Aggregate stability under a budget rule and labor mobility

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Abstract

This paper introduces labor mobility into a neoclassical growth model with public debt and investigates the effect on aggregate stability. The government follows a budget rule by stabilizing per capita debt. Migration is assumed to be pro-cyclical. In such a setup, government debt increases aggregate instability as migration has external effects, which can trigger self-fulfilling expectations. Out-migration increases per capita government debt, resulting in higher tax rates to satisfy the budget rule, which further increases out-migration. We show that this effect can occur for standard calibrations and government debt levels similar to the ones in the Euro area.

JEL classification: F22; F41; E32; E62
Keywords: Budget rules; labor mobility; government debt

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1 Introduction

Balanced-budget rules have become increasingly popular in recent years. Especially in Europe, where many countries still suffer from the European Debt Crises, balanced-budget rules have been identified as one solution to guarantee government debt sustainability. The Maastricht Treaty already introduces limits to fiscal deficits. Since 2008, many countries incorporated fiscal rules into national statute. Such rules are e.g. statutory for states in Germany and local governments in Spain. Outside of Europe, balanced-budget requirements are obligatory in most US states, however not for the federal state.

Implications of balanced-budget requirements for aggregate stability have been an issue of controversy in the economic literature. 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 parametrizations. 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 the expenditure side (Guo and Harrison, 2004), the tax type (Giannitsarou, 2007), and the utility (Nourry et al., 2013) and production function (Nishimura et al., 2013; Ghilardi and Rossi, 2014; Alfred and Bondarev, 2015) assumed. Meng and Xue (2015) show that aggregate stability is always ensured in a small open economy.

We argue that the existing literature on balanced budget rules neglects one important aspect: labor mobility.[1] In the EMU, where such rules have been extremely popular, labor mobility has been identified as an important mechanism to cushion adverse demand shocks. Increasing labor mobility has therefore been on the political agenda in Europe (Andor, 2014). Beyer and Smets (2015) show that mobility did increase over the past decades.

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

[1]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; Vandenbroucke, 2008), the migration decision (Kanbur and Rapoport, 2005; Klein and Ventura, 2009), and business cycle dynamics (Mandelman and Zlate, 2012; Clemens and Hart, 2016). 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.

taxes.

Under a standard parametrization and public debt levels similar to the ones in the Euro area, self-fulfilling expectations can occur. 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.

2 Model

Starting point is a real business cycle model, which we augment by labor migration. The economy is small and embedded into the world economy such that migration flows do not affect global variables.

2.1 Households

The economy is populated by infinitely many infinitely lived identical households with mass N. The index i indicates that the respective variable is in per capita terms. The representative household i supplies one unit of labor inelastically and maximizes expected lifetime utility

$$E_0 \sum_{t=0}^{\infty} \beta^t \log(c_{it}) \tag{1}$$

where E is the conditional expectations operator and β is the discount factor with $0 < \beta < 1$. The representative household derives utility from consumption c_{it} and faces the budget constraint

$$(1+\tau_t)c_{it} + d_{it} = w_t + (1 + r^d_{t-1})d_{i,t-1} + \Pi_{it} \ . \tag{2}$$

Consumption expenditures are subject to a distortionary consumption tax with the tax rate τ_t. Households 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_{it} that stay within the household sector with the interest rate r^d. The return is known at the time of investment. Household debt stays within the household sector. Π_{it} represents lump sum transfers of firm profits to the individual household i.

The representative household's first order conditions can be summarized by the equation

$$\beta \frac{c_{it}}{c_{it+1}} \frac{1+\tau_t}{1+\tau_{t+1}} = \frac{1}{1+r_t^d} \tag{3}$$

2.2 Firms

Firms produce output with 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 $h_t = \sum_{i=1}^{N_t} 1 = N_t$, as households supply one unit of labor inelastically, and working capital k_{t-1} that is decided on in period $t-1$. a_t represents total factor productivity.

$$y_t = a_t k_{t-1}^{\alpha} h_t^{1-\alpha} \tag{4}$$

Firms maximize the sum of discounted expected profits given the discount factor Λ

$$E_0 \sum_{t=0}^{\infty} \Lambda_{0,t}(y_t - w_t h_t - k_t + (1-\delta)k_{t-1} + (1+r_{t-1}^b)b_{t-1} - b_t - (1+r_{t-1}^s)s_{t-1} + s_t) \ . \tag{5}$$

Accumulation of working capital takes place at the firm level and is subject to the depreciation rate $\delta \in (0,1)$. Besides working capital, firms accumulate wealth via savings in government bonds b_t with the risk free interest rate r^b. As we also want to investigate the implications in a small open economy we allow for foreign debt s_t with the interest rate r^s.

This setup results in the first order conditions

$$w_t = (1-\alpha)\frac{y_t}{h_t} \tag{6}$$

$$\frac{\Lambda_{0,t}}{\Lambda_{0,t+1}} = \alpha \frac{y_t}{k_{t-1}} + (1-\delta) = (1+r_t^s) = (1+r_t^b) \ . \tag{7}$$

2.3 Government

The government faces an initial stock of public debt that is held by domestic firms b_{t-1}. It raises income by taxing consumption expenditures. The government's budget constraint reads

$$(1 + r^b_{t-1})b_{t-1} = b_t + \tau_t c_t \ , \tag{8}$$

where $c_t = \sum_{i=1}^{N} c_{it}$ represents aggregate consumption expenditures. The government stabilizes per capita debt such that $b_{it} = b_{it-1} = b_i$. Note that without labor mobility such a rule collapses to a balanced budget rule as in Schmitt-Grohe and Uribe (2003).

2.4 Labor Mobility

The determinants of population size and its persistence are still a controversial topics 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 fundamentals such as the geography. Population size follows a deterministic trend, temporary shocks therefore only have temporary effects on population size. In the random growth theory, it is assumed that 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 equilibria are inherent in this theory, temporary shocks can shift the economy to a new equilibrium.

The empirical evidence on the drivers of population size is mixed. Davis and Weinstein (2002) investigate the distribution of regional population in Japan. The authors analyze its development over a long time period and after a temporary shock, the bombings of Hiroshima and Nagasaki, and find evidence for a combination of the above theories. The pattern of regional population seems to be determined by fundamentals, quantitative differences by increasing returns. For Germany, city growth seems to depend on the political system (Brakman et al., 2004). The authors show that the strategic bombings during World War II had permanent effects in East Germany, while the effects in West Germany were only temporary. Schumann (2014) uses variation in the absorption of expellees over the different occupational zones. In this analysis, population patterns were highly persistent, fundamentals did not determine this pattern. Schumann argues that these results are consistent with empirical evidence on path dependence on regional economic development (Redding et al., 2011; Bleakley and Lin, 2012; Kline and Moretti, 2014)

In this paper, we follow Schumann (2014) and assume that temporary shocks have permanent effects on population size. We assume that the process for population size exhibits a unit root. This is similar to Rappaport (2005), who also assumes that the process for population size follows a unit root. Rappaport assumes that migration flows depend on differences in lifetime labor income relative to an outside option.

We assume that individuals decide on the economy they want to live in by comparing utility in the domestic economy $u(c_{it})$ to an alternative u_t^* from living abroad. Similar to the assumptions in a small open economy with respect to capital accumulation, $u_t^* = u^*$ is constant and unaffected by migration flows. One might think of this outside option as another economy that exhibits a similar structure as our small economy. However, the economy is large enough that migration flows between the two economies are negligible in size relative to its population such that migration does not affect u_t^*.

Differences in utility are not equalized immediately. The adjustment process is sluggish. We assume that migration flows can be described by the equation

$$\frac{N_t}{N_{t-1}} = \left(\frac{u(c_{it})}{u^*}\right)^{\mu} . \tag{9}$$

The parameter μ represents the connection between differences in utility to migration flows. A one percent increase (decrease) in utility relative to the global economy results in a μ percent increase (decrease) in the domestic population.

2.5 Model in per Capita Terms

Similar to Rappaport (2005), our formulation of the migration function results in population N_t exhibiting a unit root. Therefore, other variables such as consumption c and output y also are instationary. However, we can transform this instationary system to a stationary one by expressing the model in per capita terms and using population growth $\Pi_t^N = N_t/N_{t-1}$ instead of its size. Assuming that households and firms discount future utility and profits similarly, the system of equations is given by

$$\beta \frac{c_{it}}{c_{it+1}} \frac{1+\tau_t}{1+\tau_{t+1}} = \frac{1}{1+r_t^b} \tag{10}$$

$$(1+r_t^b) = \alpha a_{t+1} \left(\frac{k_{it}}{\Pi_{t+1}^N}\right)^{(\alpha-1)} + (1-\delta) \tag{11}$$

$$(1+\tau_t)c_{it} + k_{it} + b_i - s_{it} = a_t \left(\frac{k_{it-1}}{\Pi_t^N}\right)^{\alpha} + (1-\delta)\frac{k_{it-1}}{\Pi_t^N} + (1+r_{t-1}^b)\frac{b_i}{\Pi_t^N} - (1+r_{t-1}^b)\frac{s_{it-1}}{\Pi_t^N} \tag{12}$$

$$(1+r_{t-1}^b)\frac{b_{it-1}}{\Pi_t^N} = b_{it} + \tau_t c_{it} \tag{13}$$

$$\Pi_t^N = \left(\frac{\log(c_{it})}{u_t^*}\right)^{\mu} \tag{14}$$

as well as a process for total factor productivity $\log(a_t) = \log(a)(1-\rho) + \rho \log(a_{t-1}) + \epsilon_t$. ϵ_t represents a shock to total factor productivity with $\epsilon_t \sim$ NIID $(0, \sigma_\epsilon^2)$.

For the closed economy – with labor migration but without capital mobility – we have $s_{it} = s_i = 0$. For the small open economy, with labor as well as capital flows, $s_{it} \neq 0$. It is well known that assuming the interest rate to be exogenously given by the world interest rate $r_t^b = r^{rf}$ results in instationarity. We follow Schmitt-Grohe and Uribe (2003) and induce stationary by assuming the interest rate to depend on the foreign debt position. This results in the additional equation

$$r_t^b = r^{rf} + \psi\left(\exp\left(s_{it} - s_i\right) - 1\right) \ , \tag{15}$$

with r^{rf} being the exogenous world interest rate and s_i being steady state per capita foreign debt.

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 β determines the real interest rate via (10), which has to be equal to the global real rate in the case of capital mobility. As the population is constant in the deterministic steady state, (11) determines per capita working capital as $k_i = \left(\left(r^b + \delta\right)/\alpha\right)^{1/(\alpha-1)}$. Let us now define $\theta_b = b_i/k_i^\alpha$ as per capita government debt to GDP and $\theta_s = s_i/k_i^\alpha$ as per capita foreign debt to GDP.[2] This determines per capita consumption via (12) and (13) as $c_i = k_i^\alpha - \delta k_i - r_b s_i$ and the tax rate $\tau = r^b b_i / c_i$ 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 to $\alpha = 0.32$, the discount factor to $\beta = 0.96$, resulting in a steady state real interest rate of 4 percent. The annual depreciation rate of capital is 10 percent ($\delta = 0.1$). We also use the authors' value for $\psi = 0.00074$, the parameter for the foreign debt dependent interest rate premium, for $\rho = 0.42$, the coefficient of auto-correlation of total factor productivity,

[2] Note that the production function (4) determines GDP per capita as $y_i = k_i^\alpha$.

and for the standard deviation of innovations to technology $\sigma_\epsilon = 0.0129$. We will be looking at our model with and without capital mobility. To ensure comparability, we set the steady state ratio of foreign debt to GDP to $\theta_s = 0$. This ensures that the steady state is the same in both cases.

We also have to set the steady state government debt to GDP ratio. First, we set $\theta_b = 0$. This allows us to show the effect of migration on equilibrium dynamics after a tfp-shock. As the main aim of this paper is to analyze the effect of government debt on aggregate stability, we will abolish this assumption later on. A summary of the calibration is shown in Table 1.

Table 1: Calibration

α	β	δ	ψ	θ_b	θ_s	ρ	σ_ϵ	a
0.32	0.96	0.1	0.000742	0	0	0.42	0.0129	1

Up till now, we did not make any assumption about how rapid individuals react to deviations of utility from an outside option. This assumption determines the parameter μ. As we do not have a prejudice about the value of μ, we proceed by offering equilibrium dynamics and aggregate stability for different values of μ.

3 Equilibrium Dynamics

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

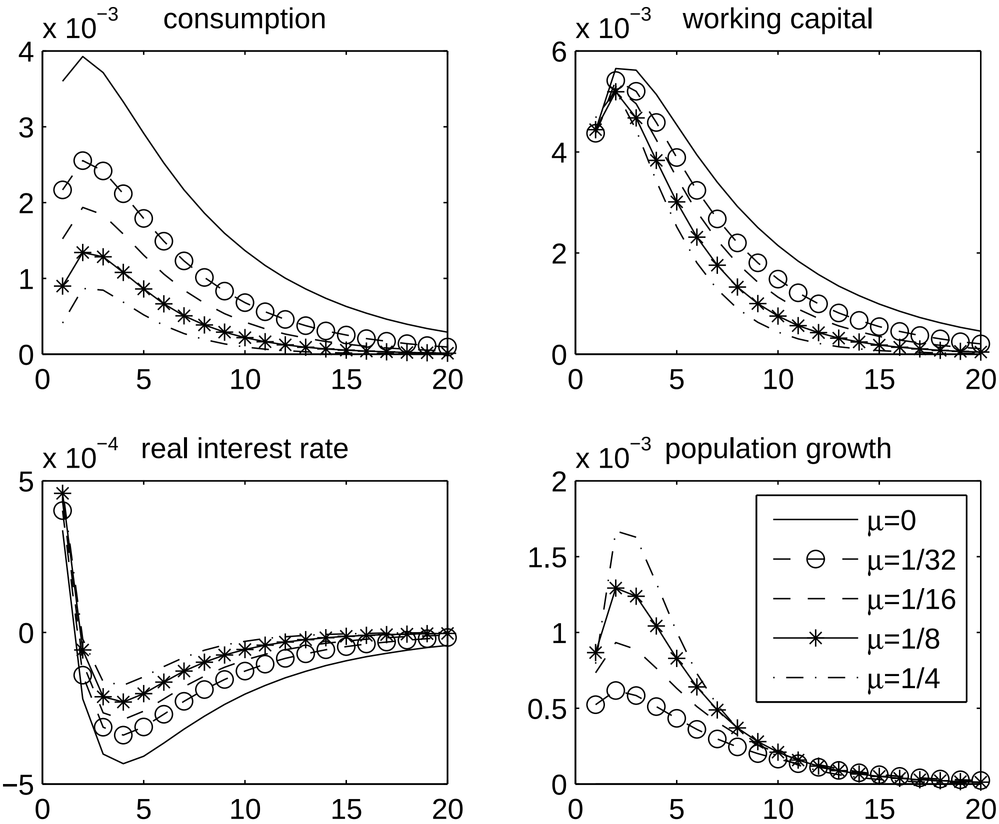
Table 2: Values for μ

μ_1	μ_2	μ_3	μ_4	μ_5
0	1/32	1/16	1/8	1/4

3.1 Closed Economy with Labor Mobility

Figure 1 shows the equilibrium dynamics in the model with labor but without capital mobility. We show the response of the per capita capital stock and of consumption as well as of the real interest rate and population growth to 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 the population growth rate represent deviations from steady state in percentage points.

Figure 1: Impulse response in a closed economy with labor mobility



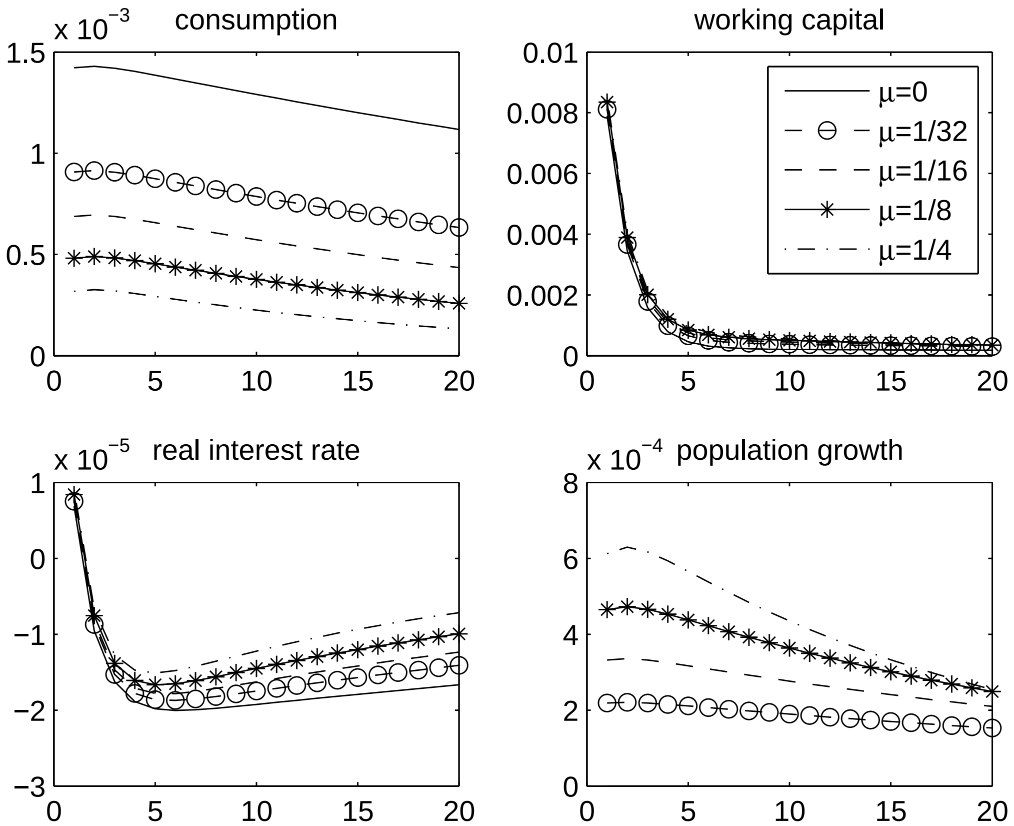
Note: Impulse response to a one standard deviation technology shock. Consumption and capital stock: percentage deviation from steady state. Real interest rate and population growth: deviation from steady state in percentage points.

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 an increased population, capital becomes relatively more productive and interest rates are higher than in the case of no labor mobility. The more migration flows react to deviations of individual consumption from steady state (the higher μ), the more cushioned are the effects of shocks to technology.

3.2 Small Open Economy with Labor Mobility

The effects of migration on equilibrium dynamics in a model with capital mobility are very similar to the one without capital mobility. Again, the more migration reacts to differences in utility, the less pronounced are the effects of shocks.

Figure 2: 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.

4 Aggregate Stability with Government Debt

Let us now investigate the effect of public debt under a budget rule that requires per capita debt to be constant on aggregate stability. Table 3 presents θ_b^{crit}, the critical values for the government debt to GDP ratio, for which our calibrated model switches from a stable one to an economy with self-fulfilling expectations. Differences between the open (with capital mobility) and the closed economy (without capital mobility) seem negligible.

Table 3: Critical debt levels for different assumptions about labor mobility

μ	θ_b^{crit}	
	closed economy	open economy
1/32	3.02	3.07
1/16	1.55	1.54
1/8	0.78	0.77
1/4	0.38	0.38

The critical values strongly depend on the degree of labor mobility. The higher labor mobility, the lower is the public debt to GDP ratio that ensures aggregate stability. Even though understanding the mechanisms that drive self-fulfilling expectations are difficult to understand (Wen, 2001), we want to give our interpretation of what drives the dynamics in this model.

The stronger individuals react to deviations from steady state utility, the stronger will be the response of population growth. To stabilize per capita debt, changes in the population size trigger an adjustment of the consumption tax rate, which reinforces the initial deviation of utility form its steady state level. This way, self-fulfilling expectations can occur.

This result is in contrast to Schmitt-Grohe and Uribe (1997), where government debt increases aggregate stability. In their model, the burden of government debt is pro-cyclical as interest rates, and therefore debt payments, increase if the economy is going well.

In our model, the effect of migration in combination with public debt might be interpreted as having an external effect. As individuals leave the economy, they do not take with them their burden of per capita public debt. Instead, this burden is distributed equally across individuals that are staying, resulting in counter-cyclical per capita government expenditures, while the income side depends on consumption expenditures and is therefore pro-cyclical.

5 Population Growth and Relative Utility in the Euro Area

The strong dependence of our results on μ, the effect of differences in utility on migration, of course raises the question of the relevance of the proposed channel of government debt on aggregate stability. To get an idea about the value of μ we estimate the equation

$$\pi_t^N = \beta_0 + \mu \log\left(\frac{\log(c_t)}{\log(c_t^*)}\right) + \varepsilon_t \ . \tag{16}$$

Using $\pi^N = \log\left(\Pi^N\right)$, (16) represents the logarithmic approximation of (9) augmented by a constant and an error term. We estimate this equation for the five EMU members that resorted on assistance of their European partners during the European Debt Crisis: Cyprus, Greece, Ireland, Portugal, and Spain.[3] For population growth π^n, we use the change in absolute population. For consumption c_t, we use per capita consumption, in purchasing power parities to allow for a cross country comparison. We deflate consumption by the price deflator for the EU28, as the EU28 represents the reference country for ppp variables.

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 Figure A.1 in the Appendix. All information is available at Eurostat.

Table 4: Population growth and relative utility

Country	Sample Period	$u(c_{i,EMU19})$		$u(c_{i,EU28})$	
		μ	σ_μ	μ	σ_μ
Cyprus	1995-2015	0.6138**	0.2367	0.9187***	0.2398
Greece	1995-2015	0.2924***	0.0877	0.3840***	0.0670
Ireland	1998-2015	1.1135***	0.2972	1.8246***	0.1695
Portugal	1995-2015	-0.0394	0.2252	0.2797***	0.3383
Spain	1995-2015	1.1541***	0.2809	1.6766***	0.2293

Note: $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

The correlation seems to be positive and statistically significant (Table 4). 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 changes in utility on population growth. The estimation is meant give us an idea whether this channel could have any practical relevance. Given the estimates, our mickey mouse model would suggest that self-fulfilling expectations do represent an actual danger for aggregate stability.

However, there are several shortcomings to our calculations. We use a simple log-utilty function. Our estimates are subject to endogeneity, as a change in per capita consumption

[3] 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.

also affects per capita consumption in the country aggregate. We asses this effect to be negligible, especially for Cyprus, Greece, Ireland, and Portugal. 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.

6 Concluding Remarks

This paper argues that the literature on balanced budget rules neglects one important aspect: labor migration. Especially in the EMU, where such rules have been extremely popular, labor mobility has increased over the past decades and increasing labor mobility still is on the political agenda.

We introduce labor mobility into a simple real business cycle model. Under a standard calibration, public debt has destabilizing effects on the economy. This is in contrast the previous literature, as Schmitt-Grohe and Uribe (1997) show that in a model without labor mobility, government debt has a stabilizing effect due to the pro-cyclicality of debt service. With labor mobility, migration has an external effect. Individuals leaving the economy shift the burden of debt service to the remaining population. Per capita public debt service is therefore counter-cyclical and increases aggregate instability.

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Appendix

Figure A.1: Population growth and utility relative to the outside option