A Conceptual Framework for Reforms Versus Debt in the Context of a Fiscal Union Within the European Monetary Union

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Abstract This paper emphasizes the importance of differences in population sizes in a model of a monetary union under alternative scenaria of monetary and fiscal policy coordination. It goes beyond Casella (The American Economic Review 82 (4):847–863, 1992) by allowing for coexistence of fiscal policy, national as well as union-wide, along with monetary policy. The paper also allows for inefficiencies in tax collection that serve as another difference across countries and for the possibility that tax and spending policy in the union are decided by means of different procedures. This is intended to explore the contrast between monetary policy outcomes determined by deliberations and voting in the ECB, given the fiscal policy stance, and national fiscal policy stance, given monetary policy. It examines what options this logic confers on smaller versus larger members of a currency union. It goes beyond both Casella (The American Economic Review 82 (4):847–863, 1992) and Ioannides (The Cyprus Bail-in: Policy Lessons from the Cyprus Economic Crisis. World Scientific Imperial College Press, 2016) in examining the impact of market reforms and of various types of technological progress and explores their consequences for the sustainability of national public debt.

1 Introduction

The Eurozone (EZ) is at a crossroads. The global financial crisis revealed the importance of the dearth of macro policy tools available to members of the European monetary union. This is in stark contrast to US. A critical issue is the limits to monetary policy tools in the absence of a fiscal union. This is the case for the Eurozone, in sharp contrast to the US fiscal union. The paper develops a stylized

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model with two countries, differing in size, which accommodates autarky versus economic integration while allowing for a fiscal union within a monetary union. The model allows examination of broad policy options and advantages that adding a fiscal union confers on those available to a monetary union. Finally, the paper extends Ioannides (2016) by allowing for market reforms and technological change as well debt in addition to tax finance.

One of the most important considerations that confronts students of the design of European integration is heterogeneity of the constituent parts. Heterogeneity is expressed in many dimensions, such as political, cultural, economic and of course in terms of the population and economic size. Newer theories of comparative advantage, such as those associated with product differentiation that new trade theory and new economic geography have utilized, have emphasized that due to the advantages of agglomerations and path dependence advancing economic integration may make constituent states even more heterogeneous. As a consequence, suboptimalities in the currency area they make up may thus be further exacerbated.

This paper emphasizes the importance of differences in population sizes. Population size directly affects real economic outcomes. It also underlies perceptions of relative importance in international economic governance and thus state actions. Therefore, it affects notions of democratic legitimacy both within and across countries. In the EU, size is critically enshrined in numerous decision making structures, such as qualified majority rules. At the same time, EU member states are equally represented in the European Commission, which is made up of a single national from each member state. This is very similar to the US parliamentary structure, where states are equally represented in the US Senate but in proportion to their populations in the US House of Representatives.

This paper borrows Casella (1992)'s framework and examines a number of scenaria above and beyond hers. In particular, it allows for coexistence of fiscal policy, national as well as union-wide, along with monetary policy. The paper also allows (c.f. Sibert 1992) for inefficiencies in tax collection that serve as another difference across countries. It allows for the possibility that tax and spending policy in the union are decided by means of different procedures. This is intended to express the contrast between monetary policy outcomes determinant by deliberations and voting in the ECB, given the fiscal policy stance, and national fiscal policy stance, given monetary policy. What options does this logic confer on smaller versus larger members of a currency union? How a small country's fundamentals affects its bargaining power, especially over a full range of fiscal policy, like taxes on different aspects of activity is an important question. It goes beyond Casella (1992) and Ioannides (2016) in examining the impact of market reforms and of various types of technological progress and explores their consequences for the sustainability of debt.

2 International Equilibrium Ala Casella (1992)

Casella (1992) assumes that individuals value a composite good, which is produced by means of intermediate varieties, and a public good, which is financed publicly by means of seignorage. The indirect utility functions depend on the country's size and real money growth in each country. A non-cooperative game among governments yields that if the elasticity of substitution among intermediates exceeds 1, uncoordinated policies give inefficient allocations. That is, each government provides more of the public good than globally socially optimal, because it ignores the negative effects on the foreign country of withdrawing resources from private production. The smaller country always allocates a larger proportion of its endowment to the public good. With a monetary union, the exchange rate between two countries' currencies is set equal to 1 and inflation rates are equalized. Then, individual private consumption is equalized across the two countries. There is no international financial equilibrium to be cleared, and the monetary regime does not impose discipline in each country's policy.

Specifically, utility functions are defined as the sum of the logs of a Dixit-Stiglitz aggregate of consumption intermediates, C_{ij}, and of the public good, Γ_j,

$$U_j = (1-g)\ln\left(\sum_{i=1}^{n} c_{ij}^{\theta}\right)^{1/\theta} + g\ln\Gamma_j,\ \ ,j = A, B, 0 < \theta < 1, \tag{1}$$

where n is the total number of intermediate varieties of the private good and Γ_j is the public good, and $j = A, B$ denotes the two countries. The elasticity of substitution among varieties is given by $\frac{1}{1-\theta}$. If it approaches 1, the two economies that are otherwise identical except for size enjoy no advantage from trade. There are no spillovers across countries and no scope for international cooperation.

Individuals live for two periods: working when young, consuming when old, saving only in the form of money holdings. New money issued finances the public good. Money of the old plus new money equals money held by the young.

Intermediates are produced with IRS using labor:

$$\ell_i = \alpha + \beta x_i,\ i = 1, \ldots, n, \tag{2}$$

where ℓ_i is the labor required to produce x_i units of variety i. The industry organizes as monopolistic competition, each variety is produced by one producer, entry is free and at the equilibrium each firm earns zero profits. The advantage of the Dixit–Stiglitz model is that the size of a country translates immediately into the number of goods produced domestically, with no counterbalancing effect on the terms of trade. If a change in the countries' relative endowments affects the terms of trade, national income depends on the overall solution of the general-equilibrium problem and is therefore much more difficult to analyze (Casella *op. cit*., p. 851). At the free entry equilibrium, each variety is produced at the same quantity:

$$x_{ij} = \frac{\alpha\theta}{\beta(1-\theta)}. \tag{3}$$

The monopolistic competition price is given by $p_j = \frac{\beta}{\theta} w_j$, and is a markup on the marginal costs in the usual fashion. The corresponding labor requirement is $\frac{\alpha}{1-\theta}$. The public good is produced using labor $\ell_{\Gamma j}$ with CRS,

$$\Gamma_j = \ell_{\Gamma j},\ j = A, B.$$

The government pays for the public good by new money printing, M_j, tax revenue, or a combination of both. If country A's size is $2 - \sigma$, then the number of varieties produced is given by

$$n_A = (2 - \sigma - \Gamma_A)\frac{1-\theta}{\alpha}. \tag{4}$$

2.1 *Market Reforms Versus Technological Progress*

The above development is predicated on free entry by all producers of intermediates. What if the range of intermediate varieties is given, $\overline{n}_A$? Then, one could think of allowing for free entry in the intermediates industry as a type of market reform. If the range of intermediates is given, monopolistic pricing still leads to the same markup $p_j = \frac{\beta}{\theta} w_j$, but profits (losses) are earned (realized). Letting free entry determine the number of varieties generally improves welfare but causes losses (gains) to the varieties producing sector. If $\overline{n}_A < n_A$, then lifting of restrictions may be seen as a stylized market reform that brings about overall benefits.

Next we introduce technological progress in the production of intermediate varieties in the following manner. Let the total labor cost of producing x_i of variety i be defined as:

$$b(x_i) = \frac{1}{\xi_i}(\alpha + \beta x_i) w_i, \tag{5}$$

where $\xi_i = \overline{\xi}(1 + \eta)^t$ is TFP-type of technological progress, with an exogenous growth rate η.

It is easy to see from (3) that at the free entry, each variety is produced at the same quantity, but since the labor cost of producing each variety, $\frac{\alpha}{\xi_i(1-\theta)}$, decreases more and more varieties are produced at equilibrium. Thus, welfare increases much more, relative to the consequences of market reform, as defined earlier.

The welfare impact of market reform, that is entry liberalization, is a function of $n_A - \overline{n}_A$, and thus has a *level effect*. The introduction of technological change in the form of TFP *growth*, increases welfare as a function of $(1 + \eta)^t$, thus implying a growth effect on social welfare.

The labor market is assumed to be Walrasian here. We could easily introduce a labor market with Pissarides-type frictions. Labor market reforms can take the form of reducing frictions as well as allowing various forms of active labor market policies.

2.2 Autarky

Under autarky, each individual consumes $C_{aut,\,A=}\frac{1}{2-\sigma}\frac{\alpha\theta}{\beta(1-\theta)}$ of each variety. The public good is financed by money creation:

$$\Gamma_A = \ell_{\Gamma_A} = m_A.$$

The range of varieties produced is given by:

$$n_A = (2 - \sigma - m_A)\frac{1-\theta}{\alpha}.$$

The corresponding value of the utility function is:

$$U_A = (1-g)\ln\left((2-\sigma-\Gamma_A)\frac{1-\theta}{\alpha}\left[\frac{1}{2-\sigma}\frac{\alpha\theta}{\beta(1-\theta)}\right]^{\theta}\right)^{1/\theta} + g\ln\Gamma_j. \qquad (6)$$

Optimal policy is characterized by the optimal provision of the public good. The autarky solution is easy to obtain and given by:

$$\Gamma_{aut,A} = \frac{\theta g}{\theta g + 1 - g}(2-\sigma) = m_A.$$

The inflation rate follows from equilibrium in the money market. That is, from each individual's budget constraint, we have:

$$n_A c_{aut,A}\frac{\beta}{\theta}w_A = w_{A,-1}$$

And from money market equilibrium, we have:

$$(2-\sigma)w_A = (2-\sigma)w_{A,-1} + M_A.$$

It is trivial to show that these two conditions are consistent, which confirms Walras' law.

2.3 International Equilibrium with National Currencies

Under international equilibrium with national currencies, each variety is still produced at the same quantity at equilibrium, but traded in both countries. Each individual spends the same amount on each variety. The imported quantity is purchased with the currency of the country where it is produced. Thus the exchange rate, in units of A currency per unit of B

$$ep_B x_{iB} = p_A x_{iA}. \tag{7}$$

Therefore,

$$ew_B = w_A, \; ep_B = p_A.$$

The number of varieties produced are:

$$n_A = (2 - \sigma - \Gamma_A)\frac{1-\theta}{\alpha}, n_B = (\sigma - \Gamma_B)\frac{1-\theta}{\alpha}. \tag{8}$$

Individuals work when young, receive their wages, $w_{A,} - 1, w_{B,} - 1$ in the form of money and consume when old. Thus, each variety in each country is consumed at:

$$c_A = \frac{w_{A,-1}}{p_A}\frac{1}{\eta_A + \eta_B}, c_B = \frac{w_{B,-1}}{p_B}\frac{1}{\eta_A + \eta_B}.$$

The market for each variety is at equilibrium if:

$$\frac{\alpha\theta}{\beta(1-\theta)} = (2-\sigma)c_A + \sigma c_B.$$

Equilibrium in the foreign exchange market requires that total expenditure on A products by B must be equal to total expenditure on B products by A:

$$\sigma p_A n_A c_B = e(2 - \sigma) p_B n_B c_A.$$

This condition determines the exchange rate, if it is flexible, or constrains the countries' monetary policies, if it is fixed.

In each country, total money demanded by the young must equal total money supplied by the old plus newly created money. That is:

$$(2 - \sigma)w_A = (2 - \sigma)w_{A,-1} + M_A; \quad \sigma w_B = \sigma w_{B,-1} + M_B. \tag{9}$$

Dividing through by w_A, w_B, respectively, expressing real money growth by m_A, m_B, using the pricing condition and solving we have:

$$\frac{w_A}{w_{A,-1}} = \frac{2-\sigma}{2-\sigma-m_A}, \frac{w_B}{w_{B,-1}} = \frac{2-\sigma}{\sigma-m_B}. \tag{10}$$

If public good provision is financed by money creation only, we have: $\Gamma_A = m_A$, $\Gamma_B = m_B$. Solving for the consumption per person of each variety, we have:

$$c_A = \frac{\alpha\theta}{\beta(1-\theta)} \frac{2-\sigma-\Gamma_A}{(2-\sigma)(2-\Gamma_A-\Gamma_B)}); \; c_B = \frac{\alpha\theta}{\beta(1-\theta)} \frac{\sigma-\Gamma_B}{\sigma(2-\Gamma_A-\Gamma_B}. \tag{11}$$

The resulting indirect utility functions are:

$$U_A = K_A + \frac{(1-g)(1-\theta)}{\theta} 1\text{n}(2-m_A-\text{m}_B) + (1-g)1\text{n}\,(2-\sigma-m_A) + \text{g}\,1\text{n}m_A, \tag{12}$$

$$U_B = K_B + \frac{(1-g)(1-\theta)}{\theta} 1\text{n}(2-m_A-\text{m}_B) + (1-g)1\text{n}\,(\sigma-m_B) + \text{g}\,1\text{n}m_B, \tag{13}$$

where K_A, K_B are functions of parameters (which notably include country sizes, $2-\sigma, \sigma$):

$$K_A = \frac{(1-g)(1-\theta)}{\theta} 1\text{n}\left[\frac{1-\theta}{\alpha}\right] + (1-g)1\text{n}\left[\frac{\theta}{\beta(2-\sigma)}\right];$$
$$K_B = \frac{(1-g)(1-\theta)}{\theta} 1\text{n}\left[\frac{1-\theta}{\alpha}\right] + (1-g)1\text{n}\left[\frac{\theta}{\beta\sigma}\right].$$

The spillovers associated with international equilibrium are clear. Money growth in A appears in country B's utility and vice versa. Higher money growth in A finances a greater quantity of the public good, benefitting A residents, but hurts B residents by withdrawing resources from the production of varieties. The equations expressing the first order conditions for country A's government with respect to m_A, taking m_B as given, and for country B's government with respect to m_B, taking m_A as given, the *reaction functions* for the two governments, are as follows:

$$\frac{(1-g)(1-\theta)}{\theta(2-m_A-m_B)} = \frac{g}{m_A} - \frac{1-g}{2-\sigma-m_A}; \quad \frac{(1-g)(1-\theta)}{\theta(2-m_A-m_B)} = \frac{g}{m_B} - \frac{1-g}{\sigma-m_B}. \tag{14}$$

Solving them simultaneously defines a Nash equilibrium in the two countries' *uncoordinated* monetary policy decisions.

Although the reaction functions cannot be solved in closed form, some results do follow. E.g., if $\theta < 1$, the elasticity of substitution is greater than one, then a government's setting its own monetary policy ignores the externality it generates for the other government. That is, each government supplies more of the public good than is socially optimal, since it ignores the negative effects on the foreigners of the associated withdrawing of resources from private production. Furthermore, it is possible to show that the *larger* of the two countries devotes a *smaller* share of its resources to the public good. This in turn implies that the larger country supplies a greater amount of the public good than the smaller one.

In sum, the public good is financed by money printing. Size matters because it affects the range of tradeable varieties. With national currencies, the exchange rate determined by international trade equilibrium: if flexible, it is determined by market clearing; if fixed, clearing establishes relationship between national monetary policies. With national currencies, total real consumption in each country depends on its labor endowment, not monetary policy. Money issues are like lump-sum taxes.

2.3.1 Market Reforms Versus Technological Progress Revisited

The results of this section may be reworked to allow for market reforms versus TFP-type technological progress. As we discussed, arbitrarily specifying a range of intermediates gives rise to profits, whereas allowing for free entry dissipates those profits, and allows a distinction between private losses and social gains from market reform. The impact of such a reform on international equilibrium with national currencies depend, of course, on the comparison between the fixed range against the equilibrium range of varieties. In this highly stylized setting, one can see that losses to those earning rents, prior to the liberalization, may be offset by gain to the economy as a whole.

Implementation of TFP-type reforms by both countries benefits them both in a symmetric fashion. If, however, only one country does, the consequences are quite dramatic. The condition for trade equilibrium, (7), must be modified. The logic of the model requires that all varieties be consumed by all individuals in both countries. Suppose that country B only introduces TFP-type technological progress. Labor in that country becomes ever more productive, which improves the real exchange rate in its favor, reducing welfare for country A. The presence of TFP at a constant growth rate η is incompatible with steady state. So, unless country A also institutes reforms, steady state equilibrium is not possible.

2.3.2 Public Debt Finance

The model so far allows for individuals to be able to transfer purchasing power over time by means of money. In addition to M_A, M_B, [Eq. (9)] newly created money in each country, we may also allow for new debt borrowing (or repayment), $d = D - D_{-1}$. We may distinguish debt from money finance by means of adding frictions; more on this, later. The challenge is to link a country's ability to deal with repayment by means of introducing structural reforms Ioannides and Pissarides

(2015). It is easier to visualize this in the context of national currencies with a fiscal system; see Sects. 3.2 and 3.3 below.

2.4 Common Currency

With countries A and B sharing a common currency, the exchange rate is always equal to one, and the international financial equilibrium does not constrain monetary policy. Nominal wages are equalized across the two countries, and for monetary equilibrium, we have that:

$$(2-\sigma)w + \sigma w = 2w = 2w_{-1} + M_A + M_B. \tag{15}$$

Per capita consumption of each variety is the same across the two countries:

$$c_A = c_B = \frac{1}{2}\frac{\alpha\theta}{\beta(1-\theta)}.$$

The total number of varieties produced is $(2-m_A-m_B)\frac{1-\theta}{\alpha}$. The associated indirect utility functions for the two countries are:

$$U_A = K'_A + \frac{1-g}{\theta}\ln(2-m_A-m_B) + g\ln m_A, \tag{16}$$

$$U_B = K'_B + \frac{1-g}{\theta}\ln(2-m_A-m_B) + g\ln m_B, \tag{17}$$

where

$$K'_A \equiv K_A + (1-g)\ln\frac{2-\sigma}{2}, K'_B \equiv K_B + (1-g)\ln\frac{\sigma}{2},$$

Even though the two countries share a currency, they can still pursue uncoordinated money creation. If money creation aims at maximizing (16), respectively (17), and thus ignore the intercountry externality, expressed by m_A's presence in the RHS of (16), respectively of (17), it would lead to too much inflation. These quantities can in fact be obtained in closed form. That is:

$$m_A = m_B = \frac{2g\theta}{2g\theta + 1 - g}. \tag{18}$$

Monetary policy, and the magnitude of the public good provided do not depend on country population sizes, but of course the constants K'_A, K'_B in (16)–(17) do.

A common central bank ought to internalize this externality and instead pursue monetary policy with an objective of maximizing a weighted sum of countries' utilities:

$$\max_{m_A, m_B} : (2-\gamma)U_A(m_A, m_B) + \gamma U_B(m_A, m_B), \tag{19}$$

with a given set of weights $(2-\gamma, \gamma)$. The resulting optimal monetary policy is:

$$m_A = \min\left\{2-\sigma, (2-\gamma)\frac{g\theta}{1-g+g\theta}\right\}, m_B = \min\left\{\sigma, \gamma\frac{g\theta}{1-g+g\theta}\right\}. \tag{20}$$

If each country's welfare is assigned the same weight, $\gamma = 1$, then as one can see, by comparing (20) with (18), the coordinated monetary policy is less expansionary than the uncoordinated one. Uncoordinated monetary policy is excessively expansionary, a well known phenomenon that has been discussed by the literature; see Casella (1992, p. 856, fn. 4).

A strictly democratic setting—a person, a vote—would require that different countries' utilities be weighted by their respective population shares. That is, in (19), $\gamma = \sigma$. As a consequence, monetary policy would reflect relative population sizes. But, what other considerations are there in setting the relative weights? How do weights affect the attractiveness of different countries' joining the monetary union. Similarly, given that they are in a monetary union, how do weight setting deters them from leaving the union?

Casella (1992) proves that in her model, there exists a minimum $\overline{\sigma}$ such that for all $\sigma < \overline{\sigma}$ the small country will require a larger relative weight in aggregate welfare than its relative size. That is, $\forall \sigma, \sigma > \overline{\sigma}$ all cooperative equilibria, if they exist, will have $\gamma > \sigma$. This is concisely summarized in *ibid.*, Fig. 3A, which plots the minimum percentage weight γ, as function of the smaller country's relative size, for such a country to be in a currency union, and in *ibid.*, Fig. 3B, which plots the minimum percentage weight γ, as function of the smaller country's relative size, for such a country to coordinate monetary policy, when countries have their own national currencies. The intuition of this result is that when a country is very small, it must demand more than proportional weight in the cooperative agreement. If this were not the case, the control exercised by the larger economy would result in a very unbalanced solution of the externality problem: the small country would end up facing the costs of the coordination without reaping enough of the benefits. Casella emphasizes that since the small country's alternative is to revert to the Nash equilibrium, "this cannot be used as a threat by the large country to enforce cooperation."

3 International Equilibrium with Fiscal Systems

In view of the Fiscal Compact Treaty of 2012 European Union (2012), it is natural to explore the scope for fiscal coordination within a monetary union. Taking cues from Sibert (1992), I assume that each government finances its public good from tax revenue, which allows for country-specific inefficiency in tax collection, and from its share of seignorage. The model also allows for effects of differences in size between the two countries in the style of Casella (1992). As already indicated, both Casella and Sibert recognize that lump-sum taxation and money creation cannot coexist: the former would be completely offset by the latter. In developing the case fiscal coordination within a monetary union, it is important to allow for proportional taxation of labor income, wages. That together with inefficiency in tax collection allows for meaningful tradeoffs. Critical conceptual problems are present here, even in the autarky case, that is whether the central bank and the government act in an uncoordinated way, whereby the resulting Nash equilibria involves setting of monetary and fiscal policy. I formulate the autarkic case first in order to fix ideas and set notation.

3.1 Autarky with a Fiscal System

Under autarky, each individual in country A consumes an equal amount, $c_{aut,A} = \frac{1}{2-\sigma}\frac{\alpha\theta}{\beta(1-\theta)}$, of each variety. The provision of the public good is financed by money creation and taxation. That is public spending is equal to $M_A + \kappa_A\tau_A w_A$ (and similarly for country B), where τ_A denotes the tax rate on wage income and κ_A the fraction of nominal tax revenue which the government collects. Thus, in real terms, the budget constraint may be expressed as:

$$\Gamma_A = \ell_{\Gamma_A} = m_A + \ (2-\sigma)\kappa_A\tau_A.$$

The range of varieties produced is given by:

$$n_A = (2-\sigma - m_A - (2-\sigma)\kappa_A\tau_A)\frac{1-\theta}{\alpha}.$$

The corresponding value of the utility function for country A (and similarly for country B) is:

$$U_A = (1-g)\ln\left(((2-\sigma)(1-\tau_A)-m_A)\frac{1-\theta}{\alpha}\left[\frac{1}{2-\sigma}\frac{\alpha\theta}{\beta(1-\theta)}\right]^{\theta}\right)^{1/\theta} + g\ln[m_A+(2-\sigma)\kappa_A\tau_A]. \tag{21}$$

Optimal provision of the public good is the same as in the autarky case:

$$\Gamma_{aut,A} = \frac{\theta g}{\theta g + 1 - g}(2-\sigma),$$

and thus is independent of how it is financed. Following Sibert (1992), optimizing (21) with respect to τ_j, given $\kappa_j \neq 0$, determines fiscal policy as distinct from monetary policy. Or else, only $(2-\sigma)\tau_j + m_j$ may be defined. The inflation rate follows from equilibrium in the money market. That is, from each individual's budget constraint, we have:

$$n_A c_{aut,A}\frac{\beta}{\theta}w_A = (1-\tau_A)w_{A,-1}.$$

And from money market equilibrium, we have:

$$(2-\sigma)(1-\tau_A)w_A = (2-\sigma)(1-\tau_A)w_{A,-1} + M_A.$$

Walras' law is again confirmed, provided that $\kappa_j = 0$, or else the adding up property is violated.

3.2 National Currencies with a Fiscal System

If x_j is the tax rate on wages, then inefficiency in tax collection leaves a tax revenue of $\kappa_j\tau_j w_j$. Thus, the public good is financed by a combination of seignorage and tax revenue

$$\Gamma_A = \ell_{\Gamma A} = m_A + (2-\sigma)\kappa_A\tau_A,\ \Gamma_B = \ell_{\Gamma B} = m_B + \sigma\kappa_B\tau_B. \tag{22}$$

The range of varieties produced in each country satisfy:

$$n_A = (2-\sigma-m_A-(2-\sigma)\kappa_A\tau_A)\frac{1-\theta}{\alpha}, n_B = (\sigma - m_B - \sigma\kappa_B\tau_B)\frac{1-\theta}{\alpha}$$

From money market equilibrium we have:

$$(2-\sigma)(1-\tau_A)w_A = (2-\sigma)(1-\tau_A)w_{A,-1} + M_A,$$

from which we obtain an expression for wage inflation,

$$(1-\tau_A)\frac{w_{A,-1}}{w_A} = 1-\tau_A - \frac{m_A}{2-\sigma},$$

and similarly for country B. Using this condition with the budge constraints allows us to solve for consumption per person of each variety. That is:

$$(n_A+n_B)c_A\frac{\beta}{\theta}w_A = (1-\tau_A)W_{A,-1}.$$

Therefore, per capita consumption of varieties in the two countries are:

$$\begin{aligned} c_A &= \frac{\alpha\theta}{\beta(1-\theta)(2-\theta)}\frac{(2-\sigma)(1-\tau_A)-m_A}{(2-m_A-m_B-(2-\sigma)\kappa_A\tau_A-\sigma\kappa_B\tau_B)}; \\ c_B &= \frac{\alpha\theta}{\beta(1-\theta)\sigma}\frac{\sigma(1-\tau_B)-m_B}{(2-m_A-m_B-(2-\sigma)\kappa_A\tau_A-\sigma\kappa_B\tau_B)} \end{aligned} \tag{23}$$

The corresponding utility functions are:

$$\begin{aligned} U_A = K_A &+ \frac{(1-g)(1-\theta)}{\theta}1\text{n}[2-m_A-m_B-(2-\sigma)\kappa_A\tau_A-\sigma\kappa_B\tau_B] \\ &+(1-g)1\text{n}[(2-\sigma)(1-\tau_A)-m_A]+g\ln(m_A+(2-\sigma)\kappa_A\tau_B), \end{aligned} \tag{24}$$

$$\begin{aligned} U_B = K_B &+ \frac{(1-g)(1-\theta)}{\theta}1\text{n}[2-m_A-m_B-(2-\sigma)\kappa_A\tau_A-\sigma\kappa_B\tau_B] \\ &+(1-g)1\text{n}[\sigma(1-\tau_B)-m_A]+g\ln(m_B+\sigma\kappa_B\tau_B). \end{aligned} \tag{25}$$

3.2.1 National Currencies and Debt Finance

In view of the discussion in Sect. 2.3.2 above, we may augment Eq. (22) above to allow for public debt finance. In like manner to the inefficiency of taxation, let δ_A, δ_B be the fraction of borrowing that may drawn upon by country A,B, respectively. That is, net borrowing $d_A = D_A - D_{A,-1}$ yields $\delta_A d_A$ available for spending, per person, and let ρ_A, ρ_B denote the interest rates associated with the outstanding debt. Augmenting Eq. (22) by introducing debt yields:

$$\begin{aligned} \Gamma_A = \ell_{\Gamma A} = m_A + (2-\sigma)[\kappa_A\tau_A + \delta_A d_A - \rho_A D_{A,-1}], \Gamma_B = \ell_{\Gamma B} \\ = m_B + \sigma[\kappa_B\tau_B + \delta_B d_B - \rho D_{B,-1}]. \end{aligned} \tag{26}$$

The model continues to allow for individuals to transfer purchasing power over time by means of money. Revenue from issuing debt is distinguished from money finance and from tax finance by means of frictions, denoted by the parameters δ_A, κ_A, respectively. The resulting modification of the model is rather trivial. Essentially, because taxes and debt revenue are lump-sum, the above formulas may be adapted easily.

The next step is to link a country's improved ability to deal with servicing and/or repayment of debt with introducing structural reforms with either level- or growth-effects. If all debt is domestic, the financing options to the government depend on the dynamic efficiency properties of the economy. In this overlapping generations economy, introduction of debt finance is welfare enhancing if the economy is dynamically inefficient.

If debt is international, that is one country borrows from the other country, then the terms

$$(2-\sigma)[\delta_A d_A - \rho_A D_{A,-1}] \text{ and } \sigma[\kappa_B \tau_B + \delta_B d_B - \rho D_{B,-1}]$$

are not independent from one another. For the same reason, international trade equilibrium requires that the debtor country has enough current account surplus to pay back the creditor country. With this refinement, the model could be developed fully for the case of debt finance with interest payments from the debtor to the creditor. We could take the previous debt level as given and we could envision alternative steady states associated with different current account regimes.

An important consequence of this is that productivity improvements in one country behoove the other to also implement them, or else it would be unable to meet its debt obligations. This is even more important in the case of productivity improvements of the growth- rather than of the level effect type.

3.3 Common Currency with a Fiscal System

We derive the counterpart for the case of common currency with national fiscal systems by working from condition for equilibrium in the money market. That is, the sum of the money holdings of the old generations plus money creation in the two economies equal to the sum of the money holding by young generations:

$$\begin{aligned}(2-\sigma)(1-\tau_A)w_A + \sigma(1-\tau_B)w_B = {} & (2-\sigma)(1-\tau_A)w_{A,-1} \\ & + \sigma(1-\tau_B)w_{B,-1} + M_A + M_B. \end{aligned} \tag{27}$$

Since nominal wages are equalized across the two countries, we may solve for $\frac{w_{A,-1}}{w_A}$ to get:

$$\frac{w_{A,-1}}{w_A} = \frac{2 - (2 - \sigma)\tau_A - \sigma\tau_B - m_A - m_B}{2 - (2 - \sigma)\tau_A - \sigma\tau_B}.$$

The total number of varieties is:

$$n_A + n_B = \frac{1 - \theta}{\alpha}(2 - m_A - m_B - (2 - \sigma)\kappa_A\tau_A - \sigma\kappa_B\tau_B).$$

$$\begin{aligned} c_A &= (1 - \tau_A)\frac{\alpha\theta}{\beta(1 - \theta)} \\ &\times \frac{2 - (2 - \sigma)\tau_A - \sigma\tau_B - m_A - m_B}{\left(2 - m_A - m_B - (2 - \sigma)\kappa_A\tau_A - \sigma\kappa_B\tau_B\right)\left(2 - (2 - \sigma)\tau_A - \sigma\tau_B\right)}, \end{aligned} \tag{28}$$

$$\begin{aligned} c_B &= (1 - \tau_B)\frac{\alpha\theta}{\beta(1 - \theta)} \\ &\times \frac{2 - (2 - \sigma)\tau_A - \sigma\tau_B - m_A - m_B}{\left(2 - m_A - m_B - (2 - \sigma)\kappa_A\tau_A - \sigma\kappa_B\tau_B\right)\left(2 - (2 - \sigma)\tau_A - \sigma\tau_B\right)} \end{aligned} \tag{29}$$

In the special case of no fiscal system, $\tau_A = \tau_B = 0$, we are back to $c_A = c_B = \frac{1}{2}\frac{\alpha\theta}{\beta(1-\theta)}$: all varieties are consumed in equal amounts.

The indirect utility functions are given by:

$$\begin{aligned} U_A = K_A' &+ \frac{(1 - g)}{\theta}\ln(2 - m_A - m_B - (2 - \sigma)\kappa_A\tau_A - \sigma\kappa_B\tau_B) \\ &+ g\ln(m_A + (2 - \sigma)\kappa_A\tau_A) + (1 - g)\ln(1 - \tau_A) \\ &- (1 - g)\ln(2 - (2 - \sigma)\tau_A - \sigma\tau_B); \\ U_B = K_B' &+ \frac{(1 - g)}{\theta}\ln(2 - m_A - m_B - (2 - \sigma)\kappa_A\tau_A - \sigma\kappa_B\tau_B) \\ &+ g\ln(m_B + \sigma\kappa_B\tau_B) + (1 - g)\ln(1 - \tau_B) \\ &- (1 - g)\ln(2 - (2 - \sigma)\tau_A - \sigma\tau_B); \end{aligned}$$

National fiscal authorities would set tax policies so as to maximize U_A with respect to τ_A, and U_B with respect to τ_B, while taking monetary policy as given.

The objective the central bank for the monetary union seeks (m_A, m_B) to maximize,

$$(2 - \gamma)U_A + \gamma U_B,$$

now becomes:

$$K+2\frac{1-g}{\theta}\ln(2-m_A-m_B-(2-\sigma)\kappa_A\tau_A-\sigma\kappa_B\tau_B)$$
$$-2(1-g)\ln(2-(2-\sigma)\tau_A-\sigma\tau_B)(2-\gamma)g\ln(m_A+(2-\sigma)\kappa_A\tau_A)+(2-\gamma)(1-g)$$
$$\times\ln(1-\tau_A)+\gamma g\,\ln(m_B+\sigma\kappa_B\tau_\mathrm{B})+\gamma(1-g)\ln(1-\tau_B).$$

From the first-order conditions for the union's central bank with respect to (m_A, m_B), we have that the resources allocated to the public good in each country are given by:

$$\Gamma_A=m_A+(2-\sigma)\kappa_A\tau_A=(2-\gamma)\frac{g\theta}{1-g+g\theta},$$
$$\Gamma_B=m_B+\sigma\kappa_B\tau_B=\gamma\frac{g\theta}{1-g+g\theta}. \tag{30}$$

Notably, such an allocation to the public good provision coincides with the solution for optimal union-wide monetary policy with no fiscal system, which implies lower money growth in the monetary union in the presence of a fiscal system than in its absence. The national fiscal authority provide for some of the resources necessary for optimal provision of the public good.

Suppose that fiscal policy is under the control of national governments. Seeking τ_A (alternatively, τ_B) to maximize U_A (alternatively, U_B) leads to first-order conditions, which once the results above for optimum monetary policy have been used may be simplified as follows:

$$\frac{1}{2-\sigma}\frac{1}{1-\tau_A}-\frac{1}{2-(2-\sigma)\tau_A-\sigma\tau_B}=\frac{\kappa_A(1-g+g\theta)}{(1-g)\theta}\left[\frac{1}{2-\gamma}-\frac{1}{2}\right]; \tag{31}$$
$$\frac{1}{\sigma}\frac{1}{1-\tau_B}-\frac{1}{2-(2-\sigma)\tau_A-\sigma\tau_B}=\frac{\kappa_B(1-g+g\theta)}{(1-g)\theta}\left[\frac{1}{\gamma}-\frac{1}{2}\right]. \tag{32}$$

It is straightforward to establish conditions under which feasible optimum national tax rates exist. In view of the fact that Eq. (31–32) are quadratic functions, we note that in general there exist two sets of solutions. At any rate, the optimal tax rates of both countries are simultaneously determined.

Manipulation of Eq. (31–32) yields:

$$\frac{1}{2-\sigma}\frac{1}{1-\tau_A}-\frac{1}{\sigma}\frac{1}{1-\tau_B}=\frac{1-g+g\theta}{2(1-g)\theta}\left[\kappa_A\frac{\gamma}{2-\gamma}-\kappa_B\frac{2-\gamma}{\gamma}\right].$$

Numerous comparative dynamics results are possible. E.g., suppose that the fiscal systems of the two countries are equally efficient, $\kappa_A=\kappa_B$. Then the sign of the LHS above is positive (negative) if $\gamma<(>)1$, that is if country B is given less weight in setting monetary policy for the monetary union. Also, suppose that country B is also smaller, that is $\sigma<1$. Then it follows that country A, the larger of the two, pays a higher tax rate. The condition above also implies that, other things being equal, the optimal tax rate of the country with a more efficient tax system would be higher. The above result allows us to explore what is implied for national optimal tax rates by the finding of Casella (1992), that the smaller country must be given more than proportional (to its population share) representation in order to voluntarily participate in a monetary union. Imposing the condition that $\gamma > \sigma$ constrains the relationship between the two respective taxes rates, country sizes and efficiencies of tax systems.

We conclude by emphasizing the fact that this simple theory shows that even though national fiscal authorities are entrusted with setting national fiscal policy, monetary union introduces profound interdependence which makes the country-specific optimal tax rates depend on the sizes of both countries as well as the efficiency of their tax systems. The result follows from a skeletal model, where countries differ only with respect to their sizes. Notably, the model does not allow for debt financing.

3.3.1 Common Currency, National Fiscal Systems and Debt Finance

In view of the discussion in Sect. 3.2.1 above, we may modify Eq. (27) above to allow for public debt finance, in addition to money and tax finance:

$$\begin{aligned}(2-\sigma)(1-\tau_A)w_A+\sigma(1-\tau_B)w_B = {} & (2-\sigma)(1-\tau_A)w_{A,-1}\\ & +\sigma(1-\tau_B)w_{B,-1}+M_A+M_B\\ & +\delta_A d_A+\delta_B d_B-\rho_A D_{A,-1}\\ & -\rho_B D_{B,-1}.\end{aligned} \tag{33}$$

Similarly, Eq. (30) must be suitably adapted to reflect the availability of resources from borrowing.

Regarding Eq. (33), if all debt is international and between the two countries in question, then $\rho_A = \rho_B$, and $D_{A,-1} + D_{B,-1} = 0$. While this simplifies (33), the condition for monetary equilibrium, it presumes that the debtor can run a trade surplus in order to be able to finance interest payments. This is sort of invisible in (33), but becomes relevant for the national budget constraints that ensure the finance of the national public goods. That is, Eq. (34) must be modified as follows:

$$\begin{aligned}\Gamma_A &= m_A + (2-\sigma)[\kappa_A\tau_A + \delta_A d_A - \rho_A D_{A,-1}],\\ \Gamma_B &= m_B + \sigma[\kappa_B\tau_B + \delta_B d_B - \rho_B D_{B,-1}].\end{aligned} \tag{34}$$

This modification has major consequences for the equilibrium allocations and associated welfare.

In like manner to the inefficiency of taxation, let δ_A, δ_B be the fraction of borrowing that may drawn upon by country A,B, respectively. That is, net borrowing $d_A = D_A - D_{A,-1}$ yields $\delta_A d_A$ available for spending, per person, and let ρ_A, ρ_B

denote the interest rates associated with the outstanding debt. Augmenting Eq. (22) by introducing yields:

$$\Gamma_A = \ell_{\Gamma A} = mA + (2-\sigma)[\kappa_A \tau_A + \delta_A d_A - \rho_A D_{A,-1}],$$
$$\Gamma_B = \ell_{\Gamma B} = m_B + \sigma[\kappa_B \tau_B + \delta_B d_B - \rho D_{B,-1}]. \tag{35}$$

The model continues to allow for individuals to transfer purchasing power over time by means of money. Revenue from issuing debt is distinguished from money finance and from tax finance by means of frictions, denoted by the parameters δ_A, κ_A, respectively. The resulting modification of the model is rather trivial. Essentially, because taxes and debt revenue are lump-sum, the above formulas may be adapted easily.

The challenge is to link a country's ability to deal with servicing and/or repayment of debt by means of introducing structural reforms with either level- or growth-effects. If all debt is domestic, the financing options to the government depend on the dynamic efficiency properties of the economy. As mentioned above, if the economy is dynamically inefficient, introducing debt finance is welfare-enhancing. If, on the other hand, one country borrows from the other country, then the terms

$$(2-\sigma)\left[\delta_A d_A - \rho_A D_{A,-1}\right], \sigma\left[\kappa_B \tau_B + \delta_B d_B - \rho D_{B,-1}\right]$$

are not independent from one another. For the same reason, international trade equilibrium requires that the debtor country has enough trade surplus to pay the creditor country. With this refinement, the model could be developed fully for the case of debt finance with interest payments from the debtor to the creditor.

An important consequence of this is that productivity improvements in one country behoove the other to also implement them, or else it would be unable to meet its debt obligations. This is even more important in the case of productivity improvements of the growth- rather than of the level effect type.

4 Concluding Remarks

In numerous ways that have been documented widely, the EZ is made up of very diverse countries. In spite of such diversity, catastrophic wars among the core European countries, that have fought many vicious conflicts over the last few years, have been prevented. Given this political success, there ought to be vast scope for coming to terms with the international coordination that is necessary to carry out fiscal policy that operated along with monetary policy and is designed to optimize outcomes over the entire union. In addition to the conventional differences among countries that have been identified by the literature, this paper introduces two more: differences in the efficiency of fiscal systems and on the terms of sovereign borrowing.

The present model provides a simple deterministic framework for understanding the role of size in the interdependence of broad macroeconomic aggregates. The mechanism for setting country-specific fiscal policy is not independent from the conduct of monetary policy. The paper goes beyond (Ioannides 2016) in allowing for debt finance under the different scenaria of international equilibrium, that is, international economic integration with national currencies and with a common currency, both in the presence of national fiscal systems. It allows us to examine in detail the setting similar to where Greece and the EZ found themselves since 2010. That is, given economic integration with a currency union, how willing should the union be (in our case, the larger of the two countries) to negotiate with one of its members and prevent breakup of the monetary union. The central role of size in the model provides for a realistic setting in assessing this question and in much simpler terms than other approaches in the literature (c.f. Alvarez and Dixit 2014).

References

Alvarez F, Dixit A (2014) A real options perspective on the future of the euro. J Monet Econ 61:78–109

Casella A (1992) Participation in a currency union. Am Econ Rev 82(4):847–863

European Union (2012) Consolidated versions of the treaty on European Union and the treaty on the functioning of the European Union. Off J Eur Union C326:55 October 26. https://www.ecb.europa.eu/ecb/legal/pdf/c 32620121026en.pdf

Ioannides YM (2016) Large versus small states in the eurozone, the democratic deficit, and future architecture. In: Michaelides A, Orphanides A (eds) The Cyprus Bail-in: policy lessons from the Cyprus economic crisis. World Scientific Imperial College Press, New Jersey

Ioannides YM, Pissarides CA (2015) Is the Greek crisis one of supply or demand? Brookings Papers on Economic Activity. Fall:349–373

Sibert A (1992) Government finance in a common currency area. J Int Money Financ 11 (6):567–578