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Aggregate stability under a budget rule and labor mobility

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ABSTRACT

Whether a balanced budget rule stabilizes or destabilizes an economy depends on various factors such as the production function or the instrument used to balance the budget. This paper argues that migration, which has widely been neglected in the literature, also affects equilibrium properties. We study the effect of pro-cyclical labor mobility in a neoclassical growth model with public debt and a balanced budget requirement. Labor mobility can destabilize the economy due to external effects. After a negative shock hits the economy, living abroad becomes relatively more attractive, resulting in out-migration. This increases per capita public debt as migrants leave behind their implicit liabilities. The government increases tax rates to satisfy the balanced budget requirement, which further depresses the economy and increases out-migration. The destabilizing effect of public debt kicks in at only slightly higher debt levels than the ones observed in the Euro area after the financial crisis.

1. Introduction

Over the past 15 years, public debt levels in Europe have increased considerably. Prior to the financial crisis, average public debt in individual Euro area member states roughly equaled 70 percent of GDP. Due to measures to prevent a meltdown of the financial system during the financial crisis, budget deficits to support the economy during the Great Recession, and the slow economic recovery especially in the periphery of the Euro area public debt increased to over 90 percent of GDP in 2014.

In 2020, public indebtedness relative to economic activity is expected to increase dramatically due to the COVID-19 pandemic. On the one hand, governments’ revenues have been eroding as containment measures and behavioral changes of individuals pushed the economy into the most severe recession since World War II. On the other hand, governments’ expenditures have been increasing due to expansionary fiscal policies to prevent the recession from being even more severe. The resulting increase in public indebtedness is especially troubling given the recent experience of the European Debt Crisis. Several member states had to pay severe premiums when borrowing or even lost access to financial markets due to doubts about their solvency. Via feedback loops between sovereign and banking sector insolvency, unfavorable financing conditions for governments transmitted to the financial sector of the respective countries (Farhi and Tirole, 2017).

This paper argues that high levels of public debt might be even more worrisome than recognized in the literature. This holds especially true in Europe, where labor mobility has increased substantially over the past decades (Beyer and Smets, 2015). On the one hand, labor mobility has been identified as an important mechanism to cushion adverse demand shocks. Increasing labor mobility has therefore been an explicit goal of European policymakers (Andor, 2014). On the other hand, labor mobility in the presence of public indebtedness has external effects as emigrants leave behind implicit liabilities: per capita public debt.

The literature already discusses potential negative effects of high public indebtedness. The vigorous debate about the effect of public debt on economic growth is probably the most prominent example (Reinhart et al., 2012). argue that economic growth sharply declines if public debt reaches a threshold value of about 90 percent of GDP (Herndon et al., 2013), challenge this view. There seems to be a negative correlation between public debt and economic growth. The threshold for the sharp decline of economic growth, however, seems to be sensitive to the weighting scheme and the sample period.

High public debt levels might also affect a government’s ability to respond to economic shocks with counter-cyclical fiscal policy. Bank-
ing crisis typically last longer for highly indebted countries than for countries with ample fiscal space (Baldacci et al., 2014). (Combes et al., 2017) show that countries with low public debt typically conduct counter-cyclical fiscal policy to dampen the business cycle. If, however, the stock of outstanding debt exceeds 86 percent of GDP, fiscal policy becomes pro-cyclical as debt sustainability becomes an issue. Using a general equilibrium model (Juesen et al., 2016), show that observed default premiums during the European Debt Crisis can be explained by the emergence of sovereign risk as governments reached their fiscal limit.

To prevent unsustainable public debt levels, the European Union introduced limits to government debt and deficits for their member states in the Maastricht Treaty. As a response to the Great Recession and the European Debt Crisis, the Stability and Growth Pact has been reformed in the Sixpack with the aim of ensuring sufficient fiscal space in future crises. The specific design of a budget rule has substantial implications for the welfare of such a rule (Landon and Smith, 2017).

The evolution balanced-budget rules depend on whether the government adjust the tax scheme (Zhang, 2020). In a seminal contribution (Schmitt-Grohe and Uribe, 1997), introduced budget requirement on the stability of the equilibrium allocation. In this paper, we augment a neoclassical growth model with labor mobility.\footnote{The literature incorporating labor mobility into general equilibrium models has been growing in recent years. These papers analyze economic growth (Rappaport, 2005; Larramona and Sanso, 2006; Vandenbroeck, 2008), the migration decision (Kanbur and Rapoport, 2005; Klein and Ventura, 2009), welfare effects (Battisti et al., 2017) or business cycle dynamics (Mandelman and Zlate, 2012; Hart and Clemens, 2019; Lozej, 2019). To the best of our knowledge, the interplay of labor mobility and public debt and the effect on aggregate stability has not been analyzed in the literature.}

The theoretical literature typically discusses the effects of a balanced budget requirement on the stability of the equilibrium allocation. In a seminal contribution (Schmitt-Grohe and Uribe, 1997), introduce a balanced-budget requirement into a neoclassical growth model with distortionary taxation of labor income. Such a rule can result in aggregate instability for empirically plausible parameter constellations. Many subsequent studies show that aggregate stability in models with balanced-budget rules depends on whether the government adjusts the budget via the income or via expenditures (Guo and Harrison, 2004), the supply of public goods (Palivos et al., 2003), the tax type (Giannitsarou, 2007), the utility function (Nourry et al., 2013), and the production function (Nishimura et al., 2013; Ghilardi and Rossi, 2014; Greiner and Bondarev, 2015).

In a small open economy, indeterminacy is less of an issue due to integration in international capital and goods markets (Meng and Xue, 2015; Huang et al., 2017). But even there, indeterminacy can occur depending on the level of production externalities and the tax scheme (Zhang, 2020).

We contribute to the literature on sustainability of public debt by introducing a widely neglected aspect: labor mobility.\footnote{The literature incorporating labor mobility into general equilibrium models has been growing in recent years. These papers analyze economic growth (Rappaport, 2005; Larramona and Sanso, 2006; Vandenbroeck, 2008), the migration decision (Kanbur and Rapoport, 2005; Klein and Ventura, 2009), welfare effects (Battisti et al., 2017) or business cycle dynamics (Mandelman and Zlate, 2012; Hart and Clemens, 2019; Lozej, 2019). To the best of our knowledge, the interplay of labor mobility and public debt and the effect on aggregate stability has not been analyzed in the literature.} The evolution of the population size since the Great Recession is another, admittedly purely descriptive, indicator that individuals take advantage of free movement within the Schengen area. Fig. 1 presents the evolution of total population for two countries that were heavily affected by the European Debt Crisis. Population growth has decreased substantially during the crisis.

In this paper, we augment a neoclassical growth model with labor mobility. When deciding on the country of residence, individuals compare individual flow utility in the domestic economy to an outside option that is – similar to the small open economy literature – unaffected by domestic variables. Following (Rappaport, 2005), population size exhibits a unit root. Investment takes place on the firm level; profits are transferred to domestic individuals. The government faces an initial stock of public debt and stabilizes per capita debt via consumption taxes.

We show that the interactions of labor mobility, public debt and the presence of a balanced budget requirement have implications for the stability of the economy. Under a standard parameterization and public debt levels only slightly higher than the ones observed in the Euro area after the financial crisis, the model ceases to be saddle-path stable. The mechanism is the following: A negative shock results in utility losses for domestic individuals. This makes living abroad relatively more attractive, resulting in out-migration. As public debt per capita increases, the government has to adjust the tax rate, putting further drag on the economy, resulting in further out-migration. Our results are robust with regard to the assumption about capital mobility and different assumptions about fiscal policy.

2. Model

We augment a real business cycle model with labor mobility. The economy is small relative to the rest of the world such that migration flows do not affect global variables.

2.1. Households

The economy is populated by $N$ infinitely-lived identical individuals. The index $i$ indicates that the respective variable is in per capita terms. The representative individual $i$ supplies one unit of labor inelastically and maximizes expected lifetime utility

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t) = E_0 \sum_{t=0}^{\infty} \beta^t \log(c_t)$$

where $E$ is the conditional expectations operator and $\beta$ is the discount factor with $0 < \beta < 1$. The representative individual derives utility from consumption $c_t$ and faces the budget constraint

$$(1 + r_{1t})c_t + d_t = w_{t} + (1 + r_{1t})d_{t, t-1} + \Pi_t.$$  

Consumption expenditures are subject to a distortionary consumption tax with the tax rate $r_{1t}$. Individuals receive labor income $w_{t}$ from supplying one unit of labor. They can transfer wealth to the next period by buying risk free bonds $d_t$ with the interest rate $r^d$. The return is known at the time of investment. Individual debt stays within the household sector. $\Pi_t$ represents lump sum transfers of firm profits to individual $i$.

The representative individual’s first order conditions can be summarized by the equation

$$\beta \frac{c_{it}}{c_{i,t+1}} \frac{1 + r_{1t}}{1 + r_{1t+1}} = \frac{1}{1 + r_{1t}^d}$$

2.2. Firms

Firms produce output according to a Cobb-Douglas production function. We aggregate individual firms and describe the maximization problem of the production sector. All variables are therefore in aggregate terms. Aggregate production $y_t$ requires the two input factors labor $h_t$, which each individual supplies inelastically, and working capital $k_{t-1}$ that is decided on in period $t - 1$. $a_t$ represents total factor productivity.

$$y_t = a_t k_{t-1} h_t^{1 - a}$$

Firms maximize the sum of discounted expected profits given the discount factor $\Lambda$

$$E_0 \sum_{t=0}^{\infty} \Lambda_{0,t} (y_t w_t h_t - k_t (1 - \delta) k_{t-1} + (1 + r_{1t}^d) b_{t-1} - b_t).$$

Accumulation of working capital takes place at the firm level. It is subject to the depreciation rate $\delta \in (0, 1)$. Besides working capital, firms buy government bonds $b_t$, which pay the risk free interest rate $r^d$.

This setup results in the first order conditions

$$w_t = (1 - a) \frac{Y_t}{h_t}$$

$$\frac{\Lambda_{0,t}}{\Lambda_{0,t+1}} = \frac{\delta Y_t}{k_{t-1}} (1 - \delta) = (1 + r_{1t}^d).$$
2.3. Government

The government faces an initial stock of public debt $b_{t-1}$, which is held by domestic firms. Each period, the government has expenditures due to repaying maturing public debt and due to wasteful government consumption $g$. Government consumption is proportional to the population size $N_{t-1}$.

Per capita government consumption $g_t$ depends on economic activity. The government raises income by taxing households’ consumption expenditures and has income due to issuing debt that has to be repaid in the following period. The budget constraint reads

$$(1 + r_{t-1}) \Delta b_{t-1} + g\gamma_{t-1} N_{t-1} = b_t + \tau_t c_t,$$

where $c_t = \sum_{i=1}^{N_{t-1}} c_{i}$ represents aggregate consumption expenditures of households. The government stabilizes per capita debt such that $b_t = b_{t-1} = b_t$. The literature typically abstracts from labor mobility and assumes that the population is constant. In such a setup, stabilizing debt and stabilizing per capita debt are equivalent. This is not the case if the workforce is mobile. We assess stabilizing capita debt to be more sensible. The Maastricht treaty for example sets limits for the debt to GDP ratio. GDP, however, is affected by the population size for obvious reasons.

2.4. Labor mobility

The determinants of population size and the persistence of shocks are still a controversial topic in economic geography. There are mainly three competing theories (Davis and Weinstein, 2002): Local fundamentals, random growth, and increasing returns to scale. Local fundamentals theory states that population size is determined by local fundamental factors such as the geography. Population size therefore follows a deterministic trend, temporary shocks only have temporary effects on population size. In the random growth theory, population growth follows a stochastic trend, temporary shocks therefore have lasting effects on population size. Increasing returns theory also postulates permanent effects of temporary shocks. As multiple equilibriums are inherent in this theory, temporary shocks can shift the economy to a new equilibrium. See Section 2.4.

The empirical evidence on the drivers of population size is mixed. The authors analyze its development over a long time period and assume that the population is constant. In such a setup, stabilizing per capita debt exhibits a unit root. Consumption abroad is therefore stable over time. Consumption abroad does not affect the world economy as it is assumed to be relatively small. Consumption abroad is therefore stable over time.

Each individual decides in period $t$ about the country of residence in period $t + 1$. This decision is based on a comparison of expected flow utility in the home economy to an alternative abroad. Similar to (Rappaport, 2005), population size follows a unit root process.

$$\log \left( \frac{N_t}{N_{t-1}} \right) = \mu E_t \left( \frac{U(c_{t+1})}{U(c_t^*)} \right) = \mu E_t \log \left( \frac{c_{t+1}^*}{c_t^*} \right)$$

$c_t^*$ represents consumption in case of living abroad. The home economy does not affect the world economy as it is assumed to be relatively small. Consumption abroad is therefore stable over time. The parameter $\mu$ represents the connection between differences in consumption opportunities and migration flows. A one percent increase (decrease) in expected consumption in the next period relative to expected consumption in case of living abroad results in a $\mu$ percent increase (decrease) in the next period’s domestic population.  

2 We discuss the shift in the time index of the country’s population size in Section 2.4.
2.5. Model in per capita terms

Similar to (Rappaport, 2005), our formulation of the migration function results in population size $N$ to exhibit a unit root. Therefore, other variables such as consumption $c$ and output $y$ also are non-stationary. We can transform this non-stationary system to a stationary one by expressing the model in per capita terms (relative to the current period’s population size $N_{t-1}$) and using population growth $\Pi_N = N_t/N_{t-1}$ instead of its size. Assuming that individuals and firms discount future utility and profits similarly, the system of equations is given by

$$\beta \frac{c_{it+1} + \tau_t}{c_{it+1} + \tau_t} = \frac{1}{1 + r^*}$$  \hspace{1cm} (10)

$$(1 + r_t^*) = a a^t (k_{it}^{-\alpha - 1}) + (1 - \delta)$$  \hspace{1cm} (11)

$$(1 + \tau_t) c_{it} + \Pi_N c_{it} + b_i = a_i (k_{it-1}^m + (1 - \delta) k_{it-1} + (1 + r_{it-1}^*) \frac{b_i}{\Pi_{it-1}})$$  \hspace{1cm} (12)

$$(1 + \tau_t) b_i = \Pi_{it-1} N c_{it} + g(y_t) = b_i + \tau_i c_{it}$$  \hspace{1cm} (13)

$$\Pi_N = \left( \frac{c_{it+1}}{c_{it}} \right)^{\mu}$$  \hspace{1cm} (14)

as well as a process for total factor productivity log($a_t$) = log($a$)/(1 - $\rho$) + $\rho$ log($a_{t-1}$) + $\epsilon_t$, $\epsilon_t$ represents a shock to total factor productivity with $\epsilon_t\%$ NIID $(0, \sigma^2_\epsilon)$, and a process for per capita government expenditures $g_t$.

The model allows us to mute labor mobility by setting $\mu = 0$. Note that muting labor mobility, which is equivalent to replacing (14) with the $\Pi_N^M = 1$, the model collapses to a rather standard rbc model.

2.6. Steady state

It is straightforward to show that our model economy has a unique steady state. In the deterministic steady state, the parameter $\beta$ determines the real interest rate via (10). (11) determines per capita working capital as $\delta = (r^* + \delta) / a^t \left[ 1 / (\alpha - 1) \right]$. Let us now define $\theta_b = b_i / (a k_{it}^m)$ as per capita government debt to GDP and $\theta_y = g(y_t) / (a k_{it}^m)$ as per capita primary expenditures to GDP. $\delta$ As the population size is constant in the deterministic steady state, this determines per capita consumption via (12) and (13) $c_i = (1 - \delta) a k_{it}^m - \delta k_i$ and the tax rate $\tau = r^* \theta_b (a k_{it}^m) / c_i + \theta_y (a k_{it}^m) / c_i$ via the government’s budget constraint (13).

2.7. Calibration

The model is calibrated for an annual frequency. We follow the calibration used in the small open economy literature (Schmitt-Grohe and Uribe, 2003). We set the capital share $\alpha = 0.32$ and the discount factor $\beta = 0.96$, resulting in a steady state real interest rate of roughly 4 percent. The annual depreciation rate of capital is 10 percent ($\delta = 0.1$). We also use the authors’ value for $\rho = 0.42$, the coefficient of autocorrelation of total factor productivity, and for the standard deviation of innovations to technology $\sigma_\epsilon = 0.0129$.

| \(a\) | \(\beta\) | \(\delta\) | \(\alpha\) | \(\theta_y\) | \(\theta_b\) | \(\rho\) | \(\sigma_\epsilon\) |
|---|---|---|---|---|---|---|---|
| 0.32 | 0.96 | 0.1 | 1 | 0 | 0.45 | 0.42 | 0.0129 |

To show the dynamics of the model, we set the steady state government debt to GDP ratio $\theta_b$ to 0. We fix primary per capita government expenditures to GDP $(\theta_y)$ at 0.45 and assume that expenditures do not react to changes in output per capita. This allows us to show the effect of a shock to total factor productivity on equilibrium dynamics. As the main aim of this paper is to analyze the effect of government debt on aggregate stability, we will introduce government debt later on. A summary of the calibration is shown in Table 1.

So far, we did not make any assumption on how rapid the population size reacts to deviations of flow utility to the outside option. This assumption determines the parameter $\mu$. As we do not have a prejudice about the value of $\mu$, we proceed by offering equilibrium dynamics and implications for aggregate stability for different values of $\mu$.

3. Equilibrium dynamics

In this section, we show equilibrium dynamics in the model with labor mobility. We present dynamics for five different values of $\mu$, the percentage increase in the domestic population if individual consumption in the domestic economy is 1 percent higher than consumption abroad. The five different values are reported in Table 2. As described in Section 2.7, we mute the effect public debt by assuming $\theta_b = 0$.

3.1. Economy with labor mobility

Fig. 2 shows equilibrium dynamics in the model with labor but without capital mobility. We present the response of the per capita capital stock and per capita consumption as well as of the real interest rate and population growth after a one standard deviation innovation in technology. Impulse responses of capital and consumption are percentage deviations from steady state. The responses of the interest rate and of the population growth rate represent deviations from steady state in percentage points.

Labor mobility cushions the effect of shocks. If individuals react stronger to differences in utility, migration is more pronounced. This however, results in resources being distributed across more individuals and a lower per capita capital stock. As labor supply increases due to a higher population, capital becomes relatively more productive and interest rates are higher compared to the case of no labor mobility. The more migration flows react to deviations of individual consumption expenditures from steady state (the higher $\mu$), the more cushioned are the effects of shocks to technology.

4. Aggregate stability with government debt

Let us now investigate the effect of government debt, primary expenditures and labor mobility on aggregate stability (Fig. 3). Shaded areas indicate parameter constellations without saddle-path stability.

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5 Note that the production function (4) determines GDP per capita as $y_i = a k_{it}^m$.

6 We use the software package Dynare to simulate the model (Adjemian et al., 2011).
Fig. 2. Impulse response in a closed economy with labor mobility. Note: Impulse response to a one standard deviation technology shock. Consumption and capital stock: percentage deviation from steady state. Real interest rate and population growth: deviation from steady state in percentage points.

Fig. 3. Aggregate stability and labor mobility. Note: Shaded areas indicate parameter constellations without saddle-path stability. $\theta_g$ and $\theta_b$ represent the government share and the debt to GDP ratio.

The parameter space with saddle-path stability decreases with increasing public indebtedness and primary government expenditures. Additionally to that, aggregate stability strongly depends on labor mobility. The higher labor mobility, the lower are the steady state ratios of public debt to GDP and primary expenditures to GDP that result in saddle-path stability.

The intuition is the following. The stronger individuals react to deviations from steady state consumption, the stronger is the response of population growth. To stabilize per capita debt, changes in population size trigger an adjustment of the consumption tax rate, which reinforces the initial deviation of consumption form its steady state level.

Migration therefore has external effects in the model. As individuals leave the economy, they do not take their implicit liability of per capita public debt with them. Instead, this burden is distributed equally across individuals that are staying in the domestic economy.

To increase transparency of what is happening in the economy, we rewrite a deterministic system of equations (10)–(14) in matrix notation as:

$$
\left( \begin{array}{c}
\hat{c}_i \\
\hat{k}_i
\end{array} \right)_{t+1} =
\left( \begin{array}{cc}
\Phi_1 & \frac{1}{\varphi} - \Phi_2 \\
\Phi_2 & \Phi_1 - \frac{1}{\varphi}
\end{array} \right)_{t+1} \left( \begin{array}{c}
\hat{c}_i \\
\hat{k}_i
\end{array} \right)_t
$$

(15)

Per capita consumption $\hat{c}_i$ and the per capita capital stock $\hat{k}_i$ are in percentage deviations from steady state. We abstract from exogenous shocks to total factor productivity and define $\Phi_1$ and $\Phi_2$ as:

$$
\Phi_1 = \frac{\frac{\alpha}{\beta} - \mu b_i (\alpha + (1 - \delta))}{\alpha \left( 1 + (\alpha - 1) \frac{b_i}{\beta} \right) - (1 - \beta (1 - \delta)) \left( \frac{1}{\beta} + (1 + \tau) (\alpha - 1) \frac{b_i}{\beta} \right)}
$$

and

$$
\Phi_2 = \frac{\frac{\alpha}{\beta} - \mu b_i (\alpha + (1 - \delta))}{\alpha \left( 1 + (\alpha - 1) \frac{b_i}{\beta} \right) - (1 - \beta (1 - \delta)) \left( \frac{1}{\beta} + (1 + \tau) (\alpha - 1) \frac{b_i}{\beta} \right)}
$$

to simplify the notation. This system has one forward looking variable, per capita consumption $\hat{c}_i$, and one backward looking variable, the capital stock $\hat{k}_i$. For low values of $\mu$, one eigenvector’s absolute value increases with $\mu$. For high values of $\mu$, the eigenvector’s absolute value decreases with $\mu$. This indicates that the parameter space with saddle-path stability decreases with increasing public indebtedness and primary government expenditures.
is larger and one is smaller than. The system is saddle-path stable. If, however, labor mobility increases beyond the thresholds presented e.g. in Fig. 3, the eigenvalue with the absolute value smaller than becomes larger than one. The transversality conditions cannot be satisfied and the system ceases to be saddle-path stable. Sovereign default becomes inevitable.

5. Robustness checks

In this section, we use alternative parameter constellations to get an idea about the robustness of our results. In the following analysis, we set the elasticity of population size with respect to consumption \( \mu \) to 0.2.

5.1. Cyclical primary government expenditures

We first allow for government expenditures to depend on economic activity as suggested by (Nourry et al., 2013). More specifically, we assume \( g_t(y_t) = g_t \left( \frac{y_t}{y_{t-1}} \right) \). We employ four different parameter values for \( \eta \). \( \eta = -1 \) represents a counter-cyclical policy where government expenditures are reduced one for one after an increase in per capita output. \( \eta = -0.1 \) is in line with empirical estimates for the Euro area (Girouard and André, 2005; Mourre et al., 2014), \( \eta = 0 \) represents our baseline calibration, and \( \eta = 1 \) represents a pro-cyclical fiscal policy. Fig. 4 illustrates the effect of the different fiscal policies on aggregate stability. Qualitatively, counter-cyclical fiscal policy increases the parameter-space of saddle-path stability, pro-cyclical policies decrease this space. Quantitatively, however, the effects seem negligible.\(^7\)

5.2. Small open economy with labor mobility

Until now, we assumed that labor is mobile and capital is immobile. However, in the open economy literature, capital is mobile and capital flows ensure the equalization of interest rates. In this section, we therefore allow for capital to move cross country borders.

Firms accumulate foreign debt \( s \). The production sector’s budget constraint now is

\[
\Pi_t = y_t - w_t h_t - k_t + (1 - \delta) k_{t-1} + (1 + r_t^F) b_{t-1} - b_t + s_t - (1 + r_{t-1}^F) k_{t-1}.
\]

(16)

It is well known that assuming an exogenous interest rate, which is given by the world interest rate \( r_t^F = r^F \), results in instability. We follow (Schmitt-Grohe and Uribe, 2003) and induce stationarity by assuming that the interest rate depends on per capita foreign debt. This results in the additional equation

\[
r_t^F = r^F + \psi (\exp(s_t - s_u) - 1),
\]

(17)

with \( r^F \) being the exogenous world interest rate. \( s_t \) is steady state per capita foreign debt. We set \( \psi \) to 0.0742.

Equilibrium dynamics in a model with capital mobility are very similar to the ones in the model without capital mobility (Fig. A2 in the appendix). Again, the stronger migration reacts to differences in consumption, the less pronounced are the effects of shocks.

Fig. 5 presents the effect of labor mobility in a small open economy on aggregate stability. Again, saddle-path stability decreases in the degree of labor mobility, public indebtedness and government consumption.
5.2.1. Foreign debt position

We now analyze the effect of foreign debt on aggregate stability. For positive values of the debt to GDP ratio $\theta_{it}$, the economy is a net debtor. For negative values, the economy is a net lender to the world economy. Fig. 6 shows that saddle-path stability increases with foreign assets. The intuition is straightforward. As foreign assets and debt are accumulated by the production sector, migration flows not only affect per capita government debt but also the per capita foreign investment position. Out-migration therefore increases per capita debt. In case of foreign assets, out-migration increases the per capita international investments, which counteracts the effect of government debt.

### 6. Population growth and relative consumption in the Euro Area

The strong dependence of the results on $\mu$, the effect of differences in consumption opportunities on migration, raises the question of the relevance of the proposed channel of government debt on aggregate stability. To get an idea about the value of $\mu$, we estimate the equation

$$\Pi_t^n = \beta_0 + \mu \log \left( \frac{c_t^n}{\mu} \right) + \epsilon_t. \quad (18)$$

Using $\Pi_t^n = \log \left( \Pi^n \right)$, (18) represents the logarithmic approximation of (9) augmented by a constant and an error term. We estimate this equation for the five EMU member states that resorted on assistance of their European partners during the European Debt Crisis: Cyprus, Greece, Ireland, Portugal, and Spain. For population growth $\pi^n$, we use the log difference of the total population. For consumption $c_t^n$, we use per capita private consumption expenditures in purchasing power parities to allow for a cross country comparison.

This leaves us with a decision on the outside option. We assess average per capita consumption in the Euro Area and in the European Union so be equally plausible. We therefore report the results for both specifications. The evolution of all the variables is shown in Fig. A1 in the Appendix. All information is available at Eurostat.

The correlation seems to be positive and statistically significant (Table 3). However, we want to emphasize that the purpose of this paper is to point out the potential channel, not to estimate a causal effect of differences in real consumption on population growth. The estimation is meant to give an idea of whether this channel could have any practical relevance.

Given these estimates, our simple model would suggest that migration flows are not yet at levels that result in an economy characterized by the absence of saddle-path stability. This can easily seen by comparing estimated coefficients with the parameter space with saddle-path stability of e.g. Fig. 3. Further increases in public debt that are almost certain given the severity of the current recession, however, might represent an actual danger to saddle-path stability.

There are several shortcomings to our calculations. Our estimates are subject to endogeneity, as changes in per capita private consumption expenditures also affect per capita consumption in the country aggregate. We assess this effect to be negligible, especially for Cyprus, Greece, Ireland, and Portugal due to their size. One could also argue that the EMU and even the EU does not represent the universe of countries of origin for immigrants and of destination countries for emigrants.

#### 7. Concluding remarks

This paper argues that the literature on the effect of public debt and balanced budget rules neglects one important aspect: labor migration. Especially in the EMU, where rules limiting public debt levels and deficits with the aim of ensuring sufficient fiscal space in a recession have been extremely popular, labor mobility has increased substantially over the past decades and further increasing labor mobility continues to be on the political agenda.

We introduce labor mobility into a simple real business cycle model with public indebtedness and a balanced budget requirement for the government. In such a setup, government debt decreases the parameter space of saddle-path stability as migration has external effects when the government is indebted. Individuals leaving the economy shift the burden of debt service to the remaining population. Per capita public debt service is counter-cyclical. This way, labor mobility can push otherwise saddle-path stable economies to unstable ones. Non-existence of a saddle-path stable equilibrium can occur for government debt levels only slightly higher than the ones observed in the Euro area after the financial crisis.

We therefore argue that reducing public indebtedness of individual member states when the economy has recovered from the COVID-19 pandemic is vital for stability in the European Union. This is especially true as increasing labor mobility is a political goal in the EU. We further argue that migration flows should be endogenized in medium term projections of the European Commission. The current commonly agreed method for calculation potential output treats the population size as exogenous. Pro-cyclicality of migration flows might therefore results into an underestimation of potential risks of high levels of public debt.

#### Conflict of competing interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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8 We do not include Latvia in our analysis, even though Latvia joined the Schengen Area in December 2007 and the EMU in 2014. However, many countries restricted the access to their labor markets for citizens of new EU member states. Therefore, at the time Latvia resorted on assistance from other EU members, emigration for Latvian citizens was probably less of an option than for workers of countries with freedom of movement.
Appendix

Fig. A1 Population growth and relative consumption opportunities. Source: Eurostat, author’s calculation.
Fig. A2 Impulse response in a small open economy with labor mobility. Note: Impulse response to a one standard deviation technology shock. Consumption and capital stock: percentage deviation from steady state. Real interest rate and population growth: deviation from steady state in percentage points.
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