\iota}^{1} (p_{i,t}^F)^{1-\epsilon^\star} di \right)^{\frac{1}{1-\epsilon^\star}} \tag{19}$$

Finally, the price of the final consumption good produced in country H is given by:

$$p_t = \left(a(p_t^H)^{1-\phi} + (1-a)(p_t^F)^{1-\phi} \right)^{\frac{1}{1-\phi}} \tag{20}$$

2.4.2 Intermediate Goods Producing Firms

Intermediate good firm i employs labour and rents capital to produce a differentiated good according to the production function:

$$y_{i,t} = A_t n_{i,t}^{\alpha} k_{i,t}^{1-\alpha} \tag{21}$$

The aggregate total factor productivity index evolves according to:

$$A_t = h_A A_{t-1} + (1-h_A)A + \epsilon_{A,t} \tag{22}$$

where A denotes the steady-state level of total factor productivity and $\epsilon_{A,t}$ is an exogenous productivity shock with standard deviation σ^A.

Firms may employ either native or immigrant workers. As argued by Ottaviano and Peri (2006), immigrant and native workers may differ due to the selectivity of migration processes, which may result in differences in skills, motivations, or occupational choices. These differences may arise from culture-specific traits or from sorting across labour market segments. To capture this possibility, natives and immigrants are assumed to be close but imperfect substitutes in production. The elasticity of substitution between them is therefore assumed to be large but finite, with $\rho < +\infty$ representing the inverse of the elasticity. Aggregate labour input is defined as:

$$n_{i,t} = \left((n_{i,t}^{H})^{1-\rho} + \omega(n_{i,t}^{F}\right)^{1-\rho})^{\frac{1}{1-\rho}} \tag{23}$$

where ω captures potential productivity differences between immigrants and native workers performing similar tasks. In particular, $\omega < 1$ may reflect incomplete transferability of country-specific skills and work experience (Chiswick, 1978), as well as the lower incentives of temporary migrants to invest in host-country-specific human capital when their expected duration of stay is limited (Dustmann, 1993; 2000).

Each firm produces a differentiated variety and operates in a monopolistically competitive market, implying a downward-sloping demand curve for its product. Firms set prices taking local demand conditions into account, which results in pricing-to-market behaviour. Demand for variety i in the domestic market is given by:

$$y_{i,t}^{H} = (\frac{1}{\iota})(\frac{p_{i,t}^{H}}{p_{t}^{H}})^{-\epsilon} y_{t}^{H} \tag{24}$$

while export demand is:

$$y_{i,t}^{H\star} = (\frac{1}{1-\iota})(\frac{p_{i,t}^{H\star}}{p_{t}^{H\star}})^{-\epsilon} y_{t}^{H\star} \tag{25}$$

where y_{i}^{H} denotes domestic sales, $y_{i}^{H\star}$ exports, and total production satisfies $y_{i,t} = y_{i,t}^{H} + y_{i,t}^{H\star}$.

Firms face quadratic costs of adjusting prices, following the formulation proposed by Rotemberg (1982).[18] Steady-state inflation is assumed to be zero in both economies. The price adjustment costs are given by:

[18]Using the Rotemberg (1982) specification instead of Calvo (1983) eliminates price dispersion across firms and simplifies aggregation when wage and price setting occur within the same firm.

$$\psi_{i,t}^{H} = \frac{\bar{\psi}}{2}(\frac{p_{i,t}^{H}}{p_{i,t-1}^{H}} - 1)^2 \quad (26)$$

$$\psi_{i,t}^{H\star} = \frac{\bar{\psi}^{\star}}{2}(\frac{p_{i,t}^{H\star}}{p_{i,t-1}^{H\star}} - 1)^2 \quad (27)$$

The parameter $\bar{\psi}$ governs the degree of price rigidity in country H, while $\bar{\psi}^{\star}$ governs price rigidity in country F. These adjustment costs apply equally to domestically and foreign-owned firms; hence nominal rigidities are country-specific rather than firm-specific.

2.5 The Cost of Adjusting Employment

In each period, m^H new jobs for natives and m^F new jobs for immigrants are created. Newly hired workers begin participating in production within the same period in which they are employed, as in Blanchard and Gali (2008) and Gertler et al. (2008).[19]

At the end of each period, jobs are exogenously destroyed at rate s. The number of jobs held by native workers at firm i evolves according to:

$$n_{i,t}^{H} = (1-s)n_{i,t-1}^{H} + m_{i,t}^{H} \quad (28)$$

and an analogous law of motion holds for immigrant workers:

$$n_{i,t}^{F} = (1-s)n_{i,t-1}^{F} + m_{i,t}^{F} \quad (29)$$

2.6 Profits

Let $R_{i,t}^{H} = p_{i,t}^{H} y_{i,t}^{H}$ denote the revenues of firm i from sales in the domestic market, and $R_{i,t}^{H\star} = e_t^r \frac{p_t}{p_t^\star} p_{i,t}^{H\star} y_{i,t}^{H\star}$ the revenues from exports. Total firm revenues are therefore given by $R_{i,t} = R_{i,t}^{H} + R_{i,t}^{H\star}$.

[19] Assuming instantaneous employment adjustment - either as specified here or through endogenous job destruction as in Krause and Lubik (2007) - helps reconcile search-and-matching labour market dynamics with observed price stickiness. Moreover, Walque et al. (2009) argue that representing employment as a jump variable is appropriate in models calibrated at lower frequencies, such as quarterly frequency.

To recruit workers, firms post vacancies at a cost proportional to revenues, expressed as a fraction $\bar{\kappa}$ of total revenues. The instantaneous profit function of firm i is therefore:

$$\frac{\Theta_{i,t}}{p_t^H} = \frac{R_{i,t}}{p_t^H} - \frac{w_{i,t}^H}{p_t^H} n_{i,t}^H - \frac{w_{i,t}^F}{p_t^H} n_{i,t}^F - \psi_{i,t}^H \frac{R_{i,t}^H}{p_t^H} - \psi_{i,t}^{H\star} \frac{R_{i,t}^{H\star}}{p_t^H} - \bar{\kappa} v_{i,t} \frac{R_{i,t}}{p_t^H} - \frac{p_t}{p_t^H} r_t^K k_{i,t} \tag{30}$$

The firm chooses $p^H i, t, p^{H\star} i, t, n^H i, t, n^F i, t, v_{i,t}, k_{i,t}$ to maximize expected discounted profits:

$$E_0 \sum \tilde{\Lambda}_{t,0} \frac{\Theta_{i,t}}{p_t^H} \tag{31}$$

subject to the demand constraints (24) - (25), the technological constraints (21) - (23), and the employment dynamics (28) - (29).

The firm's stochastic discount factor is given by:

$$\tilde{\Lambda}_{t,s} = \beta^{t-s} \frac{\lambda_t}{\lambda_s} \frac{p_t^H}{p_s^H} (\frac{p_t}{p_s})^{-1} = \Lambda_{t,s} \frac{p_t^H}{p_s^H} (\frac{p_t}{p_s})^{-1} \tag{32}$$

2.7 Labour market

2.7.1 Matching Technology

Firms post vacancies without knowing whether they will be matched with native or immigrant workers. Consequently, the probability that a worker is matched with a job depends only on the total number of unemployed workers and the number of vacancies in the economy, and not on worker nationality.

The matching process is described by a constant-returns-to-scale matching function:

$$m(u_t, v_t) = \bar{m} u_t^{\varsigma} v_t^{1-\varsigma} \tag{33}$$

Let labour market tightness be defined as $\theta_t = \frac{v_t}{u_t}$. Firms meet unemployed workers at rate:

$$q(\theta_t) = \frac{m(u_t, v_t)}{v_t} \tag{34}$$

while unemployed workers find employment with probability $\theta_t q(\theta_t)$.[20]

2.7.2 Labour Demand and Vacancies

Firms learn the nationality of a worker only during wage bargaining. The expected profit from a newly created job therefore depends on both worker productivity and wages, the latter reflecting the worker's outside option.

The first-order conditions determining labour demand for native and immigrant workers at firm i are:

$$J^H_{i,t} = \alpha mc_{i,t}\frac{y_{i,t}}{n_{i,t}}\left(\frac{n_{i,t}}{n^H_{i,t}}\right)^{\rho} - \frac{w^H_{i,t}}{p^H_t} + E_t\big(\tilde{\Lambda}_{t+1,t}(1-s)J^H_{i,t+1}\big) \tag{35}$$

$$J^F_{i,t} = \alpha\omega mc_{i,t}\frac{y_{i,t}}{n_{i,t}}\left(\frac{n_{i,t}}{n^F_{i,t}}\right)^{\rho} - \frac{w^F_{i,t}}{p^H_t} + E_t\big(\tilde{\Lambda}_{t+1,t}(1-s)J^F_{i,t+1}\big) \tag{36}$$

where mc is the Lagrange multiplier associated with the production constraints (21) - (23), J^H denotes the multiplier on the employment law of motion for natives (28), and J^F the multiplier associated with immigrant employment (29).

Firms observe the composition of unemployment in the labour market. Let η_t denote the share of unemployed natives among all unemployed workers searching in the labour market of country H:

$$\eta_t = \frac{u^H_t}{u^H_t + u^F_t} \tag{37}$$

Firms post vacancies until the expected value of a filled vacancy equals the cost of posting it. The vacancy posting condition is therefore:

$$\frac{\kappa_{i,t}}{q(\theta_t)} = \eta_t J^H_{i,t} + (1-\eta_t)J^F_{i,t} \tag{38}$$

where $\kappa_{i,t} = \bar{\kappa}\frac{R_{i,t}}{p^H_t}$ and the left-hand side represents the expected cost of filling a vacancy. The

[20]The assumption that firms cannot distinguish between natives and immigrants also implies equal employment and unemployment rates for both groups, i.e. $\frac{u_t}{n_t+u_t} = \frac{u^H_t}{n^H_t+u^H_t} = \frac{u^F_t}{n^F_t+u^F_t}$.

right-hand side captures the expected value of a match.

The dependence of labour demand on the expected value of jobs filled by natives and immigrants introduces an additional externality in the model. If immigrant workers have weaker outside options relative to their productivity, the net surplus from employing them may be higher. In such a case, an inflow of immigrants raises the expected value of a vacancy and may increase the demand for both types of labour following an immigration wave.

2.7.3 Labour Supply

The value function of a household member employed by local firm i in country H is given by:

$$\begin{aligned} W_{i,t}^{H} =&(1-t)\frac{w_{i,t}^{H}}{p_t} - \frac{\chi}{\lambda_t} + \\ & E_t\Big(\Lambda_{t+1,t}\big((1-s)W_{i,t+1}^{H} + s_t(1-\theta_{t+1}q(\theta_{t+1}))V_{t+1}^{H} + s\theta_{t+1}q(\theta_{t+1})W_{t+1}^{H}\big)\Big) \end{aligned} \tag{39}$$

where V^H denotes the value function of an unemployed household member searching for work in the domestic labour market. The value function of a worker born in H and employed abroad has an analogous form, but includes the additional disutility term $-\frac{\upsilon_t}{\lambda_t}$ reflecting home attachment:

$$\begin{aligned} W_{i,t}^{H\star} =&e_t^r(1-t^\star)\frac{w_{i,t}^{H\star}}{p_t^\star} - \frac{\chi}{\lambda_t} - \frac{\upsilon_t}{\lambda_t} + \\ & E_t\Big(\Lambda_{t+1,t}\big((1-s^\star)W_{i,t+1}^{H\star} + s^\star(1-\theta_{t+1}^\star q(\theta_{t+1}^\star))V_{t+1}^{H\star} + s_t^\star\theta_{t+1}^\star q(\theta_{t+1}^\star)W_{t+1}^{H\star}\big)\Big) \end{aligned} \tag{40}$$

The value function of an unemployed worker searching for a job at home is:

$$V_t^H = \frac{\nu_t^H}{p_t} - \frac{x_t^H}{p_t} + E_t\Big(\Lambda_{t+1,t}\big(\theta_{t+1}q(\theta_{t+1})(W_{t+1}^H - V_{t+1}^H) + V_{t+1}^H\big)\Big) \tag{41}$$

where x^H denotes the marginal nominal cost of moving from F to H for a worker born in H, $\frac{\partial X}{\partial \bar{u}^H}$.

The value function of a worker born in H and searching for work abroad is:

$$V_t^{H\star} = e_t^r \frac{\nu_t^{H\star}}{p_t^\star} - \frac{\upsilon_t}{\lambda_t} - \frac{x_t^{H\star}}{p_t} + E_t\Big(\Lambda_{t+1,t}(\theta_{t+1}^\star q(\theta_{t+1}^\star)(W_{t+1}^{H\star} - V_{t+1}^{H\star}) + V_{t+1}^{H\star})\Big) \tag{42}$$

where $x^{H\star}$ is the marginal nominal cost of emigration for a worker from H.

2.7.4 Wages

Workers and firms bargain over wages and split the match surplus along with the Nash bargaining scheme:

$$max(W_{i,t}^H - V_t)^\mu (\frac{p_t^H}{p_t} J_{i,t}^H)^{1-\mu} \tag{43}$$

where μ denotes the worker's share of the surplus from a job match. The parameter μ is country-specific, so natives and immigrants receive the same share of the match surplus within a given country.

The Nash bargaining solution implies:

$$W_{i,t}^H - V_t = (\frac{\mu}{1-\mu})(\frac{p_t^H}{p_t} J_{i,t}^H) \tag{44}$$

The negotiated real wage, denoted by a tilde, is given by:

$$\begin{aligned} \frac{\tilde{w}_{i,t}^H}{p_t} =& (1-\bar{\mu})(1-t)^{-1}(\frac{\nu_t^H}{p_t} + \frac{\chi}{\lambda_t} - \frac{x_t^H}{p_t}) + \\ & \bar{\mu}\frac{p_t^H}{p_t}(mc_{i,t}\alpha\frac{y_{i,t}}{n_{i,t}}(\frac{n_{i,t}}{n_{i,t}^H})^\rho + \theta_{t+1}q(\theta_{t+1})(1-s)E_t(\tilde{\Lambda}_{t+1,t}J_{t+1}^H)) \end{aligned} \tag{45}$$

where $\bar{\mu} = \mu((1-\mu)(1-t)+\mu)^{-1}$. The negotiated wage is increasing in worker productivity, the disutility of labour, and the outside option of the unemployed worker. The latter depends not only on the level of unemployment benefits ν^H, but also on the probability of finding a new job, i.e. on labour market tightness θ.

Equation (45) also highlights the sources of wage differences between natives and immigrants. First, the two groups may differ in their entitlement to unemployment benefits. Second, if immigrants originate from a poorer country, their marginal utility of consumption λ may be higher than that of natives, increasing their willingness to work at a given wage.

To generate sufficient volatility in employment and vacancies, the model incorporates a simple form of wage rigidity (Hall, 2005; Shimer, 2005; Costain and Reiter, 2008). As in Blanchard and Gali (2007) and Duval and Vogel (2012), persistence in real wages is introduced in an ad hoc manner. That is, wage inertia is assumed to arise from ex post distortions rather than from the underlying structure of preferences or technology, and therefore does not enter the dynamic optimization problems of households or firms. The actual wage of a worker born in H and employed in H is a weighted average of the Nash-bargained wage and the previous period's wage:[21]

$$\frac{w_{i,t}^H}{p_t} = \vartheta \frac{w_{i,t-1}^H}{p_{t-1}} + (1-\vartheta)\frac{\tilde{w}_{i,t}^H}{p_t} \tag{46}$$

2.7.5 Migration Flows

After the worker-job matching process, there remain $(1-\theta q(\theta))u^H$ unemployed natives and $(1-\theta q(\theta))u^F$ unemployed immigrants in country H. Similarly, in country F there remain $(1-\theta^\star q(\theta^\star))u^{F\star}$ unemployed natives and $(1-\theta^\star q(\theta^\star))u^{H\star}$ unemployed foreigners. At this stage, unemployed workers decide whether to remain in their current country of residence or move abroad. The following equilibrium conditions therefore hold:

$$\bar{u}_t^H + \bar{u}_t^{H\star} = (1-\theta_t q(\theta_t))u_t^H + (1-\theta_t^\star q(\theta_t^\star))u_t^{H\star} \tag{47}$$

$$\bar{u}_t^{F\star} + \bar{u}_t^F = (1-\theta_t^\star q(\theta_t^\star))u_t^{F\star} + (1-\theta_t q(\theta_t))u_t^F \tag{48}$$

Workers move across regions in order to maximize expected income. International migration therefore arises in equilibrium when $V_t^H = V_t^{H\star}$ or $V_t^{F\star} = V_t^F$. If both $V_t^H > V_t^{H\star}$ and $V_t^{F\star} > V_t^F$ hold, there is no labour migration. In the two corner cases, $V_t^H < V_t^{H\star}$ or $V_t^{F\star} < V_t^F$, all workers born in H migrate to F, or all workers born in F migrate to H, respectively.

An important implication is that when either arbitrage condition, $V_t^H = V_t^{H\star}$ or $V_t^{F\star} = V_t^F$,

[21] A similar form of wage dynamics can arise from microfoundations such as staggered real wage setting (Bodart et al., 2005) or from the interaction of price and nominal wage stickiness (Erceg et al., 2000; Knell, 2013).

is binding, emigration flows and wages in the source country are positively correlated. Workers emigrate when the expected income abroad is sufficiently high. This raises the reservation wage of unemployed stayers and may, in turn, feed through into higher wages in the source economy.

Cross-border migration entails costs, such as those associated with finding accommodation abroad, travel, or the recognition and translation of documents certifying education and work experience. These relocation costs are specified analogously to capital adjustment costs and increase with the number of workers attempting to move at a given point in time:[22]

$$\frac{X_t}{p_t} = \frac{\bar{x}}{2}\Big(\bar{u}_t^H - \big(1-\theta_t q(\theta_t)\big)u_t^H\Big)^2 e_t^r \frac{w_t^\star}{p_t^\star} = \frac{\bar{x}}{2}\Big(\bar{u}_t^{H\star} - \big(1-\theta_t^\star q(\theta_t^\star)\big)u_t^{H\star}\Big)^2 e_t^r \frac{w_t^\star}{p_t^\star} \tag{49}$$

Therefore, the marginal migration costs entering the value functions (41) and (42) are given by:

$$\frac{x_t^H}{p_t} = -\frac{x_t^{H\star}}{p_t} = \bar{x}(\bar{u}_t^H - (1-\theta_t q(\theta_t))u_t^H)e_t^r \frac{w_t^\star}{p_t^\star} \tag{50}$$

2.8 Monetary and Government Policy

2.8.1 The Monetary Authority

The monetary authority in country in H targets zero steady-state inflation and follows a Taylor rule:

$$r_t = h_r r_{t-1} + (1-h_r)(r + h_\pi \pi_t) \tag{51}$$

The parameter h_r governs the degree of interest rate smoothing, h_π captures the responsiveness of monetary policy to deviations of inflation from target, and r denotes the steady-state nominal interest rate.

[22]Introducing these costs smooths the dynamic response of temporary migration to shocks.

2.8.2 The Government

The government purchases final goods, transfers unemployment benefits to households, issues bonds, and levies income and lump-sum taxes. Government bonds are in zero net supply in the domestic economy. The government's period-by-period budget constraint is given by:

$$g_t + \frac{\nu_t^H}{p_t}\bar{u}_t^H + \frac{\nu_t^F}{p_t}\bar{u}_t^F + \frac{b_{t-1}}{p_t}(1+r_t) = \frac{\tau_t}{p_t} + \frac{b_t}{p_t} + t(\frac{w_t^H}{p_t}n_t^H + \frac{w_t^F}{p_t}n_t^F) \tag{52}$$

Government consumption is assumed to be proportional to aggregate demand, with $\bar{g}$ denoting the ratio of government consumption to private absorption:

$$g_t = h_g g_{t-1} + (1-h_g)\bar{g}(c_t + i_t) \tag{53}$$

where h_g governs the degree of inertia in government spending. The fiscal feedback rule for lump-sum (non-distortionary) taxes ensures the government's intertemporal solvency:

$$\frac{\tau_t}{p_t} = h_\tau \frac{\tau_{t-1}}{p_{t-1}} + (1-h_\tau)(\frac{\tau}{p} + h_b \frac{b_{t-1}}{p_t}) \tag{54}$$

where h_τ introduces persistence in fiscal adjustment and h_b determines the extent to which the government stabilizes the debt-to-output ratio around its zero target level.

Finally, unemployment benefits are assumed to be proportional to the average wage in the economy, w:

$$\nu_t^H = \bar{\nu}^H w_t \qquad \nu_t^F = \bar{\nu}^F w_t \tag{55}$$

The effective replacement rates, $\bar{\nu}$, are allowed to differ between natives and immigrants. This captures potential differences in demographic characteristics, limited knowledge of the welfare system among temporary migrants, shorter contributory histories, or explicit restrictions on non-natives' access to certain benefits, for example when immigrants become eligible for some transfers only after a minimum period of residence.

2.9 Aggregate Equilibrium

In equilibrium, capital markets clear:

$$k_t = \int_0^{\iota} k_{i,t} di \tag{56}$$

Aggregate employment of natives and immigrants is given by:

$$n_t^H = \int_0^{\iota} n_{i,t}^H di \qquad n_t^F = \int_0^{\iota} n_{i,t}^F di \tag{57}$$

The total number of vacancies equals:

$$v_t = \int_0^{\iota} v_{i,t} di \tag{58}$$

while that of newly created jobs:

$$m_t^H = \int_0^{\iota} m_{i,t}^H di \qquad m_t^F = \int_0^{\iota} m_{i,t}^F di \tag{59}$$

The aggregate employment dynamics follow:

$$n_t^H = (1-s) n_{t-1}^H + m_t^H \tag{60}$$

$$n_t^F = (1-s) n_{t-1}^F + m_t^F \tag{61}$$

Workers who were unmatched in the previous period, together with workers whose jobs are destroyed in the current period, enter the unemployment pool:

$$u_t^H = \bar{u}_{t-1}^H + s n_{t-1}^H \tag{62}$$

$$u_t^F = \bar{u}_{t-1}^F + s n_{t-1}^F \tag{63}$$

In addition, the following equilibrium condition holds:

$$\bar{u}_t^H + \bar{u}^{H\star} = \iota - n_t^H - n_t^{H\star} \tag{64}$$

Aggregate firm profits are given by:

$$\frac{\Theta_t}{p_t} = \frac{p_t^H}{p_t} \int_0^\iota \frac{\Theta_{i,t}}{p_t^H} di \tag{65}$$

Market clearing in the final goods sector implies:

$$a(\frac{p_t^H}{p_t})^{-\phi} Y_t = \int_0^\iota y_{i,t}^H di - \int_0^\iota \psi_{i,t}^H y_{i,t}^H di - \int_0^\iota \bar{\kappa}_t y_{i,t}^H v_{i,t} di \tag{66}$$

$$(1-a^\star)(\frac{p_t^{H\star}}{p_t^\star})^{-\phi^\star} Y_t^\star = \int_0^\iota y_{i,t}^{H\star} di - \int_0^\iota \psi_{i,t}^{H\star} y_{i,t}^{H\star} di - \int_0^\iota \bar{\kappa}_t y^H \tag{67}$$

$$a^\star(\frac{p_t^{F\star}}{p_t^\star})^{-\phi^\star} Y_t^\star = \int_{1-\iota}^1 y_{i,t}^{F\star} di - \int_{1-\iota}^1 \gamma_{i,t}^{F\star} di - \int_{1-\iota}^1 \bar{\kappa}_t^\star y_{i,t}^{F\star} v_{i,t}^\star di \tag{68}$$

$$(1-a)(\frac{p_t^F}{p_t})^{-\phi} Y_t = \int_{1-\iota}^1 y_{i,t}^F di - \int_{1-\iota}^1 \gamma_{i,t}^F di - \int_{1-\iota}^1 \bar{\kappa}_t^\star y_{i,t}^F v_{i,t}^\star di \tag{69}$$

2.10 Symmetric Equilibrium

In a symmetric equilibrium, all firms charge identical prices and produce the same quantity of output. Consequently,

$$p_{i,t}^H = p_t^H \tag{70}$$

$$\frac{p_{i,t}^H}{p_{i,t-1}^H} = \frac{p_t^H}{p_{t-1}^H} = \pi_t + 1 \tag{71}$$

$$\psi_{i,t}^H = \psi_t^H \tag{72}$$

$$y_{i,t}^H = \iota^{-1} y_t^H \tag{73}$$

Firms therefore employ identical quantities of labour and capital,

$$n_{i,t} = \iota^{-1} n_t \tag{74}$$

$$k_{i,t} = \iota^{-1} k_t \tag{75}$$

and post the same number of vacancies,

$$v_{i,t} = \iota^{-1} v_t \tag{76}$$

The cost of posting a vacancy becomes:

$$\kappa_{i,t} = \kappa_t = \bar{\kappa}\iota^{-1}(y_t^H + e_t \frac{p_t^{H\star}}{p_t^H} y_t^{H\star}) \tag{77}$$

Under symmetry, the goods market clearing conditions (66)-(69) simplify to:

$$a(\frac{p_t^H}{p_t})^{-\phi}(c_t + i_t + g_t) = y_t^H - \frac{\bar{\psi}}{2}(\pi_t^H)^2 y_t^H - \bar{\kappa}\iota^{-1} v_t y_t^H \tag{78}$$

$$(1-a^\star)(\frac{p_t^{H\star}}{p_t^\star})^{-\phi^\star}(c_t^\star + i_t^\star + g_t^\star) = y_t^{H\star} - \frac{\bar{\psi}^\star}{2}(\pi_t^{H\star})^2 y_t^{H\star} - \bar{\kappa}\iota^{-1} v_t y_t^{H\star} \tag{79}$$

$$a^\star(\frac{p_t^{F\star}}{p_t^\star})^{-\phi^\star}(c_t^\star + i_t^\star + g_t^\star) = y_t^{F\star} - \frac{\bar{\psi}^\star}{2}(\pi_t^{F\star})^2 y_t^{F\star} - \bar{\kappa}^\star(1-\iota)^{-1} v_t^\star y_t^{F\star} \tag{80}$$

$$(1-a)(\frac{p_t^F}{p_t})^{-\phi}(c_t + i_t + g_t) = y_t^F - \frac{\bar{\psi}}{2}(\pi_t^F)^2 y_t^F - \bar{\kappa}^\star(1-\iota)^{-1} v_t^\star y_t^F \tag{81}$$

3 Model Calibration

The model is calibrated for the NMS12 as the home country and the EU15 as the foreign country. Depending on parameter values, the model can be solved for a steady state either with or without temporary migration. Table 1 summarizes the calibration of the model parameters.

The calibration strategy proceeds from the closed-border to the open-border version of the model. First, the parameters governing emigration preferences are set sufficiently high to eliminate labour migration in the steady state. Next, I use macroeconomic data, existing empirical estimates, and standard parameter values from the literature complete the calibration of the closed-economy version of the model. Parameters affecting only the short-run dynamics are calibrated accordingly. Third, the value of the home-attachment parameter in the NMS12 is reduced, while keeping all other parameters unchanged, so that the steady-state solution matches an immigration rate of 1.5% in the EU15[23] and zero immigration in the NMS12. By construction, therefore, the two model versions differ only in the parameters governing emigration preferences.

The share of NMS12 workers in the total EU population is set at 21%, based on Labour Force Survey (LFS) data on the working-age population in EU Member States averaged over the period 2000-2004.[24] Consequently, an immigration rate of 1.5% in the EU15 corresponds to a steady-state temporary emigration rate of 5.7% in the NMS12.

3.1 Household Preferences

A model period corresponds to one quarter and the discount factor β is set equal to 0.99. The intertemporal elasticity of substitution is set to 1.1. The home-bias parameters are calibrated to match the import content of domestic demand.

Taking into account both the direct and indirect use of imports from the NMS12, the share of such imports in EU15 domestic demand is approximately 1%. The corresponding share of EU15 imports in NMS12 domestic demand is approximately 10%.[25]

The habit formation parameter for the EU15 is set to 0.65, corresponding to the average estimate for the euro area.[26] The habit formation parameter for the NMS12 is set to 0.7,

[23] According to Labour Force Survey (LFS) data, between 2005 and 2008 the share of NMS12 citizens in the EU15 population increased from 0.7% to 1.2%. Comparable data for earlier years are not available for all "old" Member States. However, in some EU15 countries the increase in NMS12 immigration was much larger; for example, in the UK the share rose from 0.6% in 2005 to 1.7% in 2008.

[24] Immigrants from outside the EU to both the EU15 and the NMS12 are treated as part of the native populations.

[25] Information on the import content of domestic demand is obtained from Eurostat input-output tables. The statistics are collected for: France, Germany, Denmark and Finland for 2002-2005; Italy, Spain, Austria, Portugal, Sweden, Ireland, the Czech Republic, Estonia, Hungary and Slovenia for 2005; Romania for 2003-2006; and the Netherlands for 2002. The resulting 33 observations are pooled and regressed on time-varying import-to-GDP ratios. The regression explains 63% of the variation in import intensities and is used to approximate the import content of domestic demand for EU Member States and years where input-output tables are unavailable. The estimated import intensity of domestic demand equals roughly 10% for the EU15 and 14% for the NMS12. These figures are then multiplied by the share of imports from the NMS12 in EU15 imports and the share of imports from the EU15 in NMS12 imports.

[26] References to euro-area estimates throughout the text refer to the Bayesian estimates reported by Smets and Wouters (2003), Smets and Wouters (2005), Pytlarczyk (2005), Adolfson et al. (2007), and Kolasa (2009).

reflecting higher estimates obtained for Poland and Hungary relative to the euro area.[27]

The disutility of labour parameters, $\chi^\star$ and χ, are chosen to match steady-state unemployment rates of 7.9% in the EU15 and 12.1% in the NMS12 (in the version of the model without labour migration). The implied probability of filling a vacancy is 57% in the EU15 and 77% in the NMS12, while the probability of finding a job is 30% and 20%, respectively.

The standard deviation of emigration preference shocks is set such that the steady-state response implies a one-percentage-point change in the emigration rate in the NMS12.

The elasticity of output with respect to labour in the Cobb-Douglas production function is set equal to the empirical labour income share in GDP. Total factor productivity in the NMS12 is normalized to one, while productivity in the EU15 is calibrated to match the average EU15-to-NMS12 labour productivity ratio observed during 1997-2008. The persistence and standard deviation of productivity shocks in the EU15 follow the average estimates obtained from euro-area DSGE models, while the corresponding parameters for the NMS12 are calibrated using estimates for Poland and Hungary.

3.2 Production

The elasticity of output with respect to labour in the Cobb-Douglas production function is set equal to the empirical labour income share in GDP. Total factor productivity in the NMS12 is normalized to one, while productivity in the EU15 is calibrated to match the average EU15-to-NMS12 labour productivity ratio observed during 1997-2008. The persistence and standard deviation of productivity shocks in the EU15 follow the average estimates obtained from euro-area DSGE models, while the corresponding parameters for the NMS12 are calibrated using estimates for Poland and Hungary.

Ottaviano and Peri (2008) and D'Amuri et al. (2010) estimate the elasticity of substitution between immigrants and natives to be around 20 for the U.S. and Germany, respectively.[28]

[27] Calibration of NMS12 parameters relies on Bayesian estimates reported by Jakab and Világi (2008) and Jakab and Konya (2016) for Hungary and by Kolasa (2009) for Poland.

[28] The estimates reported by Ottaviano and Peri (2008) refer to substitutability within education-experience groups and remain robust to the methodological critique by Borjas et al. (2006). Other studies report lower estimates; for example, Manacorda et al. (2012) find elasticities in the range of 5-10 for the UK. By contrast, Borjas et al. (2006), Borjas et al. (2008), and Aydemir and Borjas (2006) assume perfect substitutability between natives and immigrants within narrowly defined skill groups.

In these empirical approaches, a lower estimated elasticity typically corresponds to a smaller negative impact of immigration on native wages, because labour demand externalities are not explicitly modeled. To account for such externalities in the present model while remaining broadly consistent with the empirical evidence, the elasticity of substitution is set to a higher value of 30.

The value of ω is calibrated jointly with the location preference parameters χ and $\chi^\star$ so that the following conditions are satisfied in the open-border version of the model:[29] the immigration rate equals 1.5% in the EU15 and zero in the NMS12; immigrant wages in the EU15 are approximately 26% lower than those of natives; and the nominal wages of emigrants from the NMS12 are roughly twice as high as those of stayers. The 26% wage gap between NMS immigrants and natives corresponds to estimates reported by Brücker et al. (2009) for immigration waves to the UK before 2004. It is also close to the estimates of Barrett and McCarthy (2007b) and Barrett and McCarthy (2007a) for Ireland (around 31%), although smaller than the estimate reported by Brücker et al. (2009) for post-2004 immigration waves to the UK (42.5%).[30] The assumption that emigrants earn roughly twice as much as stayers is also consistent with the findings of Budnik (2009) for Polish migrants to the UK.

3.3 Market Structure

Markups in the two economies are assumed to be 20%, in line with Rotemberg and Woodford (1992) and consistent with the evidence on manufacturing markups in OECD countries reported by Martins et al. (1996). The elasticity of substitution between goods produced within a country, $\epsilon^\star$ and ϵ, is set to 6. Following Benigno and Thoenissen (2008), the elasticity of substitution between domestically and foreign-produced goods is set at a lower value, namely 2.

The price stickiness parameters $\bar{\gamma}^\star$ and $\bar{\gamma}$ are set to 20. This assumption implies a Phillips curve slope of 0.30, which is consistent with survey evidence on price stickiness in European

[29] The parameter $\omega^\star$ is set equal to ω, although it does not play an active role in the simulations considered.

[30] The wage gap between immigrants and natives documented by Brücker et al. (2009) largely reflects differences in returns to skills and the unequal distribution of workers across sectors and occupations. Approximately 20 percentage points of the wage gap can be explained by the overrepresentation of immigrants in low-paid jobs. Occupational sorting of recent NMS12 immigrants in the UK is also discussed by Dustmann et al. (2013) and Drinkwater et al. (2009). Barrett and McCarthy (2007b) and Barrett and McCarthy (2007a) emphasize the role of lower returns to foreign education and work experience in explaining the immigrant-native wage gap in Ireland.

countries summarized by Druant et al. (2009).[31] The chosen value also lies within the confidence interval of the estimate reported by Ireland (2001) for the UK.[32]

Euro-area studies report a broad range of estimates for investment adjustment costs, corresponding to values of $\bar{S}^{\star}$ between 5 and 9.[33] However, these studies are relatively consistent in terms of the ratio of the investment response to the output response following a TFP shock, which typically lies between 1 and 1.6. Accordingly, $\bar{S}^{\star}$ is set to 10, implying a ratio of the investment response to the output response of 1.5 after a TFP shock. The value of $\bar{S}$ is set analogously, at 1.3, to replicate the relative magnitude of investment and output responses in models estimated on Polish and Hungarian data.

3.4 Labour Markets

The elasticity of new matches with respect to unemployment in the EU15 is set to 0.5, i.e. the midpoint of the range of estimates for European economies surveyed by Petrongolo and Pissarides (2001).[34] The worker's share in the job surplus is then set equal to this elasticity.[35] For the NMS12, both parameters are set to 0.4. The lower bargaining parameter in the NMS12 is intended to reflect, on average, more flexible employment protection legislation in the larger NMS economies, such as the Czech Republic, Hungary, Poland, and Slovakia (Poeck et al., 2007).

Recruitment costs in both regions are set to 1% of output, slightly below the value of 1.5% used by Pissarides (2009). The job destruction rate in the EU15, 2.4%, is calibrated using

[31] Druant et al. (2009) focus on average price duration. Their findings suggest that average price duration is similar across the groups of EU15 and NMS12 countries included in their sample and, under the Calvo (1983) pricing scheme, would correspond to the Phillips curve slope reported here. In using this evidence to benchmark the model calibration, I rely on the property that the dynamic behaviour of models with Rotemberg and Calvo pricing is equivalent.

[32] The estimates in Ireland (2001) are in fact highly imprecise, with a mean of 77 and a standard error of 84.6.

[33] Estimated investment adjustment costs may differ across models depending on the set of rigidities included. Christiano et al. (2005) show that models without habit formation in consumption require lower investment adjustment costs to generate empirically plausible impulse responses for the U.S. Gertler et al. (2008), in turn, suggest that greater wage rigidity requires higher investment adjustment costs to match U.S. data. The euro-area models used here as benchmarks assume habit formation and no wage rigidity.

[34] The range of estimates reported by the authors is 0.3 to 0.7. A value of 0.5 corresponds to the lower end of the estimates obtained from regressions of unemployment outflows and to the upper end of those based on total hires.

[35] Hosios (1990) shows that in the basic search-and-matching model this equality is necessary and sufficient for the private value of a match to equal its social value. Here, the assumption is maintained for comparability with standard calibrations.

information on average job duration from LFS data. Although the same data imply a similar average job duration in the NMS12, the job destruction rate there is set slightly higher, at 2.5%. This choice is consistent with evidence from Bassanini and Marianna (2009), who find that job destruction is more frequent, after controlling for industry structure, in Poland than in the largest EU15 economies, Germany and France.

The reference steady-state levels of labour market tightness in the EU15 and the NMS12 are calculated using data on job vacancy rates and LFS data.[36] Average labour market tightness in the EU15 over 2003-2007 equals 0.51. The weighted average for the Czech Republic, Hungary, and Poland in 2007 is 0.31. This value is scaled down to 0.26 to better approximate a medium-run benchmark, given the strong labour market recovery in the region in the reference year, and is assumed to apply to the NMS12 as a whole. Matching efficiency is then calibrated so that the implied steady-state unemployment rates match average LFS unemployment over 2003-2007, conditional on the assumed job destruction rates, the elasticity of new matches with respect to unemployment, and steady-state labour market tightness. The resulting matching efficiency parameters are 0.41 for the EU15 and 0.45 for the NMS12.

In line with microsurvey evidence for a group of EU countries summarized by Knell (2013), no systematic differences in real wage rigidity are assumed between the EU15 and the NMS12. Accordingly, the autoregressive parameter in real wages is set to 0.7 in both economies. This degree of wage rigidity is consistent with the upper theoretical estimates implied by Taylor wage contracts in Knell (2013), and is slightly lower than the empirical estimates based on macroeconomic data for EU countries reported by Arpaia and Pichelmann (2007) and used, for example, by Duval and Vogel (2012), as well as those by Abbritti and Weber (2008).[37]

One-off migration costs are set so that a temporary shock to migration preferences implies a temporary shift in the emigration rate of a similar magnitude as the corresponding permanent shock would render in the steady-state emigration. Under this calibration, the marginal cost of movement for a single worker amounts to 10%-15% of the foreign real quarterly wage whenever

[36] More precisely, labour market tightness is measured as $\theta = \frac{VAC+NJ}{UNEMP+NJ}$. The number of vacancies, VAC, is approximated using annual enterprise survey data on job vacancy rates from Eurostat. The average number of new jobs created, NJ, is derived from LFS data on workers employed for less than six months, conditional on the calibrated quarterly job destruction rates. $UNEMP$ denotes the number of unemployed workers in the LFS.

[37] As argued by Blanchard and Gali (2007), empirical estimates of wage rigidity based on macro data are likely to be upward biased.

the total change in the emigration rate is 1 percentage point.[38]

3.5 Taxes and Transfers

Income tax rates are calibrated using the average tax wedge for low-wage employed workers over 1997-2008, based on Eurostat data. Country-specific tax wedges are weighted by each country's share in total employment in the EU15 and the NMS12, respectively. The unemployment benefit replacement rates for natives in the two economies are calibrated on the basis of net replacement rates for 2004 reported by the OECD.[39] To obtain gross replacement rates, the net rates are adjusted using the previously calibrated income tax rates. The resulting country-level gross replacement rates are then weighted by each country's share in total regional unemployment. For the NMS12, the calibrated value corresponds to the average for the Czech Republic, Hungary, Poland, and Slovakia. The resulting gross replacement rate for natives is 42% in the EU15 and 38% in the NMS12.

It is assumed that immigrants receive only 50% of the benefits that natives in comparable circumstances would claim. The relatively disadvantaged position of immigrants with respect to welfare payments is documented by Boeri and Monti (2009), who find that the probability of receiving contributory benefits in the EU15 is 4 percentage points lower for immigrants from the EU25 than for natives, and 2.5 percentage points lower for non-contributory benefits (weighted by country shares of non-participants). Dustmann et al. (2010a) estimate that immigrants from the NMS (excluding Bulgaria, Romania, Malta and Cyprus) to the UK were 13 percentage points less likely to receive benefits and 28 percentage points less likely to live in social housing than natives. Additionally, the European Survey on Income and Living Conditions (EU-SILC) data used by Boeri and Monti (2009) indicate that immigrants receive lower benefits on average than natives. This calibration is also reasonably close to the corresponding estimate of 40% reported by Dustmann et al. (2010a) for NMS immigrants in the UK. The 50% ratio of unemployment benefits received by immigrants relative to natives conveniently implies equality between the real

[38] Available estimates of migration costs, for example Bayer and Juessen (2012) for migration across U.S. states, are generally much higher. However, such estimates typically refer to total migration costs, including relocation costs, utility losses related to location preferences, and expected wage premia due to imperfect skill transferability; these components are modeled separately here.

[39] These replacement rates include all benefits received by the non-employed and are computed for six family types, separately for the initial phase of unemployment and for long-term unemployment. The replacement rates used here are averages across the twelve resulting categories.

unemployment benefit of unemployed immigrants in the EU15 and that of unemployed stayers in the NMS12.

Overall, the calibration of the model, both in the closed-border and open-border versions, ensures that wage income -a djusted for the monetary value of the disutility associated with work - is significantly higher than the instantaneous income of the unemployed in the same labour market. Consequently, as long as a worker remains in the same labour market, the value of employment exceeds the value of unemployment.[40]

Furthermore, in the open-border version of the model, the immigrant wage in the EU15 - adjusted for both the disutility of work and the disutility of residing abroad - exceeds the unemployment benefit received by natives in the NMS12. Finally, the value of employment for an immigrant in the EU15 is slightly higher than the value of employment for a stayer in the NMS12.

3.6 Other Policy Parameters

The ratio of government expenditures to private demand is calibrated to match the average share of intermediate general government consumption in GDP during 2002-2006. This share equals 6.3% in the EU15 and 6.4% in the NMS12. The persistence of government spending is set to 0.95 in both regions, consistent with the generally high estimates of this parameter reported for the euro area, Poland, and Hungary.

There is no standard calibration for fiscal policy rules. In practice, fiscal rule parameters are typically chosen to ensure the stability of the model's long-run solution and are fine-tuned using judgment-based criteria - for example, that the government debt-to-GDP ratio returns to its target level within a typical simulation horizon and that the responses to standard shocks remain smooth ((Mitchell et al., 2000; Johnson, 2001; Perez and Hiebert, 2004). In the present calibration, the inertia of lump-sum taxation is set to 0.8 and the parameter governing the speed of fiscal adjustment toward the target debt level is set to 0.4. The implied reaction of taxes to outstanding public debt is close to that assumed by Duarte and Wolman (2008) for Germany and France.

[40] That is, unemployment benefits are not “excessively high”, and the model is therefore robust to the critique of search-and-matching models put forward by Mortensen and Nagypal (2007) in response to Hagedorn and Manovskii (2008).

Available estimates of interest rate smoothing in the euro area are relatively high; accordingly, the corresponding parameter in the EU15 is set to 0.9. Estimates for Poland and Hungary are somewhat lower, so the autoregressive parameter in the NMS12 Taylor rule is set to 0.8. The elasticity of interest rates with respect to inflation is set to 2.5 in the EU15 and 2.3 in the NMS12. These values are higher than those typically estimated for the euro area, Hungary, and Poland, but the empirical estimates usually come from models in which the output gap enters the monetary policy rule. The present calibration therefore follows the observation of Henderson and McKibbin (1993) that when the output gap is omitted from the Taylor rule, the coefficient on inflation must be increased to generate similar model dynamics.

3.7 Structural Shocks

The persistence and standard deviation of productivity shocks in the EU15 are set to the average values estimated for the euro area in Smets and Wouters (2003; 2005), Pytlarczyk (2005), Adolfson et al. (2007), and Kolasa (2009). For the NMS12, the persistence is assumed to be similar to that in the EU15, while the standard deviation is set at a higher level, consistent with estimates for the Polish and Hungarian economies reported by Jakab and Világi (2008), Kolasa (2009), and Jakab and Konya (2016).

The persistence of the migration preference shock is set to 0.9, while its standard deviation is calibrated such that a one-standard-deviation innovation changes the emigration rate by one percentage point.

4 Temporary Migration in the Model

Before turning to the evaluation of the business-cycle properties of the model, I first discuss the long-run implications of an open-border immigration policy. Following Scheve and Slaughter (2001) and Coleman and Rowthorn (2004), the analysis focuses on three dimensions: the impact of immigrants on labour market outcomes for natives, the implications of immigration for public finances in the host country, and the overall macroeconomic gains - measured in terms of consumption and output - from free labour mobility for both host and source countries.

I also discuss the difference between a temporary population shock in the closed-border version of the model and a shock to emigration preferences in the open-border version. This comparison helps build intuition about the extent to which the model captures a qualitatively different phenomenon than an exogenous population shock in a framework without endogenous labour mobility.

4.1 The Steady-State with and without Migration

Table 2 reports the steady-state solutions of the model under two scenarios: one without migration and one with an immigration rate of 1.5% in the EU15. The outcomes for the host economy are presented in columns 1-3, while those for the sending economy appear in columns 4-6.

When the immigration rate in the recipient economy increases from 0% to 1.5%, the average wage declines by 0.6%. However, the corresponding reduction in the wage of natives is negligible - only 0.1%. This small and statistically insignificant response of native wages is consistent with the majority of empirical findings surveyed by Friedberg and Hunt (1995), Blanchflower et al. (2007), and Longhi et al. (2008). At the same time, the employment prospects of natives improve: the unemployment rate falls by 0.6 percentage points following the immigration wave.

In the sending country, the emigration rate increases from 0% to 5.7%, raising the average wage by 1.5%. This implies a wage elasticity with respect to emigration of 0.26. The moderate increase in wages is again consistent with empirical evidence on the impact of emigration on wages in Mexico reported by Aydemir and Borjas (2006) and Mishra (2007), as well as with evidence for Poland provided by Budnik (2008). Following the emigration wave, the unemployment rate in the NMS12 declines by 2.6 percentage points.

The net contribution of temporary immigrants to public finances in the EU15 is calculated as the difference between their income tax payments and the unemployment benefits they receive. This contribution is strictly positive and amounts to 0.23% of the receiving country's output.

Overall, free labour mobility is welfare-improving for both the receiving and the sending economies. The average consumption level increases by approximately 1% for both EU15 and NMS12 citizens. Moreover, labour migration facilitates wage convergence between the two regions, although differences in GDP and capital stocks widen.[41]

[41] TFP convergence - abstracted from in the model but likely to occur in reality - would also contribute to narrowing wage differentials while simultaneously reducing the gaps in output and capital stocks. If TFP con-

4.2 An Emigration Preference Shock

The solid lines in Figure 1 depict the effects of a temporary reduction in the disutility of emigration for NMS12 citizens, which generates a 1 percentage point increase in the emigration rate (shown in the lower-right panel of the figure). The black lines represent the behaviour of the recipient economy (EU15), while the red lines correspond to the sending economy (NMS12).

The inflow of immigrants increases labour supply in the EU15. As labour becomes more abundant and immigrants have relatively low wage expectations, firms respond by posting more vacancies. The resulting increase in labour demand limits the decline in wages. The average real wage (shown by the black line in the upper-right panel) decreases slightly, whereas the wage of natives (shown by the blue line in the same panel) remains almost unchanged.

The expansion of employment supports output growth. Investment rises in response to higher returns to capital, which stem from the increased availability of labour. Initially, however, employment expands faster than output, which temporarily raises marginal production costs and leads to higher inflation. This pro-inflationary effect is soon offset by the cost-reducing impact of capital accumulation. Through this channel, the immigration wave generates a highly persistent positive effect on economic activity.

To illustrate that the effects of endogenous temporary migration cannot easily be replicated by a population shock, I introduce such a shock in the closed-border version of the model. The black dotted lines in Figure 1 show the response of the EU15 economy to a temporary exogenous increase in population. The size of the population shock is calibrated to match the inflow of workers from the NMS12 to the EU15 implied by the emigration preference shock. Since the timing of migration responses differs between the two model versions, the population shock is assumed to be highly autocorrelated (with a persistence parameter of 0.95) to facilitate graphical comparison.

Workers entering the EU15 as a result of the population shock behave identically to EU15 natives. They therefore resemble permanent rather than temporary immigrants. In particular, they share the same productivity and wage aspirations as natives. Consequently, permanent immigration does not generate an additional positive effect on labour demand. Following the

vergence were incorporated into the model, migration would accelerate the reduction of wage differentials before TFP convergence is completed, but its role would diminish afterwards.

shock, employment gains are smaller, unemployment initially increases, and native wages decline more strongly than in the case of temporary immigration. Accordingly, output and consumption in the EU15 expand only moderately, while investment remains broadly unchanged. In short, a positive population shock in a closed-border economy leads to less favourable macroeconomic outcomes than a temporary immigration shock of comparable magnitude.

In the NMS12, the increase in emigration reduces the unemployment rate. Firms face greater difficulty filling vacancies, and the improved outside options of workersâ€”who can now seek employment either domestically or abroadâ€”strengthen their bargaining position. As a result, real wages increase. The higher wage costs dampen labour demand, which partly offsets the decline in unemployment.

Rising wages increase production costs and push prices upward. Output and investment decline, although higher wages and increased remittance inflows from emigrants help sustain the consumption of NMS12 households. Imports increase sharply and the trade balance deteriorates.

In contrast, a negative population shock in the NMS12 reduces both employment and unemployment on the domestic labour market roughly proportionally, as illustrated by the dotted red lines in Figure 1. This contrasts with the endogenous migration case, where unemployment falls significantly more than employment. As a result, the unemployment rate declines less following a population shock. The bargaining position of remaining workers improves only modestly, leading to smaller increases in real wages. Moreover, when the population shock occurs, the decline in output is accompanied by a comparable reduction in consumption.

The price level in the NMS12 and the exchange rate respond very differently to a population shock and to an emigration preference shock. Following a negative population shock, the reduced supply of goods produced in the NMS12 leads to an appreciation of the domestic currency, as scarcer goods command higher prices. Although the relative scarcity of goods following an emigration preference shock also creates appreciation pressure, this effect is more than offset by the counteracting impact of higher import demand.

5 Total Factor Productivity Shocks

The effects of a temporary and unexpected increase in total factor productivity (TFP) in the EU15 are illustrated in Figure 2, while Figure 3 presents the effects of a similar shock in the NMS12. The dotted lines show the responses in the closed-border version of the model.

In the absence of labour mobility, the responses of the two economies to a temporary TFP increase are largely symmetric. Firms' production capacities expand, reducing marginal production costs. Due to price stickiness, the resulting adjustment of prices occurs gradually. The higher supply of domestically produced tradable goods leads to a real depreciation of the local currency and a deterioration of the country's terms of trade.

The increase in TFP initially induces firms to reduce employment, reflecting higher productivity per worker. However, stronger domestic demand soon reverses this effect, and both employment and real wages may subsequently increase. Higher expected returns on installed capital stimulate investment, while increased profits and wages support higher consumption.

5.1 A Total Factor Productivity Shock in the Recipient Region

The solid lines in Figure 2 show the response of key macroeconomic variables to a positive TFP shock in the EU15 under the open-border regime, i.e. when temporary migration is allowed in equilibrium. Following the shock, improved labour market conditions in the EU15 encourage additional workers from the NMS12 to migrate. The resulting immigration wave enables firms to expand output further. Rising profits and a strong recovery in labour market conditions stimulate domestic demand. Because the effects of the favourable TFP shock are amplified, the depreciation of the EU15 currency is also more pronounced. Although the weaker exchange rate somewhat reduces the incentives for NMS12 workers to emigrate, it does not fully offset the positive incentives associated with the labour market expansion.

The average wage in the EU15 remains below the level that would prevail in the closed-border regime. This reflects the increase in the share of relatively low-paid immigrants in total employment. At the same time, real wages of natives are slightly higher when immigration restrictions are relaxed.

Columns 1 and 2 in Table 3 report the standard deviations of key macroeconomic variables following the TFP shock in the open-border and closed-border versions of the model, respectively, while column 3 presents the ratio between the two. Endogenous immigration increases the volatility of employment in the recipient country by nearly 50% and that of output by about 20%. At the same time, the volatility of real wages, marginal costs, and inflation declines by more than 10%.

Columns 1 - 3 in Table 4 report the absolute and relative persistence of macroeconomic variables following the TFP shock in the EU15. Finally, columns 1â€“3 in Table 5 present the correlations between key macroeconomic aggregates and output. The most notable difference between the models with and without temporary migration concerns the persistence and procyclicality of employment and vacancies. Both become significantly stronger under the open-border regime, reflecting the positive impact of post-shock immigration on labour demand.

Temporary migration also breaks the positive co-movement of output, investment, and employment between the EU15 and the NMS12 following an asymmetric TFP shock in the EU15. This can be seen in columns 1 - 3 of Table 6. Although the economic expansion in the EU15 still benefits NMS12 households through higher consumption, it otherwise dampens economic activity in the sending economy.

5.2 A Total Factor Productivity Shock in the Sending Region

When a positive temporary TFP shock affects the NMS12, the resulting depreciation of the regional currency encourages more workers to seek employment abroad. The solid lines in Figure 3 show the responses of the NMS12 and EU15 economies to this shock under the open-border regime.

Despite the improvement in domestic labour market conditions, emigration increases. The outflow of labour leads to a sharper decline in unemployment and a stronger increase in wages compared with the closed-border scenario. Higher emigration also raises the inflow of remittances which, together with increased labour income, supports private consumption. Nevertheless, the rise in labour costs associated with emigration dampens production, so that output increases by less than in the presence of migration restrictions.

Columns 1 - 3 in Table 7 indicate that, following a TFP shock, the volatility of employment in the NMS12 falls by about 30% and that of output by about 20% when borders within the EU are open. The co-movement of employment and real wages also becomes significantly weaker, while the volatility of real wages increases by roughly 10%.

Temporary migration therefore affects the adjustment to productivity shocks differently depending on whether the sending or the receiving economy is hit. An asymmetric positive productivity shock increases emigration from the NMS12 to the EU15 regardless of which region experiences the shock. Temporary migration amplifies the volatility of output and investment in the EU15 while dampening it in the NMS12. By contrast, the introduction of an open-border regime has a smaller impact on the volatility of private consumption.

The liberalization of immigration policies in the EU also strengthens the positive co-movement of output, investment, and employment between the two regions following an asymmetric TFP shock in the NMS12 (see columns 1 - 3 in Table 10). Output and consumption in the EU15 respond much more strongly to favourable productivity shocks in the sending economy. Finally, under a regime of free labour mobility, the variability of trade balances and current account balances over the business cycle becomes higher than under stricter immigration restrictions.

6 Robustness of the Results

The magnitude of one-off migration costs plays an important role in determining the scale of migration flows triggered by shocks and, consequently, the overall dynamics of the model with migration. In general, higher migration costs reduce the differences between the open-border and closed-border solutions. Conversely, lower migration costs strengthen the patterns described in the previous section.

For illustrative purposes, Figure 4 presents impulse response functions of macroeconomic variables to a positive TFP shock in the EU15, while Figure 5 reports responses to an analogous shock in the NMS12, under the assumption that migration costs are either 50% higher or 50% lower than in the benchmark calibration. Columns 4 and 5 in Tables 3 - 10 report the corresponding descriptive statistics.

Next, I examine the extent to which the differences in the dynamics of the two economies under alternative immigration regimes depend on specific modelling assumptions. First, the pricing-to-market assumption is replaced with the law of one price.[42] Under this alternative specification, the price of an intermediate good expressed in a given currency is identical in both regions.[43]

Firms' pricing strategies primarily affect the behaviour of the real exchange rate - whose volatility declines under the law-of-one-price assumption - as well as the terms of trade and their co-movement with the exchange rate. However, columns 6 in Tables 3 - 10 indicate that the responses of real macroeconomic variables to productivity shocks remain largely unchanged across immigration regimes.[44] Hence, the key results reported in the previous section remain robust.

Next, I consider a version of the model in which temporary immigrants consume in the host country rather than exclusively in their country of origin. Unlike the benchmark specification, this alternative setup captures the effect of home bias in consumption on the current account and trade balances of sending and receiving economies. When temporary immigrants consume in the country of residence, the household decision to send members abroad depends on relative consumer price levels between the destination and origin countries.[45]

Figure 6 illustrates the responses of EU15 macroeconomic variables to a positive domestic TFP shock under the two alternative assumptions regarding immigrants' consumption behaviour. Columns 7 in Tables 3 - 6 provide the corresponding descriptive statistics.

When NMS12 immigrants purchase consumption goods in the EU15, the open-border regime amplifies the macroeconomic effects of a domestic productivity shock more strongly than in the benchmark case where immigrants consume only in their home country. In the benchmark specification, the depreciation of the EU15 currency following a positive asymmetric TFP shock reduces the purchasing power of emigrants' expected earnings, thereby discouraging emigration from the NMS12. This occurs because migrants' wages are denominated in EU15 currency, while their consumption is priced in the home currency.

[42] Details of the alternative model specifications discussed in this section are provided in Appendix B.

[43] Purchasing power parity does not hold, however, due to the assumed home bias in consumption preferences.

[44] This result is consistent with Kollmann (2001), who shows that export pricing strategies significantly affect real variables only in economies with sufficiently large trade shares.

[45] If the law of one price holds, only the dynamics of the current account differ between models where temporary migrants consume abroad or only in their home country. The dynamics of all other variables remain unchanged, and in particular the steady-state equilibrium is unaffected.

By contrast, when immigrants consume in the EU15, the negative effect of the currency depreciation on the purchasing power of expected earnings is mitigated by the concurrent decline in EU15 consumer prices. As a result, immigration to the EU15 increases more strongly, leading to a larger expansion of regional labour supply and output.

If emigrants consume in the host country, the emigration wave following a positive productivity shock in the NMS12 is smaller than in the benchmark model. Because migrants purchase goods in the EU15, the depreciation of the NMS12 currency after the shock has a less favourable effect on the purchasing power of their earnings abroad. As shown in Figure 7, the emigration rate initially declines before recovering over time.

Columns 7 in Tables 7 - 10 compare the impulse responses of NMS12 macroeconomic variables under this alternative specification. Consistent with the weaker response of migration flows, the dynamics of output, employment, and wages in the sending economy are less sensitive to immigration policy under the assumption that migrants consume abroad.

7 Conclusions

Labour mobility remains an important element that is still largely absent from the macroeconomic models currently used to support policymaking in European countries. This paper contributes to narrowing this gap by modelling temporary migration as an endogenous adjustment mechanism in a two-country framework. The two-region model of the EU, carefully calibrated to capture the economic size and institutional differences between the "new" and "old" Member States, highlights the interactions between migration and macroeconomic activity.

Migration rates exhibit substantial volatility at the business-cycle frequency. Under a reasonable calibration of capital adjustment costs and migration costs, labour migration typically emerges in the aftermath of shocks, before the capital stock has fully adjusted. The difference in the response of an economy to shocks under open- and closed-border regimes depends largely on the magnitude of temporary migration triggered by the shock. This magnitude is determined by the interaction of two forces: exchange rate movements and developments in local labour markets. These forces may act in opposite directions and partly offset one another, as in the case of a positive TFP shock, when currency depreciation discourages emigration while improved labour market conditions encourage it.

Temporary migration can alter the volatility, persistence, and cross-correlation of macroeconomic variables in both sending and receiving economies following asymmetric productivity shocks. In general, migration smooths the adjustment of output in the sending country while amplifying the volatility of output and domestic demand in the receiving economy.

In the open-border regime, adjustment to productivity shocks in the EU15 occurs to a greater extent through changes in employment and less through real wages. As a result, host labour markets appear more flexible over the business cycle. The opposite pattern emerges in sending countries, where labour markets may appear more rigid because adjustment takes place more strongly through wages than through employment.

Even when migration flows are relatively small compared with national populations, temporary migration substantially strengthens economic interdependence between regions. Shocks and policies in one economy therefore have a greater potential to influence developments in another. When borders are open, the NMS12 economies can be particularly affected by productivity shocks in the EU15: the correlation of output between the two regions may become significantly negative, whereas it would remain positive under a closed-border regime.

The global financial crisis provided an interesting empirical context for evaluating the model's implications. The turbulence in financial markets that began in 2007 had a disproportionately strong negative impact on many of the "old" Member States relative to most accession countries. The effects of the crisis were particularly pronounced in the UK and Ireland - both major destinations for migrants from Central Europe - as well as in Spain, which, alongside Italy and France, has traditionally received significant migration flows from Romania and Bulgaria.

This raises the question of how the earlier liberalization of immigration policies may have influenced the responses of European economies to the crisis. The model suggests that a negative productivity shock - within the model framework also capturing the effects of financial disruptions - would lead to a stronger decline in output, employment, and domestic demand in economies that had previously experienced inflows of temporary immigrants. A slowdown in growth in host economies would strengthen incentives for return migration, which in turn could worsen supply-side conditions and deepen the downturn. Conversely, recessions in sending countries may be mitigated by these migration dynamics.

The recession was indeed severe in several major receiving economies, whereas Poland maintained positive GDP growth while experiencing a moderation in real wage growth. It would therefore be worthwhile to examine these developments more systematically in order to identify the role played by cross-border labour mobility in shaping the economic adjustment of European economies following the crisis.

The macroeconomic consequences of migration could also be explored in alternative modelling environments. A natural extension would be to introduce richer exchange rate dynamics, for example by modelling economies with both tradable and non-tradable sectors. In such a framework, a productivity shock in the non-tradable sector could lead to currency appreciation, in contrast with the depreciation observed in the present model where all goods are tradable. A two-sector framework would also allow for analysis of situations in which temporary immigrants are disproportionately concentrated in particular sectors.

Another promising avenue for future research would be to incorporate on-the-job search, given that a significant share of emigrants originate from the employed population. Finally, the framework could be extended to derive more precise implications for monetary and fiscal policy in economies characterized by substantial cross-border labour mobility.

References

Abbritti, M. and Weber, S. (2008). Labor market rigidities and the business cycle: Price vs. quantity restricting institutions. HEI Working Papers 01-2008, Economics Section, The Graduate Institute of International Studies.

Acosta, P. A., Lartey, E. K., and Mandelman, F. S. (2009). Remittances and the Dutch disease. *Journal of International Economics*, 79(1):102–116.

Adolfson, M., Laseen, S., Linde, J., and Villani, M. (2007). Bayesian estimation of an open economy DSGE model with incomplete pass-through. *Journal of International Economics*, 72(2):481–511.

Ahearne, A., Brücker, H., Darvas, Z., and von Weizsücker, J. (2009). Cyclical dimensions of labour mobility after EU enlargement. Working Papers 320, Bruegel.

Andolfatto, D. (1996). Business cycles and labor-market search. *American Economic Review*, 86(1):112–32.

Arpaia, A. and Pichelmann, K. (2007). Nominal and real wage flexibility in EMU. *International Economics and Economic Policy*, 4(3):299–328.

Aydemir, A. and Borjas, G. J. (2006). A comparative analysis of the labor market impact of international migration: Canada, Mexico, and the United States. NBER Working Papers 12327, National Bureau of Economic Research, Inc.

Baldwin, R. and Venables, A. J. (1994). International migration, capital mobility and transitional dynamics. *Economica*, 61(243):285–300.

Barrell, R., FitzGerald, J., and Riley, R. (2010). EU enlargement and migration: Assessing the macroeconomic impacts. *JCMS: Journal of Common Market Studies*, 48(2):373–395.

Barrett, A. and Duffy, D. (2008). Are Ireland's immigrants integrating into its labor market? *The International Migration Review*, 42(3):597–619.

Barrett, A. and McCarthy, Y. (2007a). The earnings of immigrants in Ireland: Results from the 2005 EU survey of income and living conditions. *Quarterly Economic Commentary: Special Articles*, 2007(4-Winter):42–62.

Barrett, A. and McCarthy, Y. (2007b). Immigrants in a booming economy: Analysing their earnings and welfare dependence. *Labour*, 21(4-5):789–808.

Barro, R. J. and Sala-i-Martin, X. (1992). Regional growth and migration: A Japan-U.S. comparison. NBER Working Papers 4038, National Bureau of Economic Research, Inc.

Barwell, R. (2007). The macroeconomic impact of international migration. Bank of England Quarterly Bulletin 2007 Q1.

Bassanini, A. and Marianna, P. (2009). Looking inside the perpetual-motion machine: Job and worker flows in OECD countries. IZA Discussion Papers 4452, Institute for the Study of Labor (IZA).

Bayer, C. and Juessen, F. (2012). On the dynamics of interstate migration: Migration costs and self-selection. *Review of Economic Dynamics*, 15(3):377–401.

Benigno, G. and Thoenissen, C. (2008). Consumption and real exchange rates with incomplete markets and non-traded goods. *Journal of International Money and Finance*, 27(6):926–948.

Binyamini, A. and Razin, A. (2008). Inflation-output tradeoff as equilibrium outcome of globalization. NBER Working Papers 14379, National Bureau of Economic Research, Inc.

Blanchard, O. and Gali, J. (2007). Real wage rigidities and the new keynesian model. *Journal of Money, Credit and Banking*, 39(s1):35–65.

Blanchard, O. and Gali, J. (2008). Labor markets and monetary policy: A new-keynesian model with unemployment. NBER Working Papers 13897, National Bureau of Economic Research, Inc.

Blanchard, O. J., Katz, L. F., Hall, R. E., and Eichengreen, B. (1992). Regional evolutions. *Brookings Papers on Economic Activity*, 1992(1):pp. 1–75.

Blanchflower, D. G. and Lawton, H. (2010). *The impact of the recent expansion of the EU on the UK labor market*, pages 181–215. Springer Berlin Heidelberg, Berlin, Heidelberg.

Blanchflower, D. G., Saleheen, J., and Shadforth, C. (2007). The impact of the recent migration from Eastern Europe on the UK economy. IZA Discussion Papers 2615, Institute for the Study of Labor (IZA).

Blanes, J. V. (2005). Does immigration help to explain intra-industry trade? Evidence for spain. *Review of World Economics (Weltwirtschaftliches Archiv)*, 141(2):244–270.

Bodart, V., Pierrard, O., and Sneessens, H. R. (2005). Calvo wages in a search unemployment model. DNB Working Papers 068, Netherlands Central Bank, Research Department.

Bodvarsson, Ö. B., Van den Berg, H. F., and Lewer, J. J. (2008). Measuring immigration's effects on labor demand: A reexamination of the Mariel Boatlift. *Labour Economics*, 15(4):560–574.

Boeri, T. and Monti, P. (2009). The impact of labour mobility on public finances and social cohesion. Background Analysis for the report on Labour mobility within the EU in the context of enlargement and the functioning of the transitional arrangements Deliverable 5, European Integration Consortium.

Borjas, G. J. (2001). Does immigration grease the wheels of the labor market? *Brookings Papers on Economic Activity*, 32(2001-1):69–134.

Borjas, G. J., Grogger, J., and Hanson, G. H. (2006). Immigration and african-american employment opportunities: The response of wages, employment, and incarceration to labor supply shocks. NBER Working Papers 12518, National Bureau of Economic Research, Inc.

Borjas, G. J., Grogger, J., and Hanson, G. H. (2008). Imperfect substitution between immigrants and natives: A reappraisal. NBER Working Papers 13887, National Bureau of Economic Research, Inc.

Brücker, H., Baas, T., Beleva, I., Bertoli, S., Boeri, T., Damelang, A., Duval, L., Hauptmann, A., Fihel, A., Huber, P., Iara, A., Ivlevs, A., Jahn, E. J., Kaczmarczyk, P., Landesmann, M. E., Mackiewicz-Lyziak, J., Makovec, M., Monti, P., Nowotny, K., Okólski, M., Richter, S., Upward, R., Vidovic, H., Wolf, K., Wolfeil, N., Wright, P., Zaiga, K., and Zylicz, A. (2009). Labour mobility within the eu in the context of enlargement and the functioning of the transitional arrangements. Final report, European Integration Consortium.

Budnik, K. (2008). Search equilibrium with migration: the case of Poland. National Bank of Poland Working Papers 45, National Bank of Poland, Economic Institute.

Budnik, K. (2011). Temporary migration in theories of international mobility of labour. *Bank i Kredyt*, 42(6):7–48.

Budnik, K. B. (2009). Rationality of post-accession migration. *Focus on European Economic Integration*, (1):57–83.

Calvo, G. A. (1983). Staggered prices in a utility-maximizing framework. *Journal of Monetary Economics*, 12(3):383–398.

Canova, F. and Ravn, M. O. (1998). Crossing the Rio Grande: Migrations, business cycles and the welfare state. CEPR Discussion Papers 2040, C.E.P.R. Discussion Papers.

Card, D. (1990). The impact of the Mariel boatlift on the Miami labor market. *Industrial and Labor Relations Review*, 43(2):245–257.

Chami, R., Cosimano, T. F., and Gapen, M. T. (2006). Beware of emigrants bearing gifts: Optimal fiscal and monetary policy in the presence of remittances. IMF Working Papers 06/61, International Monetary Fund.

Chiswick, B. R. (1978). The effect of americanization on the earnings of foreign-born men. *Journal of Political Economy*, 86(5):897–921.

Chortareas, G., Katirtzidis, K., and Tsoukalas, J. (2008). Macroeconomic effects of immigration in a new keynesian model. Paper presented at the conference Migration, Labour Market and Economic Growth in Europe after Enlargement hosted by the National Bank of Poland, 8-9 December 2008.

Christiano, L. J., Eichenbaum, M., and Evans, C. L. (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of Political Economy*, 113(1):1–45.

Coleman, D. and Rowthorn, R. (2004). The economic effects of immigration into the United Kingdom. *Population and Development Review*, 30(4):579–624.

Corsetti, G., Dedola, L., and Leduc, S. (2008). International risk sharing and the transmission of productivity shocks. *Review of Economic Studies*, 75(2):443–473.

Costain, J. S. and Reiter, M. (2008). Business cycles, unemployment insurance, and the calibration of matching models. *Journal of Economic Dynamics and Control*, 32(4):1120–1155.

D'Amuri, F., Ottaviano, G. I., and Peri, G. (2010). The labor market impact of immigration in Western Germany in the 1990s. *European Economic Review*, 54(4):550–570.

den Haan, W. J., Ramey, G., and Watson, J. (2000). Job destruction and propagation of shocks. *American Economic Review*, 90(3):482–498.

Drinkwater, S., Eade, J., and Garapich, M. (2009). Poles apart? EU enlargement and the labour market outcomes of immigrants in the United Kingdom. *International Migration*, 47(1):161–190.

Druant, M., Fabiani, S., Kezdi, G., Lamo, A., Martins, F., and Sabbatini, R. (2009). How are firms wages and prices linked - survey evidence in Europe. Working Paper Series 1084, European Central Bank.

Duarte, M. and Wolman, A. L. (2008). Fiscal policy and regional inflation in a currency union. *Journal of International Economics*, 74(2):384–401.

Dunlevy, J. A. and Hutchinson, W. K. (1999). The impact of immigration on American import trade in the late nineteenth and early twentieth centuries. *The Journal of Economic History*, 59(04):1043–1062.

Dustmann, C. (1993). Earnings adjustment of temporary migrants. *Journal of Population Economics*, 6(2):153–68.

Dustmann, C. (2000). Temporary migration and economic assimilation. IZA Discussion Papers 186, Institute for the Study of Labor (IZA).

Dustmann, C., Frattini, T., and Halls, C. (2010a). Assessing the fiscal costs and benefits of A8 migration to the UK. *Fiscal Studies*, 31(1):1–41.

Dustmann, C., Frattini, T., and Preston, I. P. (2013). The effect of immigration along the distribution of wages. *The Review of Economic Studies*, 80(1):145–173.

Dustmann, C., Glitz, A., and Vogel, T. (2010b). Employment, wages, and the economic cycle: Differences between immigrants and natives. *European Economic Review*, 54(1):1–17.

Dustmann, C. and Mestres, J. (2010). Savings, asset holdings, and temporary migration. *Annals of Economics and Statistics*, (97/98):289–306.

Duval, R. and Vogel, L. (2012). How do nominal and real rigidities interact? a tale of the second best. *Journal of Money, Credit and Banking*, 44(7):1455–1474.

Engler, P. (2009). Gains from migration in a new-keynesian framework. unpublished manuscript.

Erceg, C. J., Henderson, D. W., and Levin, A. T. (2000). Optimal monetary policy with staggered wage and price contracts. *Journal of Monetary Economics*, 46(2):281–313.

Foad, H. S. (2009). Assimilation and trade: Explaining the migration-trade relationship with Middle Eastern migration to Europe and North America. Working paper series, Department of Economics, San Diego State University.

Friedberg, R. M. and Hunt, J. (1995). The impact of immigrants on host country wages, employment and growth. *Journal of Economic Perspectives*, 9(2):23–44.

Gertler, M., Sala, L., and Trigari, A. (2008). An estimated monetary DSGE model with unemployment and staggered nominal wage bargaining. *Journal of Money, Credit and Banking*, 40(8):1713–1764.

Gould, D. M. (1994). Immigrant links to the home country: Empirical implications for u.s. bilateral trade flows. *The Review of Economics and Statistics*, 76(2):302–16.

Hagedorn, M. and Manovskii, I. (2008). The cyclical behavior of equilibrium unemployment and vacancies revisited. *American Economic Review*, 98(4):1692–1706.

Hall, R. E. (2005). Employment fluctuations with equilibrium wage stickiness. *American Economic Review*, 95(1):50–65.

Hanson, G. H. and Slaughter, M. J. (1999). The Rybczynski theorem, factor-price equalization, and immigration: Evidence from U.S. states. NBER Working Papers 7074, National Bureau of Economic Research, Inc.

Head, K. and Ries, J. (1998). Immigration and trade creation: Econometric evidence from Canada. *Canadian Journal of Economics*, 31(1):47–62.

Heinz, F. F. and Ward-Warmedinger, M. E. (2006). Cross-Border Labour Mobility within an Enlarged EU. Occasional Paper Series 52, European Central Bank.

Henderson, D. W. and McKibbin, W. J. (1993). A comparison of some basic monetary policy regimes for open economies: implications of different degrees of instrument adjustment and wage persistence. *Carnegie-Rochester Conference Series on Public Policy*, 39(1):221–317.

Hosios, A. J. (1990). On the efficiency of matching and related models of search and unemployment. *Review of Economic Studies*, 57(2):279–98.

Ireland, P. N. (2001). Sticky-price models of the business cycle: Specification and stability. *Journal of*

Monetary Economics, 47(1):3–18.
Jakab, Z. and Konya, I. (2016). An open economy DSGE model with search-and-matching frictions: The case of Hungary. *Emerging Markets Finance and Trade*, 52(7):1606–1626.
Jakab, Z. M. and Világi, B. (2008). An estimated DSGE model of the Hungarian economy. MNB Working Papers 2008/9, Magyar Nemzeti Bank.
Johnson, R. (2001). Fiscal reaction rules in numerical macro models. Research Working Paper RWP 01-01, Federal Reserve Bank of Kansas City.
Kahanec, M., Zaiceva, A., and Zimmermann, K. F. (2010). *Lessons from Migration after EU Enlargement*, pages 3–45. Springer Berlin Heidelberg, Berlin, Heidelberg.
Knell, M. (2013). Nominal and real wage rigidities. in theory and in Europe. *Journal of Macroeconomics*, 36:89–105.
Kolasa, M. (2009). Structural heterogeneity or asymmetric shocks? Poland and the euro area through the lens of a two-country DSGE model. *Economic Modelling*, 26(6):1245–1269.
Kollmann, R. (2001). The exchange rate in a dynamic-optimizing business cycle model with nominal rigidities: a quantitative investigation. *Journal of International Economics*, 55(2):243–262.
Krause, M. U. and Lubik, T. A. (2007). The (ir)relevance of real wage rigidity in the new keynesian model with search frictions. *Journal of Monetary Economics*, 54(3):706–727.
Kuhn, P. and Wooton, I. (1987). International factor movements in the presence of a fixed factor. *Journal of International Economics*, 22(1-2):123–140.
Leamer, E. E. and Levinsohn, J. (1995). International trade theory: The evidence. In Grossman, G. M. and Rogoff, K., editors, *Handbook of International Economics*, volume 3 of *Handbook of International Economics*, chapter 26, pages 1339–1394. Elsevier.
Lemos, S. and Portes, J. (2008). New labour? The impact of migration from Central and Eastern European countries on the UK labour market. Discussion Papers in Economics 08/29, Department of Economics, University of Leicester.
Longhi, S., Nijkamp, P., and Poot, J. (2006). The fallacy of job robbing: A meta-analysis of estimates of the effect of immigration on employment. Tinbergen Institute Discussion Papers 06-050/3, Tinbergen Institute.
Longhi, S., Nijkamp, P., and Poot, J. (2008). Meta-analysis of empirical evidence on the labour market impacts of immigration. IZA Discussion Papers 3418, Institute for the Study of Labor (IZA).
Longhi, S., Nijkamp, P., and Poot, J. (2009). The impact of immigration on the employment of natives in regional labour markets: A meta-analysis. In *Migration and Human Capital*, chapter 9, pages 173–194. Edward Elgar Publishing.
Manacorda, M., Manning, A., and Wadsworth, J. (2012). The impact of immigration on the structure of wages: Theory and evidence from Britain. *Journal of the European Economic Association*, 10(1):120–151.
Martins, J. O., Scarpetta, S., and Pilat, D. (1996). Mark-up ratios in manufacturing industries: Estimates for 14 OECD countries. OECD Economics Department Working Papers 162, OECD, Economics Department.
Merz, M. (1995). Search in the labor market and the real business cycle. *Journal of Monetary Economics*, 36(2):269–300.
Mishra, P. (2007). Emigration and wages in source countries: Evidence from Mexico. *Journal of Development Economics*, 82(1):180–199.
Mitchell, P. R., Sault, J. E., and Wallis, K. F. (2000). Fiscal policy rules in macroeconomic models: principles and practice. *Economic Modelling*, 17(2):171–193.
Mortensen, D. and Nagypal, E. (2007). More on unemployment and vacancy fluctuations. *Review of Economic Dynamics*, 10(3):327–347.
Mortensen, D. T. and Pissarides, C. A. (1994). Job creation and job destruction in the theory of unemployment. *Review of Economic Studies*, 61(3):397–415.
Ortega, J. (2000). Pareto-improving immigration in an economy with equilibrium unemployment. *Economic Journal*, 110(460):92–112.
Ottaviano, G. I. P. and Peri, G. (2006). Rethinking the effects of immigration on wages. NBER Working Papers 12497, National Bureau of Economic Research, Inc.

Ottaviano, G. I. P. and Peri, G. (2008). Immigration and national wages: Clarifying the theory and the empirics. NBER Working Papers 14188, National Bureau of Economic Research, Inc.

Perez, J. J. and Hiebert, P. (2004). Identifying endogenous fiscal policy rules for macroeconomic models. *Journal of Policy Modeling*, 26(8-9):1073–1089.

Petrongolo, B. and Pissarides, C. A. (2001). Looking into the black box: A survey of the matching function. *Journal of Economic Literature*, 39(2):390–431.

Pissarides, C. A. (1992). Loss of skill during unemployment and the persistence of employment shocks. *The Quarterly Journal of Economics*, 107(4):1371–91.

Pissarides, C. A. (2009). The unemployment volatility puzzle: Is wage stickiness the answer? *Econometrica*, 77(5):1339–1369.

Poeck, A. V., Veiner, M., and Plasmans, J. (2007). Wage flexibility in the ,,new" European Union members: How different form the ,,old" members? wp.comunite 0006, Department of Communication, University of Teramo.

Pytlarczyk, E. (2005). An estimated DSGE model for the German economy within the euro area. Discussion Paper Series 1: Economic Studies 2005/33, Deutsche Bundesbank, Research Centre.

Ramaswami, V. K. (1968). International factor movement and the national advantage. *Economica*, 35(139):309–310.

Rauch, J. E. and Trindade, V. (2002). Ethnic Chinese networks in international trade. *The Review of Economics and Statistics*, 84(1):116–130.

Rotemberg, J. J. (1982). Monopolistic price adjustment and aggregate output. *Review of Economic Studies*, 49(4):517–31.

Rotemberg, J. J. and Woodford, M. (1992). Oligopolistic pricing and the effects of aggregate demand on economic activity. *Journal of Political Economy*, 100(6):1153–1207.

Saavedra-Rivano, N. and Wooton, I. (1983). The choice between international labour and capital mobility in a dynamic model of north-south trade. *Journal of International Economics*, 14(3-4):251–261.

Saleheen, J. and Shadforth, C. (2006). The economic characteristics of immigrants and their impact on supply. Bank of England Quarterly Bulletin Q4, Bank of England.

Scheve, K. F. and Slaughter, M. J. (2001). Labor-market competition and individual preferences over immigration policy. *Review of Economics and Statistics*, 83(1):133–145.

Schmitt-Grohe, S. and Uribe, M. (2003). Closing small open economy models. *Journal of International Economics*, 61(1):163–185.

Shimer, R. (2005). The cyclical behavior of equilibrium unemployment and vacancies. *American Economic Review*, 95(1):25–49.

Sinn, H.-W. (2000). EU enlargement, migration, and lessons from german unification. *German Economic Review*, 1(3):299–314.

Smets, F. and Wouters, R. (2003). An estimated dynamic stochastic general equilibrium model of the euro area. *Journal of the European Economic Association*, 1(5):1123–1175.

Smets, F. and Wouters, R. (2005). Comparing shocks and frictions in US and euro area business cycles: a bayesian DSGE approach. *Journal of Applied Econometrics*, 20(2):161–183.

Stark, O. (1995). Return and dynamics: The path of labor migration when workers differ in their skills and information is asymmetric. *Scandinavian Journal of Economics*, 97(1):55–71.

Stark, O. and Taylor, J. E. (1991). Relative deprivation and migration: theory, evidence, and policy implications. Policy Research Working Paper Series 656, The World Bank.

Trigari, A. (2009). Equilibrium unemployment, job flows, and inflation dynamics. *Journal of Money, Credit and Banking*, 41(1):1–33.

Walque, G. D., Pierrard, O., Sneessens, H., and Wouters, R. (2009). Sequential bargaining in a neo-keynesian model with frictional unemployment and staggered wage negotiations. *Annals of Economics and Statistics*, None(95-96):223–250.

Walsh, C. E. (2005). Labor market search, sticky prices, and interest rate policies. *Review of Economic Dynamics*, 8(4):829–849.

White, R. (2007). Immigrant-trade links, transplanted home bias and network effects. *Applied Economics*, 39(7):839–852.

Yashiv, E. (2006). Evaluating the performance of the search and matching model. *European Economic Review*, 50(4):909–936.

Zaiceva, A. and Zimmermann, K. F. (2008). Scale, diversity, and determinants of labour migration in Europe. *Oxford Review of Economic Policy*, 24(3):428–452.

Tables and Graphs

Table 1: Model parameters

Parameter		Home	Foreign
ι	Population share	0.21	0.79
β	Discount factor	0.99	0.99
σ	Intertemporal elasticity of substitution	1.1	1.1
χ	Disutility of labour	0.612	0.395
υ	Disutility of emigration	0.290	0.189
h_c	Degree of external habit formation	0.70	0.65
a	Home bias	0.904	0.986
ϵ	Elasticity of substitution between intermediate goods	6	6
ϕ	Elasticity of substitution between domestic and imported goods	2	2
α	Output elasticity with respect to labour	0.67	0.69
A	Relative productivity level in F	1	1.63
ρ	Inverse elasticity of substitution between native and immigrant labour	0.03	0.03
ω	Relative productivity of immigrants	0.625	0.625
δ	Depreciation rate	0.025	0.025
s	Job destruction rate	0.025	0.024
μ	Workersâ€™ bargaining power	0.4	0.5
ϑ	Elasticity of matches with respect to unemployment	0.4	0.5
m	Matching elasticity	0.45	0.41
$\bar{\kappa}$	Vacancy posting cost	0.01	0.01
$\bar{g}$	Government consumption-to-private demand ratio	0.068	0.067
$\bar{\nu}^H/\bar{\nu}^{F\star}$	Unemployment benefit replacement rate (natives)	0.536	0.588
$\bar{\nu}^{H\star}/\bar{\nu}^F$	Unemployment benefit replacement rate (immigrants)	0.268	0.294
t	Income tax rate	0.41	0.405
$\bar{S}$	Capital adjustment cost parameter	12	10
ϑ	Degree of real wage rigidity	0.70	0.70
ψ	Price adjustment cost	20	20
$\bar{x}$	Migration cost (in terms of real wage abroad)	5	—
h_r	Interest rate smoothing parameter	0.80	0.90
h_π	Interest rate response to inflation	2.3	2.5
h_τ	Persistence of lump-sum taxation	0.80	0.80
h_b	Immediate adjustment of lump-sum taxes to public debt	0.40	0.40
h_g	Persistence of government spending	0.95	0.95
h_A	Persistence of total factor productivity shocks	0.9	0.9
σ^A	Standard deviation of total factor productivity shocks	1.2%	0.6%
h_υ	Persistence of emigration preference shocks	0.9	—
σ^υ	Standard deviation of emigration preference shocks	2.8%	—

Table 2: Steady-state comparison

	EU15 (foreign country)		Difference	NMS12 (home country)		Difference
	No migration	Migration	in % or pp	Migration	No migration	in % or pp
Immigration rate* (%)	0.00	1.50				
Emigration rate** (%)				5.73	0.00	
Average real wage rate	2.86	2.84	-0.58%	1.54	1.56	1.47%
Average real wage rate of natives	2.86	2.85	-0.14%			
Employment level	0.73	0.75	2.14%	0.19	0.18	-3.57%
Employment level of natives	0.73	0.74	0.61%			
Unemployment rate (%)	7.48	6.92	-0.56 pp	9.87	7.81	-2.06 pp
Output	3.64	3.70	1.69%	0.52	0.51	-3.10%
Consumption	2.74	2.77	1.07%	0.39	0.39	0.94%
Investment	0.67	0.68	1.55%	0.10	0.10	-2.14%
Stock of capital	26.76	27.17	1.55%	4.09	4.00	-2.14%
Real exchange rate				0.99	0.91	-8.30%
Trade balance - output ratio (%)	0.00%	0.59%	0.59 pp	0.00	-1.58	-1.58 pp
Remittances balance - output ratio (%)				0.00%	1.27%	1.27 pp
Exports - output ratio (%)	1.39	1.81	0.42 pp	9.65	7.57	-2.09 pp
Share of imports in intermediate goods (%)	1.39	1.04	-0.35 pp	9.65	12.52	2.87 pp
Net contribution of immigrants to budget balance*** (%)	0.00	0.23	0.23 pp			

* Share of temporary immigrants in the local labour force. ** Share of population staying temporarily abroad. *** As a share of output. For the EU15, columns 2–4 compare the steady state without and with immigration. For the NMS12, columns 5–7 compare the steady state with and without emigration.

Table 3: TFP shock in the EU15: standard deviations of macrovariables

Variables	EU15			NMS12			EU15 robustness			
	Baseline			Baseline			Low mig. costs	High mig. costs	Law of one price	Emigrants consume in host country
	St. dev. open-border	St. dev. closed-border	Ratio open/closed	St. dev. open-border	St. dev. closed-border	Ratio open/closed	St. dev. open-border			
Output	0.20	0.16	1.22	0.06	0.01	10.45	0.22	0.18	0.20	0.20
Private consumption	0.15	0.14	1.12	0.02	0.02	0.89	0.17	0.15	0.15	0.16
Investment	0.39	0.31	1.25	0.06	0.02	2.37	0.45	0.36	0.39	0.40
Government consumption	0.10	0.08	1.23	0.02	0.01	1.80	0.11	0.10	0.10	0.11
Employment	0.15	0.10	1.47	0.09	0.01	9.40	0.19	0.13	0.15	0.16
Real wage rate	0.07	0.08	0.86	0.05	0.01	4.45	0.07	0.07	0.07	0.07
Vacancies	4.79	4.46	1.07	1.13	0.23	4.84	5.13	4.68	4.73	4.91
Probability of job finding	0.60	0.52	1.16	0.19	0.03	6.89	0.65	0.58	0.60	0.62
Unemployment rate	0.11	0.09	1.21	0.05	0.01	6.27	0.13	0.10	0.11	0.12
Inflation	0.04	0.04	0.88	0.00	0.01	0.40	0.03	0.04	0.04	0.04
Marginal costs of production	0.11	0.13	0.85	0.01	0.00	1.77	0.09	0.11	0.11	0.10
Interest rate	0.02	0.02	0.97	0.00	0.01	0.28	0.02	0.02	0.02	0.02
Net exports to output	0.01	0.00	3.06	0.09	0.03	3.01	0.02	0.01	0.01	0.01
Current account to output	0.01	0.00	1.44	0.04	0.03	1.37	0.01	0.01	0.01	0.01
Real exchange rate	0.18	0.15	1.19	0.18	0.15	1.19	0.18	0.19	0.18	0.20
Terms of trade	0.16	0.13	1.21	0.16	0.13	1.21	0.16	0.16	0.20	0.17

Table 4: TFP shock in the EU15: persistence of macroeconomic variables

Variables	EU15			NMS12			EU15 robustness			
	Baseline			Baseline			Low mig. costs	High mig. costs	Law of one price	Emigrants consume in host country
	AR(1) open-border	AR(1) closed-border	Difference	AR(1) open-border	AR(1) closed-border	Difference	AR(1) open-border			
Output	0.98	0.98	0.01	0.99	0.93	0.05	0.98	0.98	0.98	0.98
Private consumption	0.97	0.97	0.01	1.00	0.95	0.05	0.98	0.97	0.98	0.98
Investment	0.99	0.99	0.00	0.99	0.98	0.02	0.99	0.99	0.99	0.99
Government consumption	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Employment	0.92	0.85	0.07	0.98	0.93	0.05	0.94	0.90	0.92	0.92
Real wage rate	0.98	0.98	0.01	0.96	0.99	-0.02	0.99	0.98	0.98	0.99
Vacancies	0.18	0.05	0.13	0.86	0.44	0.42	0.29	0.13	0.19	0.21
Probability of job finding	0.32	0.17	0.15	0.91	0.55	0.36	0.44	0.27	0.33	0.35
Unemployment rate	0.88	0.85	0.03	0.96	0.93	0.04	0.90	0.86	0.88	0.88
Inflation	0.30	0.28	0.02	0.16	0.41	-0.25	0.37	0.29	0.33	0.32
Marginal costs of production	0.27	0.30	-0.04	0.73	0.78	-0.05	0.26	0.27	0.27	0.26
Interest rate	0.92	0.90	0.02	0.71	0.87	-0.16	0.94	0.91	0.93	0.93
Net exports to output	0.98	0.89	0.09	0.98	0.89	0.09	0.99	0.96	0.97	0.87
Current account to output	0.93	0.89	0.04	0.93	0.89	0.04	0.98	0.89	0.91	0.95
Real exchange rate	0.90	0.89	0.01	0.90	0.89	0.01	0.92	0.90	0.93	0.91
Terms of trade	0.97	0.96	0.00	0.97	0.96	0.00	0.97	0.97	0.93	0.97

Table 5: TFP shock in the EU15: correlation of macroeconomic variables with output

Variables	EU15			NMS12			EU15 robustness			
	Baseline			Baseline			Low mig. costs	High mig. costs	Law of one price	Emigrants consume in host country
	Corr. with output open-border	Corr. with output closed-border	Difference	Corr. with output open-border	Corr. with output closed-border	Difference	Corr. with output open-border			
Private consumption	0.98	0.98	0.00	-0.40	0.97	-1.37	0.98	0.98	0.98	0.98
Investment	0.95	0.94	0.01	0.42	0.84	-0.42	0.95	0.95	0.95	0.95
Government consumption	0.59	0.56	0.03	0.36	0.32	0.04	0.58	0.59	0.59	0.59
Employment	0.87	0.75	0.12	0.99	0.90	0.09	0.90	0.86	0.87	0.89
Real wage rate	0.65	0.65	0.00	-0.89	0.66	-1.55	0.51	0.68	0.64	0.63
Vacancies	0.39	0.33	0.06	-0.10	0.35	-0.45	0.43	0.38	0.39	0.40
Probability of job finding	0.55	0.46	0.08	-0.46	0.57	-1.03	0.60	0.52	0.55	0.56
Unemployment rate	-0.79	-0.75	-0.04	0.73	-0.90	1.64	-0.81	-0.77	-0.79	-0.79
Inflation	-0.09	-0.07	-0.02	-0.20	-0.35	0.15	-0.13	-0.07	-0.10	-0.10
Marginal costs of production	-0.22	-0.25	0.03	-0.33	-0.70	0.37	-0.24	-0.22	-0.23	-0.23
Interest rate	-0.84	-0.84	0.00	-0.19	-0.90	0.71	-0.88	-0.83	-0.85	-0.85
Net exports to output	0.83	-0.84	1.67	0.85	0.94	-0.09	0.96	0.67	0.81	-0.46
Current account to output	0.56	-0.84	1.39	0.64	0.94	-0.30	0.88	0.23	0.48	0.62
Real exchange rate	0.86	0.88	-0.02	0.75	-0.93	1.68	0.88	0.85	0.89	0.84
Terms of trade	-0.97	-0.98	0.01	-0.91	0.90	-1.80	-0.97	-0.97	-0.89	-0.96

Table 6: TFP shock in the EU15: cross-border co-movement of macroeconomic variables

Variables	Cross-region			Cross-region robustness			
	Baseline			Low mig. costs	High mig. costs	Law of one price	Emigrants consume in host country
	Open border	Closed border	Difference	Open border			
Output	-0.96	0.83	-1.79	-0.98	-0.95	-0.96	-0.97
Private consumption	0.62	0.97	-0.35	0.99	0.11	0.72	0.20
Investment	-0.43	0.94	-1.37	0.15	-0.63	-0.48	-0.50
Government consumption	0.40	0.98	-0.58	0.86	0.05	0.43	0.24
Employment	-0.94	0.58	-1.52	-0.94	-0.93	-0.92	-0.94
Real wage rate	0.50	0.89	-0.40	0.51	0.45	0.47	0.39
Vacancies	-0.41	-0.21	-0.19	-0.22	-0.47	-0.09	-0.36
Probability of job finding	-0.01	-0.07	0.06	0.43	-0.27	0.20	-0.04
Unemployment rate	0.40	0.58	-0.18	0.66	-0.08	0.43	0.28
Inflation	0.84	0.99	-0.15	0.98	0.61	0.84	-0.30
Marginal costs of production	-0.82	0.68	-1.49	-0.55	-0.83	0.33	-0.77
Interest rate	0.36	0.96	-0.60	0.98	-0.32	0.53	-0.84

Table 7: TFP shock in the NMS12: standard deviations of macroeconomic variables

Variables	NMS12			EU15			NMS12 robustness			
	Baseline			Baseline			Low mig. costs	High mig. costs	Law of one price	Emigrants consume in host country
	St. dev. open-border	St. dev. closed-border	Ratio open/closed	St. dev. open-border	St. dev. closed-border	Ratio open/closed	St. dev. open-border			
Output	0.23	0.27	0.84	0.03	0.00	16.52	0.22	0.23	0.23	0.26
Private consumption	0.21	0.22	0.95	0.02	0.00	4.25	0.22	0.20	0.20	0.21
Investment	0.44	0.46	0.95	0.07	0.01	9.76	0.45	0.43	0.44	0.43
Government consumption	0.13	0.13	0.98	0.02	0.00	6.81	0.14	0.13	0.13	0.13
Employment	0.11	0.15	0.73	0.05	0.00	16.27	0.11	0.11	0.10	0.13
Real wage rate	0.15	0.14	1.09	0.01	0.00	4.82	0.16	0.15	0.15	0.14
Vacancies	7.55	7.53	1.00	0.63	0.11	5.97	7.59	7.53	6.63	7.37
Probability of job finding	1.03	0.82	1.26	0.09	0.01	6.93	1.07	1.01	0.91	0.95
Unemployment rate	0.15	0.14	1.10	0.03	0.00	9.73	0.19	0.14	0.15	0.14
Inflation	0.06	0.06	0.95	0.00	0.00	2.22	0.06	0.06	0.05	0.06
Marginal costs of production	0.20	0.20	1.02	0.02	0.00	11.51	0.21	0.20	0.19	0.21
Interest rate	0.05	0.06	0.91	0.00	0.00	2.66	0.06	0.05	0.05	0.06
Net exports to output	0.11	0.06	1.89	0.02	0.01	1.95	0.15	0.09	0.11	0.06
Current account to output	0.08	0.06	1.35	0.01	0.01	1.42	0.10	0.07	0.08	0.05
Real exchange rate	0.27	0.30	0.91	0.27	0.30	0.91	0.28	0.27	0.26	0.29
Terms of trade	0.21	0.23	0.91	0.21	0.23	0.91	0.22	0.21	0.29	0.23

Table 8: TFP shock in the NMS12: persistence of macroeconomic variables

Variables	NMS12			EU15			NMS12 robustness			
	Baseline			Baseline			Low mig. costs	High mig. costs	Law of one price	Emigrants consume in host country
	AR(1) open-border	AR(1) closed-border	Difference	AR(1) open-border	AR(1) closed-border	Difference	AR(1) open-border			
Output	0.98	0.98	0.00	0.99	0.90	0.09	0.97	0.98	0.98	0.97
Private consumption	0.97	0.97	0.00	0.99	0.95	0.04	0.97	0.97	0.97	0.97
Investment	0.99	0.99	0.00	0.99	0.98	0.02	0.99	0.99	0.99	0.99
Government consumption	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Employment	0.45	0.71	-0.25	0.99	0.90	0.09	0.42	0.47	0.50	0.61
Real wage rate	0.99	0.99	0.00	0.96	0.99	-0.03	0.99	0.99	0.99	0.98
Vacancies	-0.18	-0.12	-0.06	0.91	0.13	0.78	-0.17	-0.19	-0.16	-0.15
Probability of job finding	-0.06	-0.07	0.01	0.93	0.29	0.64	0.01	-0.09	-0.01	-0.09
Unemployment rate	0.74	0.71	0.04	0.98	0.90	0.08	0.83	0.69	0.79	0.67
Inflation	0.28	0.32	-0.04	0.57	0.48	0.08	0.30	0.28	0.48	0.31
Marginal costs of production	0.31	0.33	-0.03	0.51	0.31	0.20	0.31	0.30	0.34	0.34
Interest rate	0.87	0.88	-0.01	0.92	0.90	0.02	0.88	0.86	0.91	0.87
Net exports to output	0.94	0.87	0.07	0.95	0.87	0.08	0.96	0.93	0.93	0.84
Current account to output	0.92	0.87	0.05	0.92	0.87	0.05	0.94	0.91	0.90	0.88
Real exchange rate	0.84	0.85	-0.01	0.84	0.85	-0.01	0.83	0.84	0.87	0.85
Terms of trade	0.95	0.95	0.00	0.95	0.95	0.00	0.95	0.95	0.87	0.95

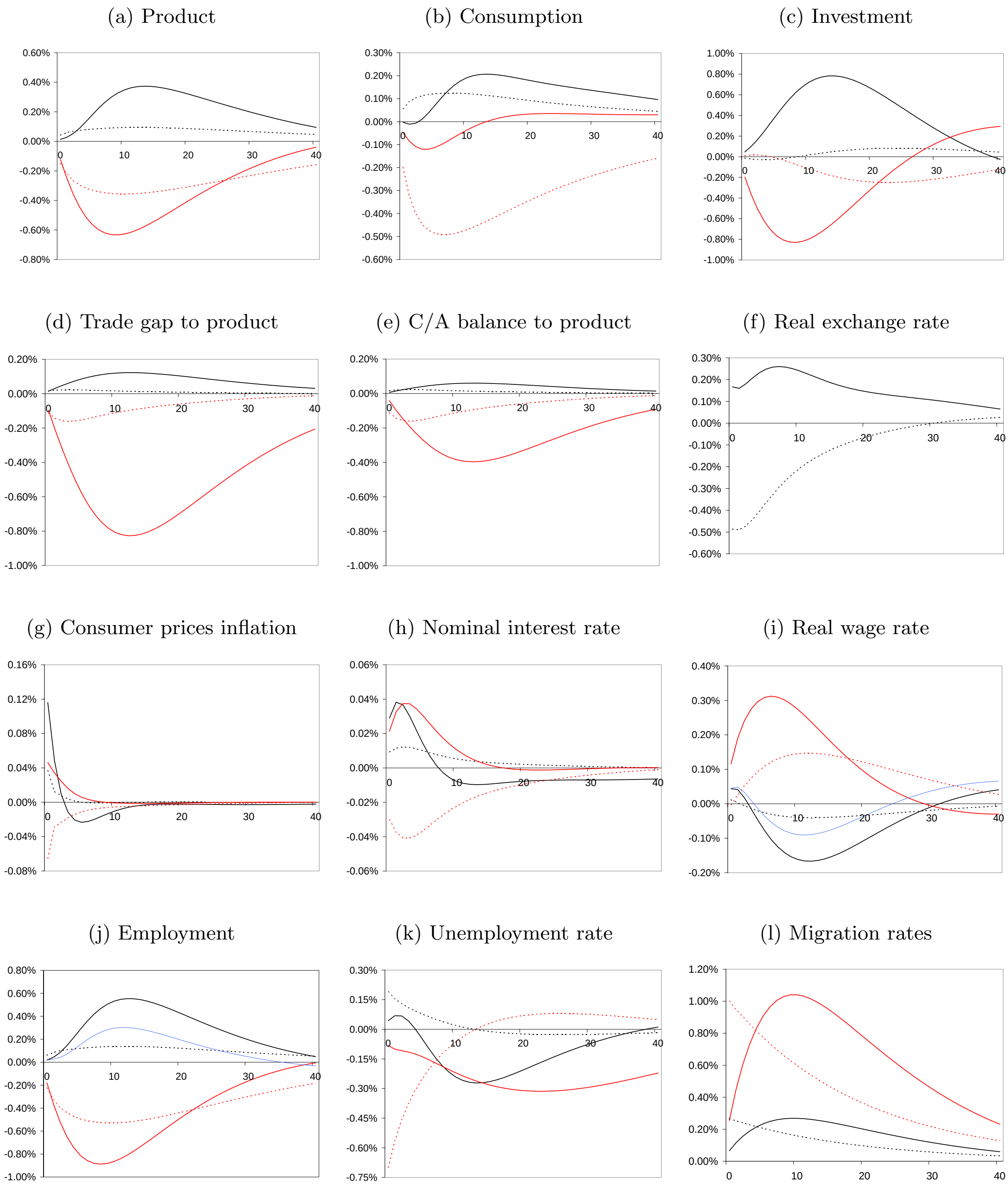
Table 9: TFP shock in the NMS12: correlation of macroeconomic variables with output

Variables	NMS12			EU15			NMS12 robustness			
	Baseline			Baseline			Low mig. costs	High mig. costs	Law of one price	Emigrants consume in host country
	Corr. with output open-border	Corr. with output closed-border	Difference	Corr. with output open-border	Corr. with output closed-border	Difference	Corr. with output open-border			
Private consumption	0.99	0.99	0.01	0.98	0.95	0.03	0.99	0.99	0.99	0.99
Investment	0.92	0.94	-0.02	0.97	0.84	0.13	0.91	0.93	0.92	0.92
Government consumption	0.60	0.57	0.03	0.57	0.24	0.33	0.60	0.59	0.58	0.57
Employment	0.17	0.57	-0.40	0.98	0.93	0.05	0.04	0.22	0.18	0.50
Real wage rate	0.90	0.78	0.12	-0.74	0.56	-1.30	0.88	0.91	0.89	0.78
Vacancies	0.23	0.22	0.01	0.51	0.45	0.06	0.25	0.22	0.22	0.22
Probability of job finding	0.34	0.30	0.05	0.76	0.64	0.12	0.40	0.32	0.35	0.30
Unemployment rate	-0.65	-0.57	-0.08	-0.93	-0.93	0.00	-0.71	-0.60	-0.66	-0.49
Inflation	-0.18	-0.19	0.01	-0.30	-0.32	0.02	-0.21	-0.17	-0.31	-0.18
Marginal costs of production	-0.24	-0.26	0.02	-0.08	-0.40	0.32	-0.26	-0.23	-0.29	-0.27
Interest rate	-0.77	-0.79	0.01	-0.80	-0.94	0.13	-0.81	-0.76	-0.84	-0.77
Net exports to output	-0.96	-0.79	-0.17	0.81	0.93	-0.12	-0.95	-0.95	-0.96	-0.74
Current account to output	-0.93	-0.79	-0.14	0.69	0.93	-0.24	-0.94	-0.91	-0.91	-0.85
Real exchange rate	0.79	0.81	-0.02	-0.45	-0.92	0.47	0.78	0.80	0.85	0.82
Terms of trade	-0.97	-0.98	0.00	0.70	0.83	-0.13	-0.97	-0.98	-0.85	-0.98

Table 10: TFP shock in the NMS12: cross-border co-movement of macroeconomic variables

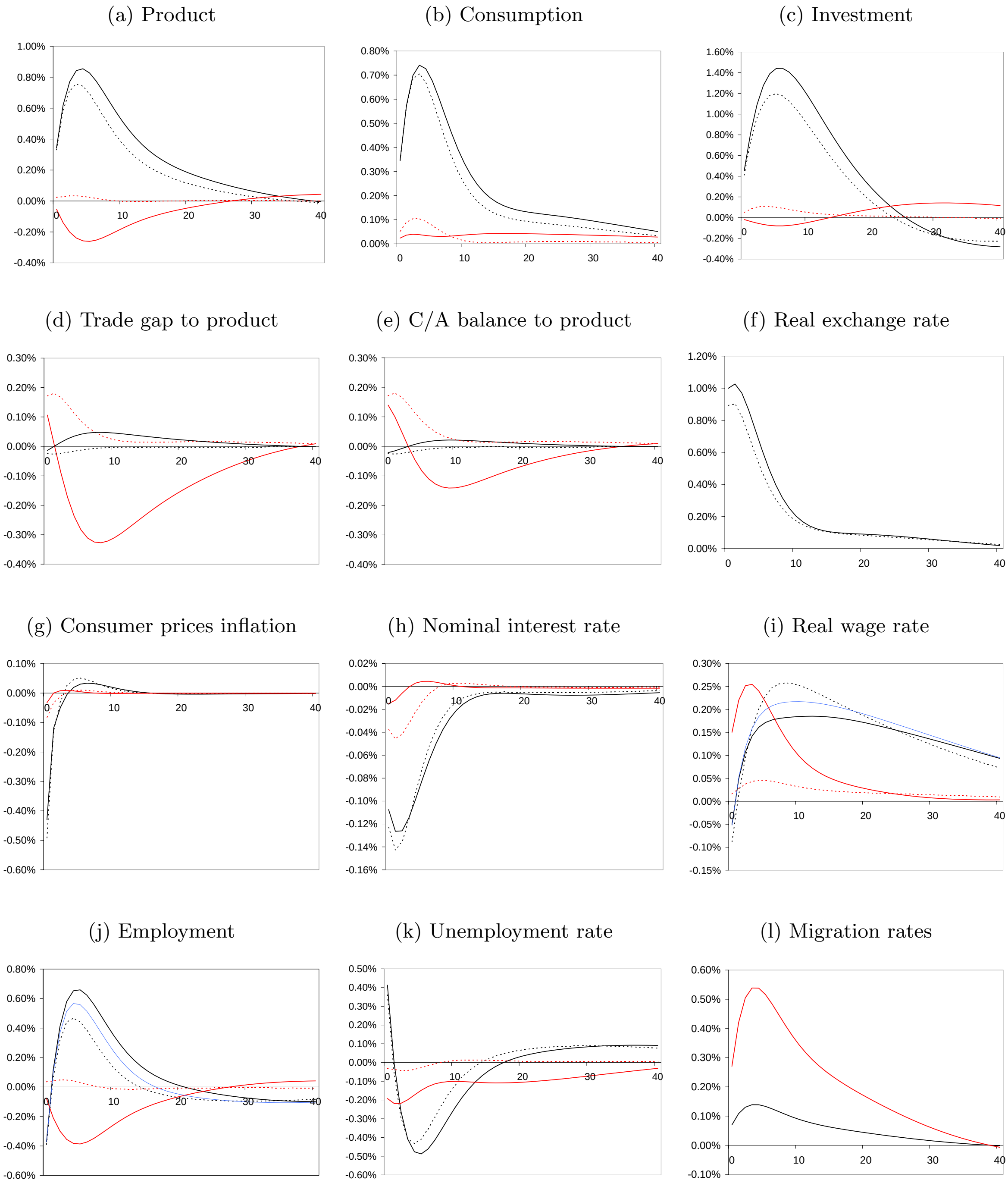
Variables	Cross-region			Cross-region robustness			
	Baseline			Low mig. costs	High mig. costs	Law of one price	Emigrants consume in host country
	Open border	Closed border	Difference	Open border			
Output	0.83	0.80	0.03	0.78	0.85	0.83	0.25
Private consumption	0.81	0.96	-0.15	0.76	0.84	0.87	0.37
Investment	0.95	0.94	0.01	0.92	0.96	0.95	0.79
Government consumption	0.95	0.98	-0.03	0.93	0.97	0.96	0.81
Employment	0.36	0.32	0.04	0.24	0.38	0.42	0.02
Real wage rate	-0.32	0.97	-1.28	-0.35	-0.29	-0.32	0.40
Vacancies	0.01	-0.56	0.58	0.09	-0.05	0.29	-0.53
Probability of job finding	0.15	-0.44	0.59	0.27	0.08	0.39	-0.34
Unemployment rate	0.66	0.32	0.34	0.65	0.64	0.71	-0.21
Inflation	-0.64	0.95	-1.60	-0.66	-0.60	-0.11	0.58
Marginal costs of production	-0.96	0.03	-0.99	-0.95	-0.96	-0.89	0.70
Interest rate	-0.04	0.98	-1.02	-0.07	0.03	0.25	0.16

Figure 1: Impulse responses to a positive migration-preference shock in the NMS12



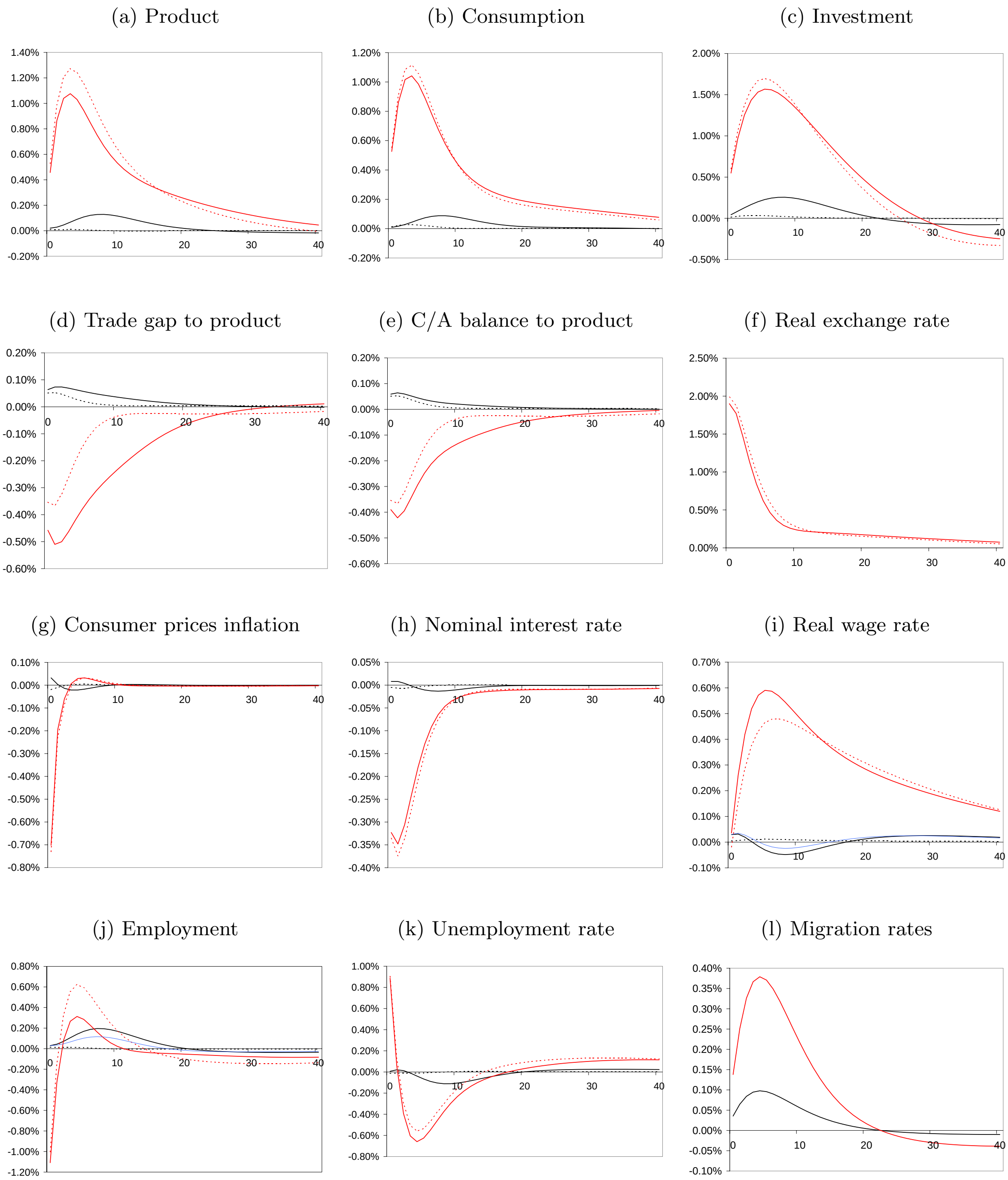
Black lines denote responses of EU15 variables, while red lines denote responses of NMS12 variables. Solid lines correspond to the open-border regime, whereas dotted lines represent the closed labour market regime. In the final panel, the black solid line shows the temporary immigration rate in the EU15, while the red solid line shows the temporary emigration rate of NMS12 workers. Blue lines distinguish the responses of variables for EU15 natives.

Figure 2: Impulse responses to a TFP shock in the EU15 (foreign country)



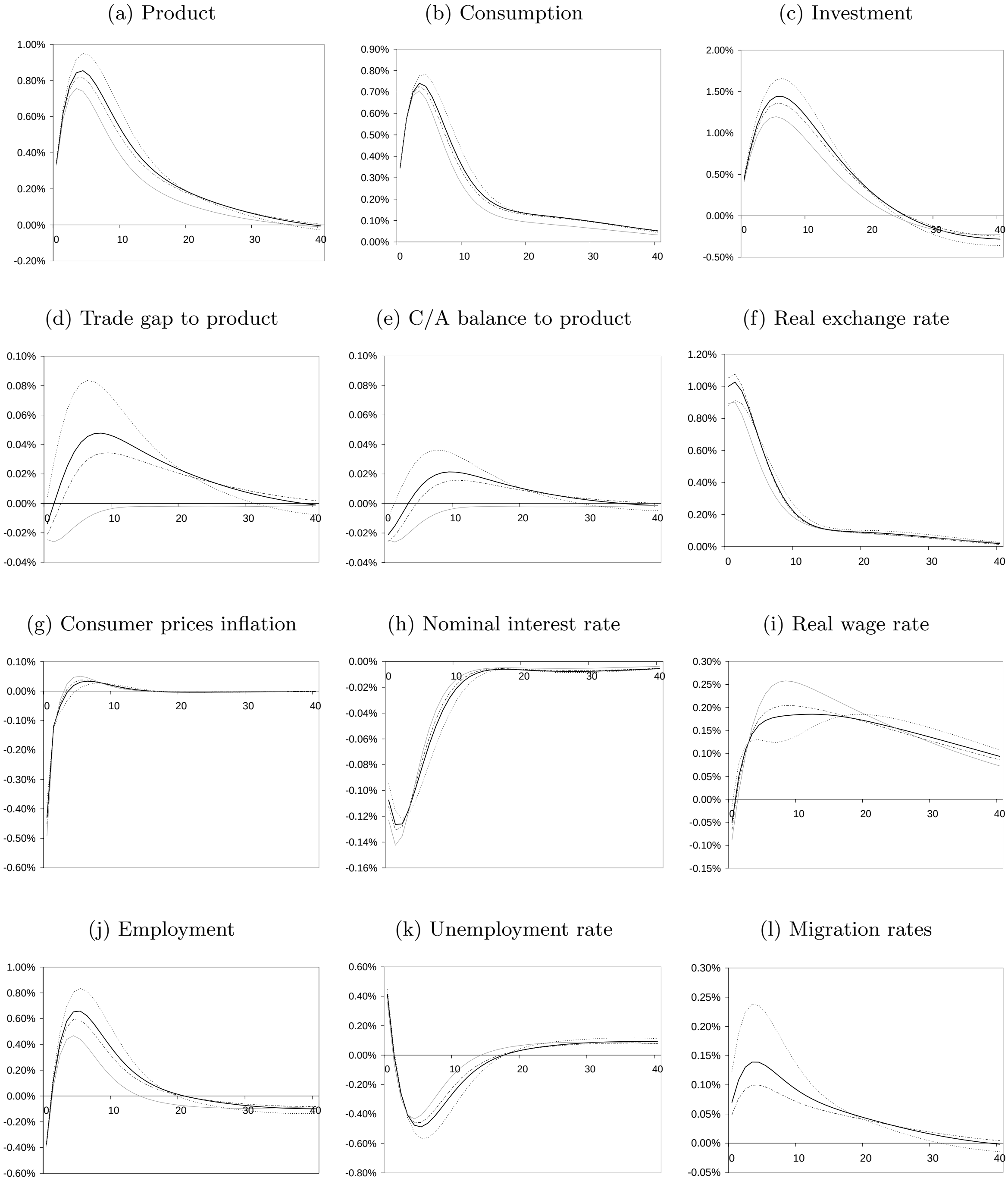
Black lines denote responses of EU15 variables, while red lines denote responses of NMS12 variables. Solid lines correspond to the open-border regime, whereas dotted lines represent the closed labour market regime. In the final panel, the black solid line shows the temporary immigration rate in the EU15, while the red solid line shows the temporary emigration rate of NMS12 workers. Blue lines distinguish the responses of variables for EU15 natives.

Figure 3: Impulse responses to a TFP shock in the NMS12 (home country)



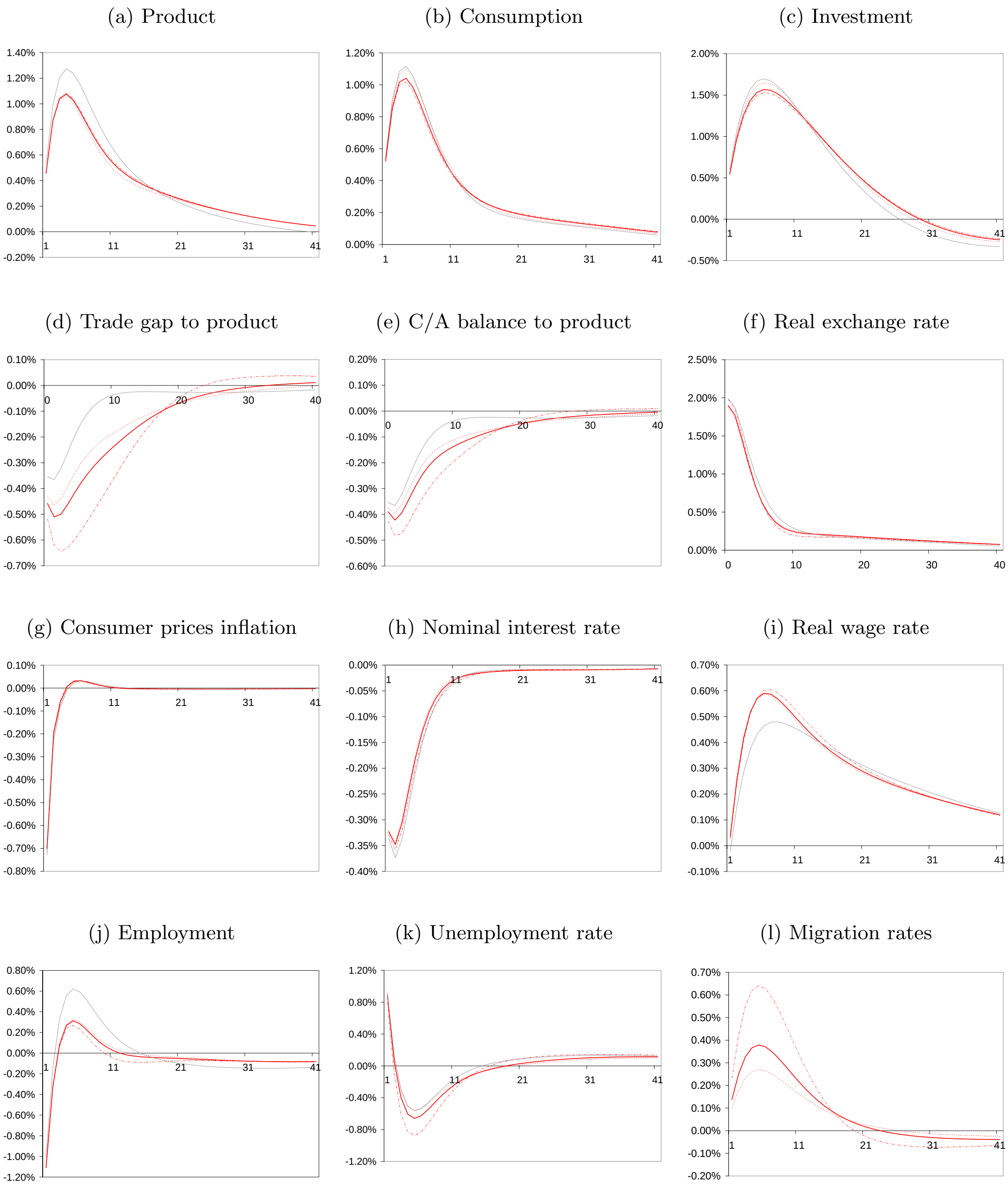
Black lines denote responses of EU15 variables, while red lines denote responses of NMS12 variables. Solid lines correspond to the open-border regime, whereas dotted lines represent the closed labour market regime. In the final panel, the black solid line shows the temporary immigration rate in the EU15, while the red solid line shows the temporary emigration rate of NMS12 workers. Blue lines distinguish the responses of variables for EU15 natives.

Figure 4: Positive TFP shock in the EU15 under alternative migration cost calibrations



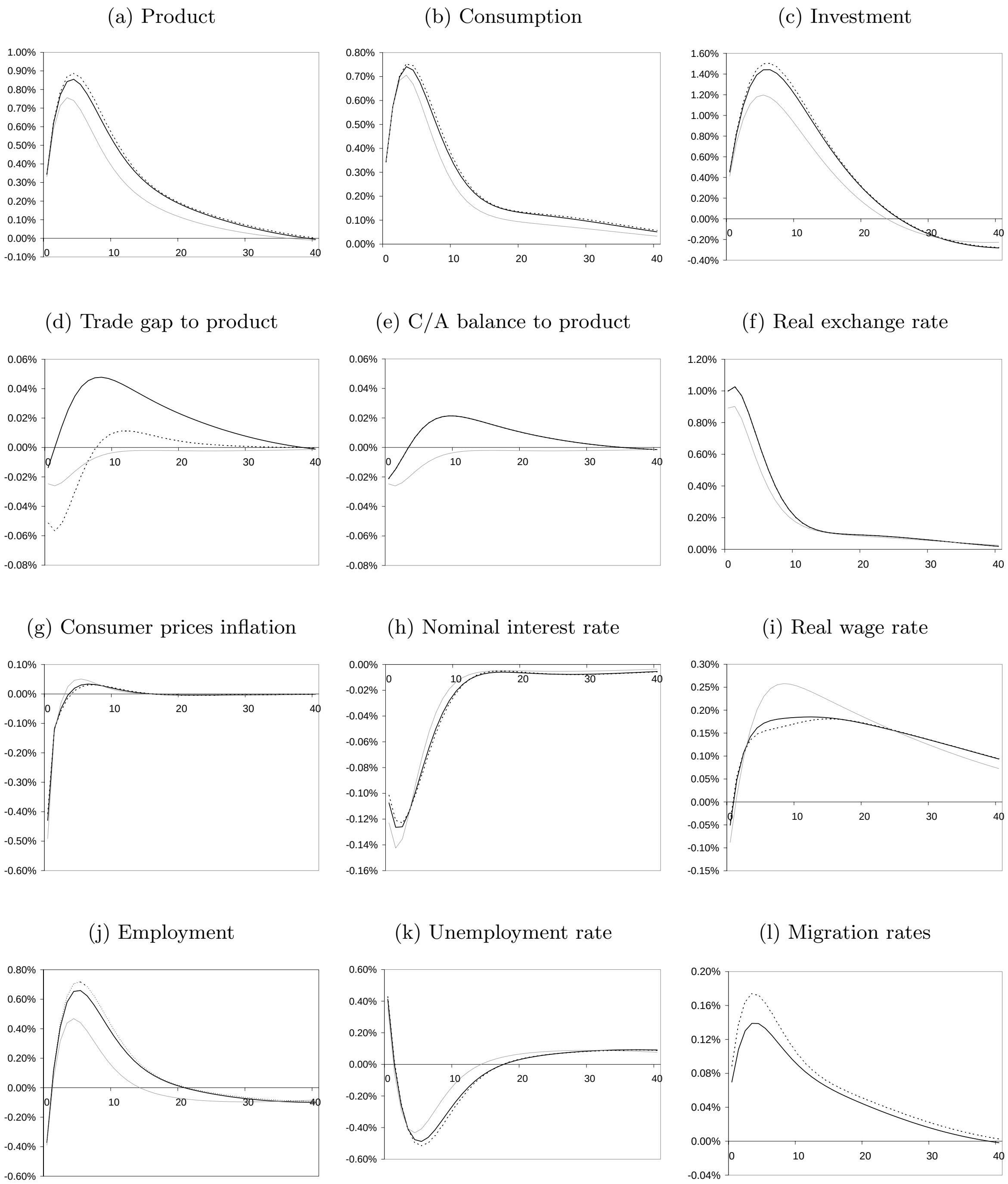
Black lines show the responses of EU15 variables under the open-border regime. Solid lines corresponds to the benchmark calibration of migration costs, dotted lines to migration costs 50% lower than in the benchmark, and dashed lines to migration costs 50% higher. Solid grey line shows the impulse responses under a closed labour market.

Figure 5: ositive TFP shock in the NMS12 under alternative migration cost calibrations



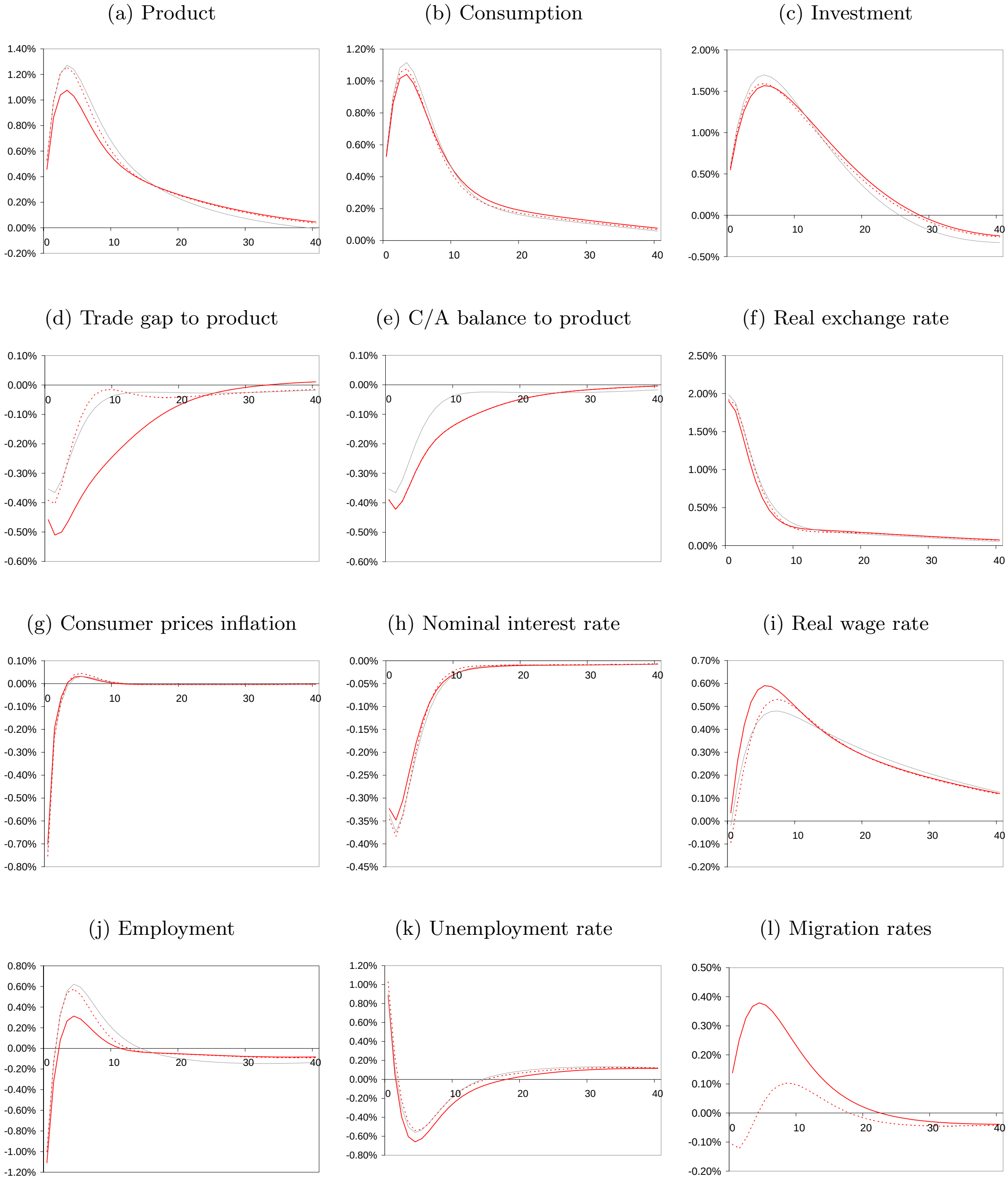
Rred lines show the responses of NMS12 variables under the open-border regime. Solid lines corresponds to the benchmark calibration of migration costs, dotted lines to migration costs 50% lower than in the benchmark, and dashed lines to migration costs 50% higher. Solid grey line shows the impulse responses under a closed labour market.

Figure 6: Positive TFP shock in the EU15: alternative modelling of home bias



Black lines show the responses of EU15 variables under the open-border regime. Solid line represents the benchmark model, while dotted lines assumes that temporary migrants consume in their country of residence. Solid grey line shows the impulse responses under a closed labour market.

Figure 7: Positive TFP shock in the NMS12: alternative modelling of home bias



Red lines show the responses of NMS12 variables under the open-border regime. Solid line represents the benchmark model, while dotted lines assumes that temporary migrants consume in their country of residence. Solid grey line shows the impulse responses under a closed labour market.

A Annex - Symmetric equilibrium

The shadow price of consumption:

$$\lambda_t =((c_t - h_c c_{t-1})/\iota)^{-\sigma} \tag{A.1}$$
$$\lambda^\star_t =((c^\star_t - h^\star_c c^\star_{t-1})/(1-\iota))^{-\sigma} \tag{A.2}$$

Household discount factor:

$$E_t\Lambda_{t+1,t} =\beta E_t \frac{\lambda_{t+1}}{\lambda_t} \tag{A.3}$$
$$E_t\Lambda^\star_{t+1,t} =\beta E_t \frac{\lambda^\star_{t+1}}{\lambda^\star_t} \tag{A.4}$$

The Euler's equation:

$$1 =E_t\Lambda_{t+1,t}(1+r_t)\frac{p_t}{p_{t+1}} \tag{A.5}$$
$$1 =E_t\Lambda^\star_{t+1,t}(1+r^\star_t)\frac{p^\star_t}{p^\star_{t+1}} \tag{A.6}$$

International financial market:

$$e^r_t = \bar{\xi}\frac{\lambda^\star_t}{\lambda_t} \tag{9}$$

Household budget constraints:

$$\begin{aligned} c_t + i_t + \frac{b_t}{p_t} = (1-t)\frac{w^H_t}{p_t}n^H_t + e^r_t(1-t^\star)\frac{w^{H\star}_t}{p^\star_t}n^{H\star}_t + \frac{\nu^H_t}{p_t}\bar{u}^H_t + e^r_t\frac{\nu^{H\star}_t}{p^\star_t}\bar{u}^{H\star}_t + \\ + r^K_t k_{t-1} + (1+r_{t-1})\frac{b_{t-1}}{p_t} + \frac{\Theta_t}{p_t} - \frac{\tau_t}{p_t} - \frac{X_t}{p_t} + e^r_t\frac{X^\star_t}{p^\star_t} \end{aligned} \tag{A.7}$$

$$\begin{aligned} c^\star_t + i^\star_t + \frac{b^\star_t}{p^\star_t} = (1-t^\star)\frac{w^{F\star}_t}{p^\star_t}n^{F\star}_t + (e^r_t)^{-1}(1-t)\frac{w^F_t}{p_t}n^F_t + \frac{\nu^{F\star}_t}{p^\star_t}\bar{u}^{F\star}_t + (e^r_t)^{-1}\frac{\nu^F_t}{p_t}\bar{u}^F_t + \\ + r^{K\star}_t k^\star_{t-1} + (1+r^\star_{t-1})\frac{b^\star_{t-1}}{p^\star_t} + (1+r^\star_{t-1}) + \frac{\Theta^\star_t}{p_t} - \frac{\tau^\star_t}{p_t} - \frac{X^\star_t}{p^\star_t} + (e^r_t)^{-1}\frac{X_t}{p_t} \end{aligned} \tag{A.8}$$

Capital accumulation:

$$k_{t+1} =(1-\delta)k_t + \big(1 - S(\frac{i_t}{i_{t-1}})\big)i_t \tag{10}$$
$$k^\star_{t+1} =(1-\delta^\star)k^\star_t + \big(1 - S^\star(\frac{i^\star_t}{i^\star_{t-1}})\big)i^\star_t \tag{A.9}$$

Capital adjustment costs:

$$S(\frac{i_t}{i_{t-1}} - 1) = \frac{\bar{S}}{2}(\frac{i_t}{i_{t-1}} - 1)^2 \tag{11}$$

$$S^\star(\frac{i_t^\star}{i_{t-1}^\star}) = \frac{\bar{S}^\star}{2}(\frac{i_t^\star}{i_{t-1}^\star} - 1)^2 \tag{A.10}$$

The Tobin-Q:

$$Q_t = \frac{\lambda_t^K}{\lambda_t} \tag{A.11}$$

$$Q_t^\star = \frac{\lambda_t^{K\star}}{\lambda_t^\star} \tag{A.12}$$

The value of installed capital:

$$Q_t = E_t \Lambda_{t+1,t} \big(r_{t+1}^K + (1-\delta) Q_{t+1}\big) \tag{A.13}$$

$$Q_t^\star = E_t \Lambda_{t+1,t}^\star \big(r_{t+1}^{K\star} + (1-\delta^\star) Q_{t+1}^\star\big) \tag{A.14}$$

Investment demand:

$$Q_t\Big(\big(1 - S(\frac{i_t}{i_{t-1}})\big) - S'(\frac{i_t}{i_{t-1}})\frac{i_t}{i_{t-1}}\Big) = 1 - E_t\big(\Lambda_{t+1,t} Q_{t+1} S'(\frac{i_{t+1}}{i_t})(\frac{i_{t+1}}{i_t})^2\big) \tag{A.15}$$

$$Q_t^\star\Big(\big(1 - S^\star(\frac{i_t^\star}{i_{t-1}^\star})\big) - S^{\star\prime}(\frac{i_t^\star}{i_{t-1}^\star})\frac{i_t^\star}{i_{t-1}^\star}\Big) = 1 - E_t\big(\Lambda_{t+1,t}^\star Q_{t,t+1}^\star S^{\star\prime}(\frac{i_{t+1}^\star}{i_t^\star})(\frac{i_{t+1}^\star}{i_t^\star})^2\big) \tag{A.16}$$

Production function:

$$y_t = A_t n_t^\alpha k_t^{1-\alpha} \tag{A.17}$$

$$y_t^\star = A_t^\star (n_t^\star)^{\alpha^\star} (k_t^\star)^{1-\alpha^\star} \tag{A.18}$$

Employment composite:

$$n_t = \big((n_t^H)^{1-\rho} + \omega (n_t^F)^{1-\rho}\big)^{\frac{1}{1-\rho}} \tag{A.19}$$

$$n_t^\star = \big((n_t^{F\star})^{1-\rho^\star} + \omega^\star (n_t^{H\star})^{1-\rho^\star}\big)^{\frac{1}{1-\rho^\star}} \tag{A.20}$$

The real cost of capital:

$$(1-\alpha) mc_t \frac{y_t}{k_t} = \frac{p_t}{p_t^H} r_t^K \tag{A.21}$$

$$(1-\alpha^\star) mc_t^\star \frac{y_t^\star}{k_t^\star} = \frac{p_t^\star}{p_t^{F\star}} r_t^{K\star} \tag{A.22}$$

Profits:

$$\frac{\Theta_t}{p_t} = \frac{p_t^H}{p_t}\Big((1-\frac{\psi}{2}(\pi_t^H)^2 - \frac{\bar{\kappa} v_t}{\iota})y_t^H + e_t^r \frac{p_t^{H\star}}{p_t^\star}(\frac{p_t^H}{p_t})^{-1}(1-\frac{\psi^\star}{2}(\pi_t^{H\star})^2 - \frac{\bar{\kappa} v_t}{\iota})y_t^{H\star} - n_t^H \frac{w_t^H}{p_t^H} - n_t^F \frac{w_t^F}{p_t^H} - \frac{p_t}{p_t^H} r_t^K k_{t-1}\Big) \tag{A.23}$$

$$\frac{\Theta_t^\star}{p_t^\star} = \frac{p_t^{F\star}}{p_t^\star}\Big((1-\frac{\psi^\star}{2}(\pi_t^{F\star})^2 - \frac{\bar{\kappa}^\star v_t^\star}{(1-\iota)} v_t^\star)y_t^{F\star} + (e_t^r)^{-1} \frac{p_t^F}{p_t}(\frac{p_t^{F\star}}{p_t^\star})^{-1}(1-\frac{\psi}{2}(\pi_t^F)^2 - \frac{\bar{\kappa}^\star v_t^\star}{(1-\iota)})y_t^F - n_t^{F\star} \frac{w_t^{F\star}}{p_t^{F\star}} - n_t^{H\star} \frac{w_t^{H\star}}{p_t^{F\star}} - \frac{p_t^\star}{p_t^{F\star}} r_t^{K\star} k_{t-1}^\star\Big) \tag{A.24}$$

Vacancy costs:

$$\kappa_t = \bar{\kappa}\iota^{-1}\big(y_t^H + e_t^r(\frac{p_t^{H\star}}{p_t^\star})(\frac{p_t^H}{p_t})^{-1} y_t^{H\star}\big) \tag{A.25}$$

$$\kappa_t^\star = \bar{\kappa}^\star(1-\iota)^{-1}\big(y_t^{F\star} + (e_t^r)^{-1}(\frac{p_t^{F\star}}{p_t^\star})^{-1}(\frac{p_t^F}{p_t})y_t^F\big) \tag{A.26}$$

Firm discount factor:

$$E_t\tilde{\Lambda}_{t+1,t} = E_t\Lambda_{t+1,t}\frac{p_{t+1}^H}{p_t^H}(\frac{p_{t+1}}{p_t})^{-1} \tag{A.27}$$

$$E_t\tilde{\Lambda}_{t+1,t}^\star = E_t\Lambda_{t+1,t}^\star\frac{p_{t+1}^{F\star}}{p_t^{F\star}}(\frac{p_{t+1}^\star}{p_t^\star})^{-1} \tag{A.28}$$

The value of a job:

$$J_t^H = mc_t\alpha\frac{y_t}{n_t}(\frac{n_t}{n_t^H})^\rho - \frac{w_t^H}{p_t^H} + E_t\big(\tilde{\Lambda}_{t+1,t}(1-s)J_{t+1}^H\big) \tag{A.29}$$

$$J_t^F = \omega mc_t\alpha\frac{y_{i,t}}{n_t}(\frac{n_t}{n_t^F})^\rho - \frac{w_t^F}{p_t^H} + E_t\big(\tilde{\Lambda}_{t+1,t}(1-s)J_{t+1}^F\big) \tag{A.30}$$

$$J_t^{F\star} = mc_t^\star\alpha^\star\frac{y_{i,t}^\star}{n_t^\star}(\frac{n_t^\star}{n_t^{F\star}})^{\rho^\star} - \frac{w_t^{F\star}}{p_t^{F\star}} + E_t\big(\tilde{\Lambda}_{t+1,t}^\star(1-s^\star)J_{t+1}^{F\star}\big) \tag{A.31}$$

$$J_t^{H\star} = \omega^\star mc_t^\star\alpha^\star\frac{y_t^\star}{n_t^\star}(\frac{n_t^\star}{n_t^{H\star}})^{\rho^\star} - \frac{w_t^{H\star}}{p_t^{F\star}} + E_t\big(\tilde{\Lambda}_{t+1,t}^\star(1-s^\star)J_{t+1}^{H\star}\big) \tag{A.32}$$

Job creation condition:

$$\frac{\kappa_t}{q(\theta_t)} = \eta_t J_t^H + (1-\eta_t)J_t^F \tag{A.33}$$

$$\frac{\kappa_t^\star}{q(\theta_t^\star)} = \eta_t^\star J_t^{F\star} + (1-\eta_t^\star)J_t^{H\star} \tag{A.34}$$

Producer price inflation:

$$\pi_t^H = \frac{p_t^H}{p_{t-1}^H} - 1 \qquad \pi_t^F = \frac{p_t^F}{p_{t-1}^F} - 1 \tag{A.35}$$

$$\pi_t^{H\star} = \frac{p_t^{H\star}}{p_{t-1}^{H\star}} - 1 \qquad \pi_t^{F\star} = \frac{p_t^{F\star}}{p_{t-1}^{F\star}} - 1 \tag{A.36}$$

Pricing:

$$\begin{aligned}\Big((1-\epsilon)\big(1-\frac{\psi}{2}(\pi_t^H)^2 - \bar{\kappa}\iota^{-1}v_t\big) + \epsilon mc_t\Big) - \psi(1+\pi_t^H)\pi_t^H + \\ E_t\tilde{\Lambda}_{t,t+1}\psi(1+\pi_{t+1}^H)\pi_{t+1}^H\frac{y_{t+1}^H}{y_t^H} = 0\end{aligned} \tag{A.37}$$

$$\begin{aligned}\Big((1-\epsilon)\big(1-\frac{\psi^\star}{2}(\pi_t^{H\star})^2 - \bar{\kappa}\iota^{-1}v_t\big) + \epsilon mc_t(e_t^r\frac{p_t^{H\star}}{p_t^\star}\frac{p_t}{p_t^H})^{-1}\Big) - \psi^\star(1+\pi_t^{H\star})\pi_t^{H\star} + \\ E_t\tilde{\Lambda}_{t,t+1}\frac{e_{t+1}^r}{e_t^r}\frac{p_{t+1}^{H\star}}{p_{t+1}^\star}(\frac{p_{t+1}^H}{p_{t+1}})^{-1}(\frac{p_t^{H\star}}{p_t^\star})^{-1}\frac{p_t^H}{p_t}\psi^\star(1+\pi_t^{H\star})\pi_t^{H\star}\frac{y_{t+1}^{H\star}}{y_t^{H\star}} = 0\end{aligned} \tag{A.38}$$

$$\begin{aligned}\Big((1-\epsilon^\star)\big(1-\frac{\psi^\star}{2}(\pi_t^{F\star})^2 - \bar{\kappa}^\star(1-\iota)^{-1}v_t^\star\big) + \epsilon^\star mc_t^\star\Big) - \psi^\star(1+\pi_t^{F\star})\pi_t^{F\star} + \\ E_t\tilde{\Lambda}_{t,t+1}^\star\psi^\star(1+\pi_{t+1}^{F\star})\pi_{t+1}^{F\star}\frac{y_{t+1}^{F\star}}{y_t^{F\star}} = 0\end{aligned} \tag{A.39}$$

$$\begin{aligned}\Big((1-\epsilon^\star)\big(1-\frac{\psi}{2}(\pi_t^F)^2 - \bar{\kappa}^\star(1-\iota)^{-1}v_t^\star\big) + \epsilon mc_t^\star e_t^r\frac{p_t^{F\star}}{p_t^\star}\frac{p_t}{p_t^F}\Big) - \psi(1+\pi_t^F)\pi_t^F + \\ E_t\tilde{\Lambda}_{t,t+1}^\star(\frac{e_{t+1}^r}{e_t^r})^{-1}(\frac{p_{t+1}^{F\star}}{p_{t+1}^\star})^{-1}\frac{p_{t+1}^F}{p_{t+1}}\frac{p_t^{F\star}}{p_t^\star}(\frac{p_t^F}{p_t})^{-1}\psi(1+\pi_{t+1}^F)\pi_{t+1}^F\frac{y_{t+1}^F}{y_t^F} = 0\end{aligned} \tag{A.40}$$

Product markets clearing:

$$a(\frac{p_t^H}{p_t})^{-\phi}(c_t + i_t + g_t) = y_t^H - \frac{\bar{\psi}}{2}(\pi_t^H)^2 y_t^H - \bar{\kappa}\iota^{-1}v_t y_t^H \tag{78}$$

$$(1-a^\star)(\frac{p_t^{H\star}}{p_t^\star})^{-\phi^\star}(c_t^\star + i_t^\star + g_t^\star) = y_t^{H\star} - \frac{\bar{\psi}^\star}{2}(\pi_t^{H\star})^2 y_t^{H\star} - \bar{\kappa}\iota^{-1}v_t y_t^{H\star} \tag{79}$$

$$a^\star(\frac{p_t^{F\star}}{p_t^\star})^{-\phi^\star}(c_t^\star + i_t^\star + g_t^\star) = y_t^{F\star} - \frac{\bar{\psi}^\star}{2}(\pi_t^{F\star})^2 y_t^{F\star} - \bar{\kappa}^\star(1-\iota)^{-1}v_t^\star y_t^{F\star} \tag{80}$$

$$(1-a)(\frac{p_t^F}{p_t})^{-\phi}(c_t + i_t + g_t) = y_t^F - \frac{\bar{\psi}}{2}(\pi_t^F)^2 y_t^F - \bar{\kappa}^\star(1-\iota)^{-1}v_t^\star y_t^F \tag{81}$$

Consumer price index:

$$p_t = \big(a(p_t^H)^{1-\phi} + (1-a)(p_t^F)^{1-\phi}\big)^{\frac{1}{1-\phi}} \tag{20}$$

$$p_t^\star = \big(a^\star(p_t^{F\star})^{1-\phi^\star} + (1-a^\star)(p_t^{H\star})^{1-\phi^\star}\big)^{\frac{1}{1-\phi^\star}} \tag{A.41}$$

Consumer price inflation:

$$\pi_t = \frac{p_t}{p_{t-1}} - 1 \tag{A.42}$$

$$\pi_t^\star = \frac{p_t^\star}{p_{t-1}^\star} - 1 \tag{A.43}$$

Labour market tightness:

$$\theta_t = \frac{v_t}{u_t} \tag{A.44}$$

$$\theta_t^\star = \frac{v_t^\star}{u_t^\star} \tag{A.45}$$

The probability of finding a worker:

$$q(\theta_t) = \bar{m}(\theta_t)^{-\varsigma} \tag{A.46}$$

$$q(\theta_t^\star) = \bar{m}^\star(\theta_t^\star)^{-\varsigma^\star} \tag{A.47}$$

The aggregate unemployment level at beginning of a period :

$$u_t = u_t^H + u_t^F \tag{A.48}$$

$$u_t^\star = u_t^{F\star} + u_t^{H\star} \tag{A.49}$$

The unemployment level at the beginning of a period:

$$u_t^H = \bar{u}_{t-1}^H + s n_{t-1}^H \tag{62}$$

$$u_t^F = \bar{u}_{t-1}^F + s n_{t-1}^F \tag{63}$$

$$u_t^{F\star} = \bar{u}_{t-1}^{F\star} + s^\star n_{t-1}^{F\star} \tag{A.50}$$

$$u_t^{H\star} = \bar{u}_{t-1}^{H\star} + s^\star n_{t-1}^{H\star} \tag{A.51}$$

The share of natives in unemployment:

$$\eta_t = \frac{u_t^H}{u_t^H + u_t^F} \tag{A.52}$$

$$\eta_t^\star = \frac{u_t^{F\star}}{u_t^{F\star} + u_t^{H\star}} \tag{A.53}$$

The evolution of employment:

$$n_t^H = (1-s)n_{t-1}^H + \theta_t q(\theta_t) u_t^H \tag{A.54}$$

$$n_t^F = (1-s)n_{t-1}^F + \theta_t q(\theta_t) u_t^F \tag{A.55}$$

$$n_t^{F\star} = (1-s^\star)n_{t-1}^{F\star} + \theta_t^\star q^\star(\theta_t^\star) u_t^{F\star} \tag{A.56}$$

$$n_t^{H\star} = (1-s^\star)n_{t-1}^{H\star} + \theta_t^\star q^\star(\theta_t^\star) u_t^{H\star} \tag{A.57}$$

Labour market equilibrium:

$$\bar{u}_t^H + \bar{u}_t^{H\star} = \iota - n_t^H - n_t^{H\star} \tag{64}$$

$$\bar{u}_t^F + \bar{u}_t^{F\star} = 1 - \iota - n_t^F - n_t^{F\star} \tag{A.58}$$

Migration flows:

$$\bar{u}_t^H + \bar{u}_t^{H\star} = u_t^H\big(1 - \theta_t q(\theta_t)\big) + u_t^{H\star}\big(1 - \theta_t^\star q(\theta_t^\star)\big) \tag{47}$$

$$\bar{u}_t^{F\star} + \bar{u}_t^F = u_t^{F\star}\big(1 - \theta_t^\star q(\theta_t^\star)\big) + u_t^F\big(1 - \theta_t q(\theta_t)\big) \tag{48}$$

Migration cost:

$$\frac{X_t}{p_t} = \frac{\bar{x}}{2}\Big(\bar{u}_t^H - \big(1 - \theta_t q(\theta_t)\big)u_t^H\Big)^2 e_t^r \frac{w_t^\star}{p_t^\star} \tag{49}$$

$$\frac{X_t^\star}{p_t^\star} = \frac{\bar{x^\star}}{2}\Big(\bar{u}_t^{F\star} - \big(1 - \theta_t^\star q(\theta_t^\star)\big)u_t^{F\star}\Big)^2 (e_t^r)^{-1}\frac{w_t}{p_t} \tag{A.59}$$

The marginal cost of migration:

$$\frac{x_t^H}{p_t} = -\frac{x_t^{H\star}}{p_t} = \bar{x}(\bar{u}_t^H - \big(1 - \theta_t q(\theta_t)\big)u_t^H\Big)e_t^r \frac{w_t^\star}{p_t^\star} \tag{50}$$

$$\frac{x_t^{F\star}}{p_t^\star} = -\frac{x_t^F}{p_t^\star} = \bar{x}^\star\Big(\bar{u}_t^{F\star} - \big(1 - \theta_t^\star q(\theta_t^\star)\big)u_t^{F\star}\Big)(e_t^r)^{-1}\frac{w_t}{p_t} \tag{A.60}$$

Migration condition:

$$\begin{aligned} &\frac{\nu_t^H}{p_t} - \frac{x_t^H}{p_t} + \frac{\mu}{1-\mu}\theta_{t+1} q(\theta_{t+1})\frac{p_t^H}{p_t} E_t \tilde{\Lambda}_{t+1,t} J_{t+1}^H = \\ &e_t^r \frac{\nu_t^{H\star}}{p_t^\star} - \frac{\upsilon_t}{\lambda_t} - \frac{x_t^{H\star}}{p_t} + \frac{\mu^\star}{1-\mu^\star}\theta_{t+1}^\star q(\theta_{t+1}^\star) e_t^r \frac{p_t^{F\star}}{p_t^\star} E_t \tilde{\Lambda}_{t+1,t}^\star J_{t+1}^{H\star} \end{aligned} \tag{A.61}$$

$$\begin{aligned} &\frac{\nu_t^{F\star}}{p_t^\star} - \frac{x_t^{F\star}}{p_t^\star} + \frac{\mu^\star}{1-\mu^\star}\theta_{t+1}^\star q(\theta_{t+1}^\star)\frac{p_t^{F\star}}{p_t^\star} E_t \tilde{\Lambda}_{t+1,t}^\star J_{t+1}^{F\star} = \\ &(e_t^r)^{-1}\frac{\nu_t^F}{p_t} - \frac{\upsilon_t^\star}{\lambda_t^\star} - \frac{x_t^F}{p_t^\star} + \frac{\mu}{1-\mu}\theta_{t+1} q(\theta_{t+1})(e_t^r)^{-1}\frac{p_t^H}{p_t} E_t \tilde{\Lambda}_{t+1,t} J_{t+1}^F \end{aligned} \tag{A.62}$$

The Nash bargained wage:

$$\begin{aligned}\frac{\tilde{w}_t^H}{p_t} =&(1-\bar{\mu})(1-t)^{-1}(\frac{\nu_t^H}{p_t}+\frac{\chi}{\lambda_t}-\frac{x_t^H}{p_t})+\\ &\bar{\mu}\frac{p_t^H}{p_t}\big(mc_t\alpha\frac{y_t}{n_t}(\frac{n_t}{n_t^H})^{\rho}+\theta_{t+1}q(\theta_{t+1})(1-s_t)E_t(\tilde{\Lambda}_{t+1,t}J_{t+1}^H)\big)\end{aligned} \tag{45}$$

$$\begin{aligned}\frac{\tilde{w}_t^F}{p_t} =&(1-\bar{\mu})(1-t)^{-1}(\frac{\nu_t^F}{p_t}+e_t^r\frac{\chi^\star}{\lambda_t^\star}-e_t^r\frac{\upsilon_t^\star}{\lambda_t^\star}-e_t^r\frac{x_t^F}{p_t^\star})+\\ &\bar{\mu}\frac{p_t^H}{p_t}\big(\omega mc_t\alpha\frac{y_{i,t}}{n_{i,t}}(\frac{n_{i,t}}{n_{i,t}^F})^{\rho}+\theta_{t+1}q(\theta_{t+1})(1-s_t)E_t(\tilde{\Lambda}_{t+1,t}J_{t+1}^F)\big)\end{aligned} \tag{A.63}$$

$$\begin{aligned}\frac{\tilde{w}_t^{F\star}}{p_t^\star} =&(1-\bar{\mu}^\star)(1-t)^{-1}(\frac{\nu_t^{F\star}}{p_t^\star}+\frac{\chi^\star}{\lambda_t^\star}-\frac{x_t^{F\star}}{p_t^\star})+\\ &\bar{\mu}^\star\frac{p_t^{F\star}}{p_t^\star}\big(mc_t^\star\alpha^\star\frac{y_t^\star}{n_t^\star}(\frac{n_t^\star}{n_t^{F\star}})^{\rho^\star}+\theta_{t+1}^\star q(\theta_{t+1}^\star)(1-s_t^\star)E_t(\tilde{\Lambda}_{t+1,t}^\star J_{t+1}^{F\star})\big)\end{aligned} \tag{A.64}$$

$$\begin{aligned}\frac{\tilde{w}_t^{H\star}}{p_t^\star} =&(1-\bar{\mu}^\star)(1-t)^{-1}(\frac{\nu_t^{H\star}}{p_t^\star}+(e_t^r)^{-1}\frac{\chi}{\lambda_t}-(e_t^r)^{-1}\frac{\upsilon_t}{\lambda_t}-(e_t^r)^{-1}\frac{x_t^{H\star}}{p_t})+\\ &\bar{\mu}^\star\frac{p_t^{F\star}}{p_t^\star}\big(\omega^\star mc_t^\star\alpha^\star\frac{y_t^\star}{n_t^\star}(\frac{n_t^\star}{n_t^{H\star}})^{\rho^\star}+\theta_{t+1}^\star q(\theta_{t+1}^\star)(1-s_t^\star)E_t(\tilde{\Lambda}_{t+1,t}^\star J_{t+1}^{H\star})\big)\end{aligned} \tag{A.65}$$

$$\bar{\mu} =\mu\big((1-\mu)(1-t)+\mu\big)^{-1} \tag{A.66}$$

$$\bar{\mu}^\star =\mu\big((1-\mu^\star)(1-t)+\mu^\star\big)^{-1} \tag{A.67}$$

Wages:

$$\frac{w_t^H}{p_t} =\vartheta\frac{\tilde{w}_t^H}{p_t}+(1-\vartheta)\frac{\tilde{w}^H}{p} \tag{A.68}$$

$$\frac{w_t^F}{p_t} =\vartheta\frac{\tilde{w}_t^F}{p_t}+(1-\vartheta)\frac{\tilde{w}^F}{p} \tag{A.69}$$

$$\frac{w_t^{F\star}}{p_t} =\vartheta^\star\frac{\tilde{w}_t^{F\star}}{p_t}+(1-\vartheta^\star)\frac{\tilde{w}^{F\star}}{p} \tag{A.70}$$

$$\frac{w_t^{H\star}}{p_t} =\vartheta^\star\frac{\tilde{w}_t^{H\star}}{p_t}+(1-\vartheta^\star)\frac{\tilde{w}^{H\star}}{p} \tag{A.71}$$

The average wage:

$$w_t =\frac{n_t^H w_t^H+n_t^F w_t^F}{n_t^H+n_t^F} \tag{A.72}$$

$$w_t^\star =\frac{n_t^{F\star}w_t^{F\star}+n_t^{H\star}w_t^{H\star}}{n_t^{F\star}+n_t^{H\star}} \tag{A.73}$$

Monetary policy:

$$r_t =h_r r_{t-1}+(1-h_r)(r+h_\pi\pi_t) \tag{51}$$

$$r_t^\star =h_r^\star r_{t-1}^\star+(1-h_r^\star)(r^\star+h_\pi^\star\pi_t^\star) \tag{A.74}$$

Government policy:

$$g_t + \frac{\nu_t^H}{p_t} u_t^H + \frac{\nu_t^F}{p_t} u_t^F + \frac{b_{t-1}}{p_t}(1+r_t) = \frac{\tau_t}{p_t} + \frac{b_t}{p_t} + t(\frac{w_t^H}{p_t} n_t^H + \frac{w_t^F}{p_t} n_t^F) \tag{52}$$

$$g_t^\star + \frac{\nu_t^{F\star}}{p_t^\star} u_t^{F\star} + \frac{\nu_t^{H\star}}{p_t^\star} u_t^{H\star} + \frac{b_{t-1}^\star}{p^\star}(1+r_t^\star) = \frac{\tau_t^\star}{p_t^\star} + \frac{b_t^\star}{p^\star} + t^\star(\frac{w_t^{F\star}}{p_t^\star} n_t^{F\star} + \frac{w_t^{H\star}}{p_t^\star} n_t^{H\star}) \tag{A.75}$$

Budget adjustment rule:

$$\frac{\tau_t}{p_t} = h_\tau \frac{\tau_{t-1}}{p_{t-1}} + (1-h_\tau)(\frac{\tau}{p} + h_b \frac{b_{t-1}}{p_t}) \tag{55}$$

$$\frac{\tau_t^\star}{p_t^\star} = h_\tau^\star \frac{\tau_{t-1}^\star}{p_{t-1}^\star} + (1-h_\tau^\star)(\frac{\tau^\star}{p^\star} + h_b^\star \frac{b_{t-1}^\star}{p_t^\star}) \tag{A.76}$$

Government spending:

$$g_t = (1-h_g)\bar{g}(c_t + i_t) + h_g g_{t-1} \tag{53}$$

$$g_t^\star = (1-h_g^\star)\bar{g}^\star(c_t^\star + i_t^\star) + h_g g_{t-1}^\star \tag{A.77}$$

Unemployment benefits:

$$\nu_t^H = \bar{\nu}^H w_t \qquad \nu_t^F = \bar{\nu}^F w_t \tag{55}$$

$$\nu_t^{F\star} = \bar{\nu}^{F\star} w_t^\star \qquad \nu_t^{H\star} = \bar{\nu}^{H\star} w_t^\star \tag{A.78}$$

Total factor productivity:

$$A_t = h_A A_{t-1} + (1-h_A)A + \epsilon_{A,t} \tag{22}$$

$$A_t^\star = h_A^\star A_{t-1}^\star + (1-h_A^\star)A^\star + \epsilon_{A,t}^\star \tag{A.79}$$

Migration preference shocks:

$$\upsilon_t = (1-h_\upsilon)\upsilon + h_\upsilon \upsilon_{t-1} + \epsilon_{\upsilon,t} \tag{1}$$

$$\upsilon_t^\star = (1-h_\upsilon^\star)\upsilon^\star + h_\upsilon^\star \upsilon_{t-1}^\star + \epsilon_{\upsilon,t}^\star \tag{A.80}$$

B Annex - Variations of the Model

B.1 Law-of-one-price

Under the law-of-one-price the price of a variety is equal on the two markets when expressed in the same currency:

$$p_{i,t}^{H} = e_t p_{i,t}^{H\star} \tag{B.1}$$

$$p_{i,t}^{F} = e_t p_{i,t}^{F\star} \tag{B.2}$$

The pricing conditions take a form:

$$\begin{aligned}
&[(1-\epsilon)(1-\frac{\psi}{2}(\frac{p_t^H}{p_{t-1}^H}-1)^2\frac{y_t^H}{y_t}-\frac{\psi^\star}{2}(\frac{p_t^H}{p_{t-1}^H}\frac{e_{t-1}}{e_t}-1)^2\frac{y_t^{H\star}}{y_t}-\bar{\kappa}\iota^{-1}v_t)+\epsilon mc_t]-\\
&-\psi\frac{p_t^H}{p_{t-1}^H}(\frac{p_t^H}{p_{t-1}^H}-1)\frac{y_t^H}{y_t}-\psi^\star(\frac{p_t^H}{p_{t-1}^H}\frac{e_{t-1}}{e_t})(\frac{p_t^H}{p_{t-1}^H}\frac{e_{t-1}}{e_t}-1)\frac{y_t^{H\star}}{y_t}+\\
&+E_t\tilde{\Lambda}_{t,t+1}(\psi(\frac{p_{t+1}^H}{p_t^H})(\frac{p_{t+1}^H}{p_t^H}-1)\frac{y_{t+1}^H}{y_{t+1}}+\psi^\star(\frac{p_{t+1}^H}{p_t^H}\frac{e_t}{e_{t+1}})(\frac{p_{t+1}^H}{p_t^H}\frac{e_t}{e_{t+1}}-1)\frac{y_{t+1}^{H\star}}{y_{t+1}})\frac{y_{t+1}}{y_t}=0
\end{aligned} \tag{B.3}$$

$$\begin{aligned}
&[(1-\epsilon^\star)(1-\frac{\psi^\star}{2}(\frac{p_t^{F\star}}{p_{t-1}^{F\star}}-1)^2\frac{y_t^{F\star}}{y_t^\star}-\frac{\psi}{2}(\frac{p_t^{F\star}}{p_{t-1}^{F\star}}\frac{e_t}{e_{t-1}}-1)^2\frac{y_t^F}{y_t^\star}-\bar{\kappa}^\star(1-\iota)^{-1}v_t^\star)+\epsilon^\star mc_t^\star]-\\
&-\psi^\star\frac{p_t^{F\star}}{p_{t-1}^{F\star}}(\frac{p_t^{F\star}}{p_{t-1}^{F\star}}-1)\frac{y_t^{F\star}}{y_t^\star}-\psi(\frac{p_t^{F\star}}{p_{t-1}^{F\star}}\frac{e_t}{e_{t-1}})(\frac{p_t^{F\star}}{p_{t-1}^{F\star}}\frac{e_t}{e_{t-1}}-1)\frac{y_t^F}{y_t}+\\
&+E_t\tilde{\Lambda}_{t,t+1}^\star(\psi^\star(\frac{p_{t+1}^{F\star}}{p_t^{F\star}})(\frac{p_{t+1}^{F\star}}{p_t^{F\star}}-1)\frac{y_{t+1}^{F\star}}{y_{t+1}^\star}+\psi(\frac{p_{t+1}^{F\star}}{p_t^{F\star}}\frac{e_{t+1}}{e_t})(\frac{p_{t+1}^{F\star}}{p_t^{F\star}}\frac{e_{t+1}}{e_t}-1)\frac{y_{t+1}^F}{y_{t+1}^\star})\frac{y_{t+1}^\star}{y_t^\star}=0
\end{aligned} \tag{B.4}$$

B.2 Implemented home-bias

Let φ be a share of stayers in the population of H, namely $\varphi_t = (n_t^H + \bar{u}_t^H)\iota^{-1}$. The members of the domestic household are assumed to pool their income before choosing their per capita consumption and investments, but consumption goods of temporary emigrants are purchased abroad.

B.2.1 Production sector

In each economy there are two types of final goods produced to serve different needs of natives and temporary immigrants. In H that is Y (defined as in the benchmark model) and $\tilde{Y}$. The latter equals:

$$\tilde{Y}_t = ((a^\star)^{\frac{1}{\phi^\star}}(y_t^F)^{\frac{\phi^\star-1}{\phi^\star}} + (1-a^\star)^{\frac{1}{\phi^\star}}(y_t^H)^{\frac{\phi^\star-1}{\phi^\star}})^{\frac{\phi^\star}{\phi^\star-1}} \tag{B.5}$$

Therefore, the composite $\tilde{Y}$ is similar to $Y^\star$ but involves the inputs of goods traded in H. In F the consumption good purchased by immigrants is denoted by $\tilde{Y}^\star$. The price of goods for immigrants are:

$$\tilde{p}_t = (a^\star(p_t^F)^{1-\phi^\star} + (1-a^\star)(p_t^H)^{1-\phi^\star})^{\frac{1}{1-\phi^\star}} \tag{B.6}$$

$$\tilde{p}_t^\star = (a(p_t^{H\star})^{1-\phi} + (1-a)(p_t^H)^{1-\phi})^{\frac{1}{1-\phi}} \tag{B.7}$$

The demand for home produced goods equals:

$$a(\frac{p_t^H}{p_t})^{-\phi}(\varphi_t c_t + i_t + g_t) + (1-a^\star)(\frac{p_t^H}{\tilde{p}_t})^{-\phi^\star}(1-\varphi_t^\star)c_t^\star \tag{B.8}$$

and for foreign produced goods:

$$(1-a)(\frac{p_t^F}{p_t})^{-\phi}(\varphi_t c_t + i_t + g_t) + a^\star(\frac{p_t^F}{\tilde{p}_t})^{-\phi^\star}(1-\varphi_t^\star)c_t^\star \tag{B.9}$$

B.2.2 Household Decisions

Choosing their per capita consumption level household members take into account the following budget constraint:

$$\Psi_t c_t + i_t + \frac{b_t}{p_t} \leq \frac{W_t}{p_t} + r_t^K k_t + (1+r_{t-1})\frac{b_{t-1}}{p_t} + \frac{\Theta_t}{p_t} - \frac{\tau_t}{p_t} - \frac{X_t}{p_t} + e_t^r \frac{X_t^\star}{p_t^\star} \tag{B.10}$$

where $\Psi_t = \varphi_t + (1-\varphi_t)e_t^r \frac{\tilde{p}^\star}{p_t^\star}$. And a similar relative prices expression for the F household is $\Psi_t^\star = \varphi_t^\star + (1-\varphi_t^\star)(e_t^r)^{-1}\frac{\tilde{p}}{p_t}$. Shadow price of consumption for natives of H should now equal $\lambda_t = (\frac{c_t - h_c c_{t-1}}{\iota \Psi_t})^{-\sigma}$.

Transfers of earnings between economies (interpreted as remittances) are now of the form:

$$\begin{aligned} T = e_t^r(1-t^\star)\tfrac{w_t^{H\star}}{p_t^\star}n_t^{H\star} + e_t^r\tfrac{\nu_t^{H\star}}{p_t^\star}u_t^{H\star} - (1-\varphi_t)e_t^r\tfrac{\tilde{p}^\star}{p_t^{star}}c_t \\ -(1-t)\tfrac{w_t^F}{p_t}n_t^F + \tfrac{\nu_t^F}{p_t}u_t^F + (1-\varphi_t^\star)\tfrac{\tilde{p}}{p_t}c_t^\star \end{aligned} \tag{B.11}$$

The value function of a H-born employed in H is:

$$W_{i,t}^H = (1-t)\frac{w_{i,t}^H}{p_t} - \frac{\chi}{\lambda_t} - \frac{\partial \Psi_t}{\partial n_t^H}c_t + E_t(\Lambda_{t+1,t}((1-s_t)W_{i,t+1}^H + s_t(1-\theta_{t+1}q(\theta_{t+1}))V_{t+1}^H + s_t\theta_{t+1}q(\theta_{t+1})W_{t+1}^H)) \tag{B.12}$$

The value function of a H-born unemployed worker in H:

$$V_t^H = \frac{\nu_t^H}{p_t} - \frac{x_t^H}{p_t} - \frac{\partial \Psi_t}{\partial \bar{u}_t^H}c_t + E_t(\Lambda_{t+1,t}(\theta_{t+1}q(\theta_{t+1})(W_{t+1}^H - V_{t+1}^H) + V_{t+1}^H)) \tag{B.13}$$

The value function of a H-born who looks for a work abroad:

$$V_t^{H\star} = e_t^r\frac{\nu_t^{H\star}}{p_t^\star} - \frac{\upsilon_t}{\lambda_t} - \frac{x_t^{H\star}}{p_t} - \frac{\partial \Psi_t}{\partial \bar{u}_t^{H\star}}c_t + E_t(\Lambda_{t+1,t}(\theta_{t+1}^\star q(\theta_{t+1}^\star)(W_{t+1}^{H\star} - V_{t+1}^{H\star}) + V_{t+1}^{H\star})) \tag{B.14}$$

As $\frac{\partial \Psi_t}{\partial n_t^H}c_t = \frac{\partial \Psi_t}{\partial \bar{u}_t^H}c_t$ and $\frac{\partial \Psi_t}{\partial n_t^{H\star}}c_t = \frac{\partial \Psi_t}{\partial \bar{u}_t^{H\star}}c_t$ the wage bargaining conditions remain as in the benchmark model. The migration conditions are, however, modified to take account of a change in the average costs of a consumption good when a household member changes her place of residence:

$$\begin{aligned} \tfrac{\nu_t^H}{p_t} - \tfrac{x_t^H}{p_t} - \tfrac{\partial \Psi_t}{\partial \bar{u}_t^H}c_t + \tfrac{\mu}{1-\mu}\theta_t q_{t+1}(\theta_{t+1})\tfrac{p_t^H}{p_t}E_t\tilde{\Lambda}_{t+1,t}J_{t+1}^H = \\ e_t^r\tfrac{\nu_t^{H\star}}{p_t^\star} - \tfrac{\upsilon_t}{\lambda_t} - \tfrac{x_t^{H\star}}{p_t} + \tfrac{\mu^\star}{1-\mu^\star}\theta_{t+1}^\star q_{t+1}(\theta_{t+1}^\star)e_t^r\tfrac{p_t^{F\star}}{p_t^\star}E_t\tilde{\Lambda}_{t+1,t}^\star J_{t+1}^{H\star} \end{aligned} \tag{B.15}$$

where $\frac{\partial \Psi_t}{\partial \bar{u}_t^H} = -\frac{\partial \Psi_t}{\partial \bar{u}_t^{H\star}} = \iota^{-1}(1 - e_t^r \frac{\tilde{p_t^\star}}{p_t^\star})$.

In the model version with transplanted home bias monetary and fiscal policies remain as in the benchmark model. Yet, the replacement of the inflation rate in the Tylor rule by the weighted average of (native and immigrant) consumption baskets prices does not significantly affect the results. A change in the government expenditures generating rule so that they stay proportional to the total private domestic demand affects in turn the steady-state solution of the model, which would complicate the comparison of the short-term dynamics of the model versions.

Acknowledgements

The author would like to thank Maciej Bukowski, Heinz Herrmann, Zbigniew Hockuba, Mathias Hoffmann, Michael Krause, Piotr Mechocki, Stéphane Moyen, Wolfgang Pointner, and Nikolai Stähler for helpful comments and suggestions.

Katarzyna Budnik
European Central Bank, Frankfurt am Main, Germany; email: katarzyna.budnik@ecb.europa.eu

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

This paper can be downloaded without charge from www.ecb.europa.eu, from the Social Science Research Network electronic library or from RePEc: Research Papers in Economics. Information on all of the papers published in the ECB Working Paper Series can be found on the ECB's website.

PDF ISBN 978-92-899-7844-6 ISSN 1725-2806 doi:10.2866/3141387 QB-01-26-114-EN-N