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The Political Economy of a Diverse Monetary Union

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Abstract

We analyze the political economy of monetary unification among countries with different quality of institutions. Countries with stronger institutions have lower public spending and better productive incentives, even under a stronger currency. Governments under weaker institutions spend more and must occasionally devalue. In a diverse monetary union prices and flows adjust quickly while institutional differences persist, so the common exchange rate has large redistributive effects. Public spending in the weaker country is less constrained and may rise, so productive incentives are reduced by both a fiscal and common exchange rate effect. A weak country government may agree to a common currency that reduces productive capacity as it enables more public spending. Strong country production benefits from a weaker currency, but in a crisis the survival of the monetary union may require fiscal transfers, justified by the implicit gains. Even when a diverse monetary union is on aggregate beneficial to all countries, firms in weaker countries and savers in stronger countries lose.

Keywords: Monetary unions; institutional quality; political economy; fiscal union; fiscal transfers

JEL Codes: 033, O47; D72; F33; F45

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1 Introduction

The EMU is an unique example of a voluntary monetary union among diverse countries. It was widely considered a success in its first decade, as it facilitated European trade and financial integration. Its resilience has been severely tested since 2008, when its fragility in the absence of a common fiscal framework was revealed, leading to a sharp contrasts between core and periphery economies. With hindsight, the euro has deeply integrated EU economies, but it has not led to institutional convergence. Persistent structural differences are a key challenge in the debate on its future.

This paper offers a political economy interpretation of the emergence and persistence of a monetary union among countries with very different institutional quality. It contributes insight on why an institutionally diverse monetary union (DMU) may be rationally agreed to by politicians even when its fragility is anticipated, and why it may survive even if it requires fiscal transfers to avoid a break up.

The early literature since the pioneering work of Mundell (1961) stressed the trade-off between trade benefits and an independent monetary policy as a determinant of optimal currency areas, but did not elaborate on the equilibrium level of a common currency. At the onset of the euro many authors such as Alesina and Barro (2002) thought it could provide a monetary credibility anchor for economies with a history of devaluations, while recognizing that the adjustment challenge would fall on the weaker economies. The euro experience suggests that institutional structures do not converge easily. We model public and private choices in a reduced form setup where market prices and trade flows adjust quickly to structural changes, labor markets adjust slowly while deeper institutional characteristics persist over the medium term.

A key ingredient is the recognition that a common currency among diverse countries will reflect average characteristics. A DMU leads to an implicit devaluation for stronger economies, boosting production and fiscal capacity. It also enables financially constrained politicians in weaker countries to borrow more and more cheaply, as a credible commitment not to devalue reduces borrowing rates. Productive incentives in weaker economies may benefit or lose by the common currency, depending on the balance of the interest and exchange rates and fiscal burden effect.

Politicians are self-interested and trade off productive efficiency and political benefits using weights determined by their national institutional quality. The political decision to introduce a common currency may not reflect a mutually beneficial outcome since political motives may override economic welfare. In a weaker country politicians may choose to join because of relaxed fiscal constraints, while worse productive incentives lowers fiscal capacity, increasing the need for a transfer in downturns. In an intermediate country the fiscal effect is ambiguous, so production can benefit when lower interest rates compensate for the stronger currency, and a transfer may not be

required.

The analysis shows how DMU impacts financial prices, capital flows and policy choices, resulting in redistributive effects across and within countries, in good and bad times. A credible DMU clearly benefits production and fiscal capacity in strong countries, and may lower them in weaker economies. Because of its effect on the exchange rate level a DMU redistributes fiscal capacity, so it is an (implicit) transfer union from the start, even before any fiscal transfers take place. Some economic groups within countries also benefit more than others. A DMU has a positive effect on firm profits and employment (thought not wages) in stronger countries, while savers may lose purchasing power. In weaker countries firms are harmed, while savers gain from a stronger currency and public sector employment may also benefit.

1.1 Discussion of the framework

Our analysis adopts a reduced form model, with plausible conditions on how capital markets and private investment adjust to changes in taxation, interest and currency rates. This allows to focus on policy choices (spending and taxation, devaluing, joining and remaining in a DMU) and their redistributive effects. Our ultimate goal is a positive view of how a diverse monetary unification may arise and persist.

In the model, institutional quality differs across countries, reflecting structural features in the spirit of Douglas North's view (North, 1991). Deep societal features that define social demands and public governance do not adjust rapidly to new circumstances such as the introduction of a common currency. The model also recognizes how joining a monetary union has been a political choice not directly chosen by voters (none of current EMU members held a referendum on the euro).

We model institutional quality as the government preference weight for productive efficiency versus political benefits such as private gains or boosting their chance of re-election. When institutions are good, political preferences internalize productive incentives better. Our formulation is consistent with the notion that better institutions lead to more productivity, stability and growth (Acemoglu et al., 2003, 2005; Barro, 1991; Alesina et al., 1996).

We refrain from any ethical judgment on bad institutions. These may reflect poor governance leading to less constrained opportunism, or a conflictual context with contrasting demands on public choices. Good institutions are empirically more common in homogeneous societies, perhaps because of easier consensus on public decisions. In culturally and ethnically divided countries political choices are more conflicted, and excess spending may be critical to remain in power.

Our results are largely driven by a varying "speed of adjustment" of economic and societal variables. Market prices adjust quickly, affecting investment, capital flows and exchange rates.

Nominal wages adjust at an intermediate speed, reflecting choices mediated at the political level. Institutional change requires a longer historical frame (Williamson, 2000). Redistributive effects are larger than in a traditional model because of this varying speed of adjustment.

We adopt a functional reduced form nominal exchange rate determination that captures the notion that countries in current account surplus have stronger currencies as they accumulate reserves or gold, a plausible view consistent with European economic history and supported by empirical evidence (Monacelli and Perotti, 2010; Kollmann, 2010; Ravn et al., 2012). The common currency will be valued based on the common current account balance, so it produces a revaluation for weaker economies and a devaluation for stronger ones. Our results on the equilibrium effects of a common currency depend only on this notion.

Firms produce tradable goods anticipating public policy and thus future currency and tax rates. When repayment requires extreme tax rates, firms evade taxation, for instance by hiding their profits. Thus, highly indebted countries face a maximum tax rate above which they need to devalue to avoid a default in adverse states. A devaluation increases productive incentives by lowering real wages, but comes at a political cost as some constituents will blame the politician for lower real wages and the revaluation of current wealth. To avoid this political cost, strong governments never devalue by printing currency, but by joining a DMU they can experience a "hidden" devaluation. Voters do not punish a government for such a devaluation, either because it is misunderstood, its effects only appear over time, or it is compensated by one-off real benefits such as lower transaction costs.

In case of a devaluation safety seeking foreign investors were not willing to fund public spending. Presumably they dislike any variation in payoffs, or anticipate an unequal treatment in case of default (Kohlscheen, 2010). In a credible DMU the weaker country relinquishes the valuable option to devalue, so benefits from lower interest rates and access to international capital flows. However, as institutional quality is unchanged a transfer may be required to sustain the monetary union in a downturn. We do not study the monetary policy decisions of a common central bank, that may be able to devalue the common currency as an alternative to an explicit fiscal transfer.

Our setup abstracts from well-known benefits of a monetary union (diversification, transaction costs) that benefit all member countries. It also ignores the benefits to strong currency economies of avoiding competitive devaluations within the MU (Frieden, 1998). Even without these benefits we show that DMU can be credible and mutually beneficial.

The rest of this paper is structured as follows. Section 2 describes the model setup. Section 3 solves for the equilibrium with independent currencies. Section 4 solves for the equilibrium with a monetary union among diverse countries, showing under what condition such a DMU emerges and remains credible even in adverse states. In Section 5 we discuss the redistributive effects of a DMU. Section 6 relates our model to the European Monetary union. Section 7 places the work in

the literature, and section 8 concludes.

2 Model

2.1 Environment and timing

Consider an economy with two countries $j \in \{S, W\}$ and two dates $t = 0, 1$. Each country consist of households and firms, and a government. Initially each country has its own currency with an exchange rate with respect to the dominant currency of a third reference country (rest of the world), which we will refer to as the dollar.

Countries differ in their institutional quality, defined as a stronger capacity for productive public policy. We denote institutional quality in country j as the weight $\beta^j \in (0, 1)$ that the government assigns to the productive capacity of the economy (our measure of economic welfare) versus the weight $1 - \beta^j$ on political or private benefit gained by public spending. A high β country is institutionally stronger ($j = S$), and a low β is institutionally weaker ($j = W$).

Timing

At $t = 0$ households start with an unit endowment of domestic currency. Households provide labor to firms and the government, and invest their cash in firm equity and domestic and foreign government bonds. First, firms decide on their productive capacity and raise the required funding. Then the government chooses public spending, paid for by issuing government bonds.

At $t = 1$ firms produce a traded good, and governments produce public goods. Once production is completed the state of the economy is revealed to be $s \in \{H, L\}$, where $Pr(s = H) = p$. The state determines the price of the traded good denominated in dollars, so the economy is perfectly correlated across countries.

Upon observing the state, governments may devalue if at risk of default. The traded good is sold for dollars and revenues are exchanged for domestic currency at the exchange rate. Firms and the governments pay wages for production. Firm and workers are taxed by the government to repay public debt. Firms distribute their after-tax profits to its equity holders. Table 1 summarizes.

Table 1: Timing

t=0		t=1	
Beginning of period	End of period	Beginning of period	End of period
1. Firms issue equity	4. Firms hire labor	1. Production	4. Labor paid
2. Government issues bonds	5. Government hires labor	2. State of the world	5. Taxation
3. Households invest		3. Devaluation or not	6. Financial payoffs

2.2 Households

There is a continuum of identical households of mass 1, who hold an unit endowment of domestic currency. Households derive utility from real wealth (in dollars) and from public goods. They have preferences over real wealth as we do not model the production of a non-tradable consumption good.[1] Households maximize their risk neutral expected utility given by

$$E[U^j] = E[W^j] + V(g^j)$$

subject to the budget constraint

$$I^j + B^j + F^j \leq 1$$

and where household's state contingent real wealth at the final period equals

$$W_s^j = \pi_s^j(I^j) + \frac{B^j(1+i^j) + (1-\tau_s)w(L_F^j + L_G^j)}{\epsilon_s^j} + \frac{F^j}{\epsilon_0^j}(1+r)$$

The government provides g^j public goods with real social value $V(g^j)$. Households work and invest. They invest I^j in domestic firm equity and B^j in domestic government bonds. Households cannot invest in foreign firm equity. Firm profits π_s^j are paid to the household in compensation for its equity investment, and the interest rate on domestic government bonds is i^j. Households also convert F^j of their endowment into dollars, and invest in foreign (dollar-denominated) government bonds that pay the risk free rate r.

Households provide L_F^j units of labor to produce the traded good, and L_G^j units of labor to produce public goods, both for the nominal wage w. Workers and firms are taxed at the same rate τ, chosen ex post to ensure solvency. In the final period the nominal income streams are converted to dollars using the state contingent $t = 1$ exchange rate ϵ_s^j.

The labor market is not our focus, so it is described in reduced form. Labor is paid a predetermined nominal wage set in domestic currency. Labor supply is perfectly elastic at this nominal wage and there is no disutility from working. Wages are set equal in terms of domestic currency units across countries, so stronger currency countries have higher real wages.

[1] The non-tradable sector is not crucial to our mechanisms as we focus on the exchange rate effect of a common currency on tradable production. Preferences over real wealth have also been used by Kumhof et al. (2015) and Francis (2009).

2.3 Government

The government chooses public spending G^j by maximizing its expected utility

$$\max_{G^j} \beta^j(E[\theta_s f(K, L_F^j)] + V(g^j)) + (1-\beta^j)G^j - \mathbb{1}C(\Delta\epsilon_L^j),$$

subject to a fiscal solvency constraint (also called the debt repayment condition) in all states

$$\tau_s^j(\theta_s f(K, L_F^j)\epsilon_s^j + w(L_F^j + L_G^j)) \geq G^j(1+i^j) \tag{1}$$

and where

$$g^j = \frac{G^j}{w} \tag{2}$$

Institutional quality in country $j \in \{S, W\}$ is measured by β^j. The real value of firm production equals $\theta_s f(K, L_F^j)$, where θ_s is the dollar price of the traded good that becomes known at time $t = 1$. Public spending is used to hire labor to produce public goods (equation 2). Public goods have a real social value $V(g^j)$, with $V' > 0$ and $V'' < 0$. Public spending affects production by raising the expected tax rate, and via its effect on interest and exchange rates.

As in Grossman and Helpman (1994) and Foarta (2018) the government is run by a self-interested politician. Political preferences balance productive and unproductive uses of resources with weights that reflect institutional quality. Better institutions support productive uses of resources, given by real firm output plus the social value of public goods.[2]

An imaginary country with perfect institutions ($\beta^j = 1$) chooses the social optimal public spending G^{FB} that maximizes the productive usage of resources. Additional spending on public goods is unproductive, but may provide private or political benefits to politicians. We will refer to $G^j - G^{FB}$ as excess public spending. Excess spending may directly benefit politicians in a context of poor accountability, or be needed to maintain control in a diverse and conflictual society.

The government funds its spending by issuing public debt in its own currency (in case of MU, in the common currency). The fiscal solvency constraint (equation 1) ensures debt repayment in all states. The left side of the fiscal solvency constraint is the tax base and the right side the total required debt repayment. This equation defines the state contingent tax rate required at $t = 1$ for fiscal solvency.

Firms evade taxation above a threshold tax rate $\bar{\tau}$, determined by the cost of tax evasion. When this fiscal constraint is binding, the government can avoid a default by devaluing its currency. A devalued currency implies lower real wage cost, so it incentives production ex ante, boosting the

[2] This notion of economic welfare may differ from social welfare in a context with redistributive motives.

tax base.

In case of devaluation the indicator function equals 1 and the government suffers a political cost $C(\Delta\epsilon^j)$, where $\Delta\epsilon^j$ is the change in the exchange rate, $C' > 0$ and $C'' > 0$. The interpretation of this cost function is that constituents increasingly dislikes a devaluation as real wages and savings revalue, so a devaluation has political repercussions. We assume that a devaluation is preferred over a default, so no government ever defaults, which seems to describe the experience in Europe since WWII.

A government that may devalue loses access to foreign safety seeking investors, so its spending is constrained by net domestic savings. Such a fiscal borrowing constraint is not necessarily binding, even for a country that may devalue. Note that as the private sector invests first, it will not be directly constrained by the public spending decision, though it's choices will be affected by the anticipated taxation.

2.4 Production

The economy consists of an unit mass of perfectly competitive identical firms run under a mandate to maximize profits. Firms have a Cobb-Douglas production function

$$f(K, L_F^j) = A\bar{K}^{\alpha} {L_F^j}^{1-\alpha} \ ,$$

with $0 < \alpha < 1$. They have a fixed capital endowment $\bar{K}$ and choose their labor input to maximizes expected real profits[3]

$$\max_{L_F^j} E[\pi^j]$$

subject to

$$wL_F^j \leq I^j$$

and where firm profit equals

$$\pi_s^j = ((1-\tau_s^j)\theta_s f(K, L_F^j)\epsilon_s^j - wL_F^j)\frac{1}{\epsilon_s^j} + (I^j - wL_F^j)\frac{1}{\epsilon_0^j}(1+r)$$

At $t = 0$ firms obtain cash I^j by issuing equity to the households. Firms hire L_F^j units of labor to produce and invest the remaining $I^j - wL_F^j$ in domestic and foreign government bonds (that in expectation yield the same real return). Firm production depends on its expected profitability

[3]We interpret firm labor demand as private investment. Our results do not change if capital investment is also a choice variable, as in an earlier version of this paper (Perotti and Soons, 2019).

as firms anticipate the public spending, fiscal and devaluation choices. After-tax firms profits are distributed back to the equity holders at the end of the final period. Firms can ex post choose to evade taxes by hiding their profits at a cost c. Capital fully depreciates after being used in production.

2.5 Exchange Rate Determination

There are many exchange rate determination models. We adopt a functional reduced form model of nominal exchange rate determination in which the external exchange rate depends on the ratio of domestic money supply to domestic reserves of the dominant numeraire (dollar) currency.[4] This is in contrast to standard New Keynesian models where the exchange rate is determined by the law of one price (e.g. Gali and Monacelli (2005)). While these models are usefull to study relative *changes* in exchange rates, we seek to match the difference in equilibrium exchange rate *levels* in the medium- to long term.[5]

The exchange rate of country j at $t = 1$ is given by

$$\epsilon_1^j = \begin{cases} \frac{1}{1+rCA^j}, & \text{in normal times} \\ \epsilon_{DEV}, & \text{in a fiscal crisis} \end{cases}$$

where the current account balance equals

$$CA^j = 1 - I^j - G^j$$

The exchange rate is normalized to 1 when total spending equals the domestic endowment. Spending and devaluation choices are fully anticipated and priced at $t = 0$, so lack of arbitrage implies $\epsilon_0^j = E[\epsilon_1^j]$.

This exchange rate determination can be understood as follows. At $t = 0$ all countries start with one unit of dollar reserves against their one unit endowment of domestic currency. The $t = 1$ exchange rate depends on the future dollar reserves backing the domestic money supply, which depends on the net current account position. In a surplus country the household buys foreign bonds that pay a dollar denominated return. Thus, a surplus country accumulates dollars (at the rate r) and enjoys a stronger currency compared to a deficit country, which depletes its reserves as

[4] We define the nominal exchange rate as the of units of domestic currency needed to acquire one dollar, so a weaker currency has a higher exchange rate.

[5] It is not simple to mirror our exchange rate determination to the standard approach in New Keynesian models as firms face identical international prices and we do not explicitly model a nontradable sector. Future work could further elaborate on an exchange rate determination process that captures the persistent difference in exchange rate levels between institutionally stronger and weaker countries, and the persistent revaluation after introducing a common currency.

it pays imported capital a dollar return. Note that the current account balance is determined at $t = 0$ by household choices. In our setting the country maintains a stable nominal money supply, unless a fiscal crisis induces a devaluation to ensure solvency.[6]

A devaluation may be required to avoid sovereign default. A devaluation implies that the central bank prints domestic money, diluting the dollar backing per unit of domestic currency and weakening the currency. We abstract from seignorage profits, so ignore that the printed money can be used to reduce outstanding nominal debt.[7] The required devaluation ϵ_{DEV} to ensure solvency is determined by setting $\tau_L = \bar{\tau}$ in the debt repayment condition.

2.6 Interest Rate Determination

Savings invested abroad receive a safe dollar rate of return r. Domestic interest rates are set such that risk neutral domestic investors receive in expectation the same return as for lending internationally. The nominal interest rate i is then determined by:

$$(1 + i^j) = \frac{1}{\epsilon_0^j}(1 + r)E[\epsilon_1^j]$$

Public debt in countries that never devalue pays the risk free rate r, while countries that may devalue face a higher nominal rate $i^j > r$. We refer to the difference $\Delta i^j = i^j - r$ as the devaluation premium. We abstract from safety premia by assuming that the rest of the world supplies and demands safe government bonds.[8]

2.7 Monetary Union

The decision to join a monetary union is a political decision, so it requires the government to be better off. A credible monetary union serves as a commitment device for governments not to devalue in the future (Giavazzi and Pagano, 1988), so there is no exchange rate variability between periods. We assume that in case of monetary unification the representative household in both countries receive their unit endowment in the common currency.[9]

The new common currency reflect the common current account balance, so is repriced vis-a-vis

[6] To obtain a constant nominal money supply we consider a stationary model where the household immediately consumes its profit net of the investment costs.

[7] Seignorage profits complicate the derivations without adding intuition.

[8] Results would be reinforced by capital flows to safe haven currencies that trade at a premium (Maggiori, 2017; Gourinchas and Rey, 2007).

[9] The change in denomination does not cause capital gain or losses as we abstract from previous holdings of domestic claims. We discuss wealth effects in Section 5.

the dollar. The exchange rate of the common currency with the dollar is given by

$$\epsilon_1^{MU} = \frac{2}{2 + r(CA^S + CA^W)}$$

Crucially, our exchange rate determination implies that, ceteris paribus, the common exchange rate level is valued in between individual exchange rates. Even so, in case the common currency leads to a de facto devaluation politicians are not blamed by its constituents, so there is no political devaluation cost. This may be because of the hidden or misunderstood nature of the implicit devaluation, or because there are (temporary) real benefits that compensate.

For a monetary union to be credible to survive, any fiscally challenged country that is unable to devalue requires a transfer T_L in the low state to satisfy its fiscal solvency constraint. Without this transfer the fiscally challenged country would need to leave the monetary union and devalue to ensure solvency.[10] We first assume that the transfer is expected to take place, then analyse when it will indeed be an equilibrium choice for the stronger country to pay rather than break up the monetary union. Breaking up the monetary union is certainly costly, even more than a simple devaluation. However, our results do not depend on such an arbitrary cost, so for simplicity we set it to zero.

2.8 Reasonable Restrictions

For tractability we propose two plausible restrictions on the international safe rate of return r and the nominal wage w. They amount to ensure a "no-free-lunch" setup that rules out absurd cases, in order to focus on the case of interest.[11]

Assumption 1. $\underline{r} < r < \bar{r}$ and $w < \bar{w}$ where $\underline{r}$, $\bar{r}$ and $\bar{w}$ depend on endogenous choice variables G^j and L_F^j.

These conditions on r restrict the elasticity of exchange rates to the capital surplus and the response of fiscal capacity to public spending, in order to rule out that excess public spending may pay for itself. Production cannot benefit from inefficient public spending, so spending cannot boost taxable production by an exchange rate benefit larger than the direct fiscal cost. They also rule out unrealistic equilibria where excess public spending boost the net surplus, strengthening the currency.

[10] An alternative to a transfer could be to use (un)conventional monetary policy to weaken the common currency, decreasing the required ex post transfer. We recommend the study of such (temporary) measures to counterbalance the structural imbalances within a DMU for future research.

[11] Thus we establish an existence result in the relevant parameter range rather than characterize all possible equilibria.

The upper bound on w additionally ensures that the required devaluation increases in public spending.

The condition cannot be expressed fully in explicit form, but essentially defines a range for r.[12] As the restrictions affect the responses of endogenous variables, we show by simulation in the appendix that they are satisfied for a wide range of plausible parameters.

3 Equilibrium before Monetary Unification

We first solve for the equilibrium choice of government spending and firm production in each country before monetary unification.

Maximizing the government objective function implicitly determines public spending as

$$1-\beta^j = -\beta^j(E[\theta_s \frac{\partial f(K, L_F^j)}{\partial G^j}] + \frac{V'(g^j)}{w}) \tag{3}$$

where the marginal political benefit of public spending equals the utility-weighted effect on public good provision and productive capacity, which depends on the equilibrium response of firms.

Firms choose production by maximizing real profits, anticipating government choices. The first order condition is given by

$$E[(1-\tau^j)\theta f'(K, L_F^j)\epsilon_1^j] - w = w(1+r) \tag{4}$$

The left side of (4) is the expected marginal profit of production, while the right hand side is its opportunity cost. The firm sets its productive capacity so that households are indifferent between investing in firm equity or in government bonds.

Firm production differs across diverse countries due to sovereign spending, which has three direct effects: the debt volume effect, the interest rate effect and the exchange rate effect.

The direct effect of public spending on the expected tax rate is an increase in outstanding debt, which will require a higher ex post tax rate. If at the higher level of public debt the country may need to devalue, firms and the government will also face a higher devaluation premium Δi^j (the interest rate effect). Both these direct effects of public spending increase expected tax rates, decreasing firm incentives to produce.

Higher public spending also increases domestic absorption, thus reducing the capital surplus and weakening the exchange rate. Since nominal wages are already set, real wage costs decrease. This exchange rate effect has a positive direct effect on the incentive to invest that may counterbalance

[12] Assumption 1 stipulates that exchange rate gain is neither too strong nor too weak compared to the fiscal burden effect. The range for r exists because the interest rate directly affects the debt repayment linearly, while its effect on the exchange rate is convex.

its negative effects. The indirect effects (contained in the appendix) are more complex as the impact of public spending on investment depends on the equilibrium value of all financial variables.

Proposition 1 summarizes the equilibrium without monetary union.

Proposition 1. *If $\beta^W < \beta^S$, then $G^W \geq G^S$ and $f(K, L_F^W) \leq f(K, L_F^S)$.*

Proof: *Follows from assumption 1. For details see appendix.*

A government with imperfect institutions derives political utility from spending. Before monetary unification a government under weaker institutions will have more excess spending, higher tax rates and a weaker currency. Firms anticipate government choices and choose a lower productive capacity.

Lemma 1. *If β is sufficiently low, i.e. $\beta < \beta^*$, an unconstrained government will devalue in the low state of the economy.*

Proof: *See appendix.*

The tax rate in the low state in the weak country is given by

$$\tau_L^W = \frac{G^W(1+i^W)}{\theta_L f(K, L_F^W)\epsilon_L^W + w(L_F^W + L_G^W)}$$

which is increasing in public spending. When tax rates are high, firms will ex post prefer paying c and evade taxation. So, when institutions are sufficiently weak the unconstrained public choice results in a required tax rate above the maximum tax rate in the low state.

In that case the government balances the utility gain from additional public spending to the devaluation cost C and the effect on production including a devaluation. Some weak government may prefer to spend less and not devalue. It chooses to spend as desired and devalue when

$$(1-\beta)\Delta G - C(\Delta\epsilon_L) > -\beta(E[\theta\epsilon f'(K, L_F)\Delta L_F] + \frac{V'(g)}{w}\Delta G) \ , \tag{5}$$

where $\Delta G > 0$ is the additional spending when choosing to devalue, and ΔL_F is the impact on labor demand.

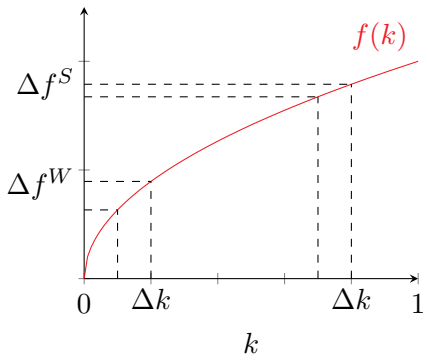
When $\beta < \beta^*$ the spending benefits exceed the devaluation cost, and the government chooses to spend as desired and devalue in the low state.[13]

Why do stronger countries not devalue, since a devaluation benefits production? There are two reasons. First, stronger governments do not wish to increase public spending so only compare the exchange rate benefit to the political cost C. Second, weaker countries are more inclined to

[13] The convexity of the devaluation cost $C(\Delta\epsilon_L)$ is such that a government devalues only enough to avoid default.

devalue because for an equal devaluation $\Delta\epsilon^j$ they obtain a larger productive benefit due to the concavity of the production function. Figure 1 shows how for a given boost to private investment, a devaluation is more beneficial for a weaker country with lower investment.

Figure 1



We define a stronger country as a country where the government chooses not to devalue. This means that devaluation costs are sufficiently large such that government only choose to devalue to avoid a sovereign default, such as in lemma 2.

Lemma 2. *When $C(\Delta\epsilon_L) > E[\theta\epsilon f'(K, L_F)\Delta L_F]$, no stronger government devalues.*

Proof: *This condition is obtained by setting $\Delta G = 0$ and $\beta = 1$ in equation (5).*

When governments are expected to devalue they lose access to international safety seeking capital flows, so its spending may be constrained to domestic savings $1 - I^j$. However, this is not a binding constraint for all devaluing governments.

Lemma 3. *If β is sufficiently low, i.e. $\beta < \beta^{**}$, desired government spending exceeds domestic savings, so that $CA \leq 0$.*

Proof: *Proposition 1 says that*

$$\frac{\partial G^j}{\partial \beta^j} < 0$$

and assumption 1 implies that

$$\frac{\partial CA^j}{\partial G^j} < 0$$

A sufficiently weak government desires to spend more than its domestic savings. Lemma 1 and 3 together define a government expected to devalue that cannot borrow on international capital

markets so its spending is constrained by domestic savings.

4 Monetary Union Equilibrium

4.1 Homogeneous Monetary Union

The euro monetary union led to large improvements in transacting costs, factor mobility and diversification. These benefits may increase in heterogeneity and contribute to the resilience of a DMU. Our setup abstracts from these benefits to analyse purely financial motivations for its rise and persistence.

Without real benefits there is no obvious reason why two identical countries would benefit from forming an homogeneous MU. Thus, a surprising result is that a monetary union of two identical countries can be mutually beneficial.

Proposition 2. *A monetary union between two identical stronger countries with $\beta^j > \beta^*$ increases production in both economies. A monetary union between two identical weaker countries can only be credible if they are sufficiently close to the devaluation threshold, in which case production benefits.*

Proof: *The exchange rate benefit of public spending is smaller after monetary unification (for reasonable current account balances)*

$$\frac{\partial \epsilon^{MU}}{\partial G^j} = \frac{2r(\frac{w\partial {L_F^j}^{MU}}{\partial G^j} + 1)}{(2 + r(CA^j + CA^i))^2} < \frac{r(w\frac{\partial L_F^j}{\partial G^j} + 1)}{(1 + rCA^j)^2} = \frac{\partial \epsilon^j}{\partial G^j} \tag{6}$$

While the fiscal cost in terms of higher taxation do not change. Thus all governments decrease spending in a homogeneous MU, which benefits production.

Monetary unification, even without fiscal coordination, induces more public spending restraint. Under a common currency the exchange rate benefit of public spending is shared while its fiscal cost is still fully internalized, the inverse of the political cost-accounting mechanism in Weingast et al. (1981). Thus, countries that never devalue reduce excess spending when they introduce a common currency, which benefits their productive capacity.

Before monetary unification all constrained governments spend the same amount as they are equally limited to domestic savings. As a result they devalue by the same amount in the bad state, and face the same expected exchange and interest rate. A monetary union between identical constrained countries is not credible since it does not produce a stable currency as it requires a certain devaluation of the common currency in bad times. The exception is a monetary union among intermediate β countries sufficiently close to the devaluation threshold. In that case the

MU spending restraint may remove each country's need to devalue, ensuring currency stability and improving productive incentives.

4.2 A Diverse Monetary Union

We define a diverse monetary union as a currency union between a strong country that never devalues and a weak country that would devalue on its own when constrained by domestic savings, so $\beta^W < \beta^{**} < \beta^* < \beta^S$ and lemma 2 holds. To save on notation we assume that $\beta^* = \beta^{**}$. We analyze the equilibrium conditional on institutionally diverse monetary unification. Later we verify that it is indeed a credible equilibrium outcome.

Once constrained countries join a credible DMU they cannot devalue, so they gain access to international borrowing to fund their preferred level of public spending. As they are still subject to a maximum tax rate constraint, weak countries in a DMU will require a transfer to avoid default. The required transfer is given by

$$T_L^W = G^{W_{MU}}(1+r) - \bar{\tau}(\theta_L f(K, L_F^{W_{MU}})\epsilon^{MU} + wL_F^{W_{MU}} + G^{W_{MU}}) \ , \tag{7}$$

which is decreasing in institutional quality of the weaker government, so a weaker country requires a larger transfer.

DMU Equilibrium

Firm labor demand in a DMU is given by

$$L_F^{j_{MU}} = (\frac{E[\theta(1-\tau^{j_{MU}})\epsilon^{MU}](1-\alpha)AK^\alpha}{w(2+r)})^{\frac{1}{\alpha}} \tag{8}$$

and depends on the domestic tax and interest rates and the common exchange rate. The key general equilibrium effect of a DMU is a common external exchange rate and interest rate. Thus, any difference in production among member countries must result only from different national tax rates.

Tax rates differ because governments remain inclined to spend distinct amounts, but also because of the required transfer in the adverse state. In good times the tax rate is higher in the weak country with higher public spending. In bad times the tax rate may be higher in the strong country with lower public spending if the required transfer funded by its tax payers is large. As the transfer is decreasing in institutional quality there is a lower bound $\hat{\beta}$ on the institutional quality of the weak country for which productive incentives after DMU remain better in the strong country.[14]

[14] The lower bound $\hat{\beta}$ depends on β^S.

The following proposition summarizes the outcomes conditional on diverse monetary unification.

Proposition 3. *After monetary unification, if* $\hat{\beta} < \beta^W < \beta^* < \beta^S$*, then* $G^{W_{MU}} > G^{S_{MU}}$*,* $T_L^S \leq 0 \leq T_L^W$ *and* $f(K, L_F^{W_{MU}}) < f(K, L_F^{S_{MU}})$ *.*

Proof: *See appendix.*

Not all weaker countries that would devalue on their own require a transfer after DMU. Consider a DMU where the weak country institutional quality is $\beta^I < \beta^W < \beta^*$, with β^I close to β^*. The weak government before DMU wishes to spend more than net domestic savings, and needs to devalue in the bad state. Joining in a DMU reduced the exchange rate benefit of public spending and lowers interest rates, but also leads to an currency appreciation. In an intermediate weak country close to the devaluation threshold the net effect may be extra fiscal capacity, even if it marginally increases spending at a lower interest rate. Even though it devalued before DMU, no transfer is required after.

Lemma 4. *After monetary unification, if* $\beta^I < \beta^W < \beta^* < \beta^S$*, then* $T_L^S = T_L^W = 0$*.*

Proof: *See explanation in text.*

To analyse the decision to join and sustain a DMU, we will next study the impact of DMU on public spending and production.

The DMU impact on public spending

As institutional quality is unaffected by unification, so is the political benefit of excess spending. Joining a DMU affects public spending only by altering its effect on productive capacity. To an unconstrained stronger government the interest rate effect does not change, while the exchange rate effect is smaller. The exchange rate benefits of public spending are shared with other countries, while the taxation cost is unchanged (proposition 2). Thus, a stronger country will unambiguously decrease its public spending after joining a DMU.

In the weaker country DMU lowers interest rates and relaxes the foreign borrowing constraint. Foreign safety seeking investors are now willing to buy public debt, so the government can spend as desired. A credible DMU allows a weaker government to commit to a higher real value of public debt. Still, there is an intermediate case when the weak country has institutional quality $\beta^I < \beta^W < \beta^*$ and the effect on spending is ambiguous.

Lemma 5 summarizes the effect of DMU on public spending.

Lemma 5. *Public spending in a strong country with* $\beta^* < \beta^S$ *decreases. In an intermediate country with* $\beta^I < \beta^W < \beta^*$ *the effect on public spending is ambiguous, while in a weak country*

with $\beta^W < \beta^I$ public spending increases.

Proof: *See appendix.*

The DMU effect on productive capacity

Productive capacity is determined by firm labor demand, as given by equation (8). The effect of a DMU on production depends on its impact on the external exchange rate, expected taxation and interest rates.

When comparing production before and after monetary unification, it holds that it rises provided that

$$E[\theta(\epsilon^{MU} - \epsilon^j)] > E[\theta(\tau^{j_{MU}}\epsilon^{MU} - \tau^j\epsilon^j)] \tag{9}$$

Equation 9 compares the exchange rate effect against the change in tax rates.

To assess whether a DMU benefits productive capacity, first consider the case of unchanged tax rates. Equation 9 simplifies to

$$\epsilon^{MU} > \epsilon^j$$

This condition requires the common currency to be weaker than the countries' own currency, which is the case in the stronger country.

The common exchange rate is determined by the common current account balance, so is expected to be between the two previous exchange rates. Before the DMU the stronger country exported excess savings abroad, which appreciated its currency relative to the dollar. After the DMU its excess savings can be absorb by the weaker government without causing an appreciation. The combined current account balance will move towards neutrality. This implies that once the DMU is announced the stronger country experiences a weaker exchange rate, while the weaker country revalues. The de facto currency devaluation lowers domestic real wages in the stronger country, encouraging investment, and vice versa in the weaker country. The exchange rate effect of DMU is larger when institutions are more diverse.

Tax rates in both countries are also affected by the common currency. First consider the change in tax rates in the stronger country. The expected tax rate in the strong country after monetary unification is given by

$$E[\tau^{S_{MU}}] = E[\frac{G^{S_{MU}}(1+r)}{\theta_s f(K,L_F)^{S_{MU}}\epsilon_1^{MU} + wL_F^{S_{MU}}} + G^{S_{MU}}] + (1-p)\frac{T_L^W}{\theta_L f(K,L_F)^{S_{MU}}\epsilon_1^{MU} + wL_F^{S_{MU}} + G^{S_{MU}}}$$

and consists of the domestic debt repayment plus the transfer in the low state. The strong country

experiences no interest rate effect, and its government spends less after DMU (lemma 5), so the equilibrium effect on expected tax rates depends on the required transfer relative to the exchange rate benefit. The required transfer is given by equation (7), which is decreasing in institutional quality of the weaker country, and decreasing in the common exchange rate.

Clearly each stronger country can bear a maximum transfer T^* below which the DMU effect on expected tax rates is less significant than its exchange rate benefit, so that monetary unification remains beneficial to its productive capacity, where

$$T^* = \frac{(\epsilon^{MU} - \epsilon^S + E[\theta\tau^S\epsilon^S] - p\theta_H\tau_H^{S_{MU}}\epsilon^{MU})(\theta_L f(K, L_F^{S_{MU}})\epsilon^{MU} + wL_F^{S_{MU}} + G^{S_{MU}})}{(1-p)\theta_L\epsilon^{MU}} - G^{S_{MU}}(1+r)$$

Clearly, a DMU together with a weak country with intermediate institutions that does not require any transfer ($\beta^W \geq \beta^I$) benefits production in the stronger country. Suppose now that production in some stronger country with $\beta^S > \beta^*$ benefits from DMU with a some weaker country with $\beta^W < \beta^I$, so the required transfer is smaller than the maximum transfer. We proceed to determine the range of institutional quality for which production in the strong country benefits.

If the stronger country would have stronger institutions it has a larger exchange rate benefit, but the required transfer will also be larger as the weaker economy experiences a larger revaluation. If the negative effect of a larger transfer is stronger than the exchange rate benefit, there must be an upper bound $\bar{\beta}^{S-PC}$ on institutional quality of the strong country for which its production benefits from DMU with the given weaker country with $\beta^W < \beta^I$. If the change in the exchange rate benefit is larger than the effect on the transfer there may be a lower bound $\underline{\beta}^{S-PC}$ on institutional quality for which production benefits.

Both $\bar{\beta}^{S-PC}$ and $\underline{\beta}^{S-PC}$ depend on institutional quality in the weaker country. If the weaker country would have worse institutions it requires a larger transfer, but DMU also provides a larger exchange rate benefit to the stronger economy. If the negative effect of a larger transfer on productive investment is more significant than the positive exchange rate effect, than the distance $\bar{\beta}^{S-PC} - \underline{\beta}^{S-PC}$ is decreasing in institutional quality in the weaker country, and vice versa.

Lemma 6 summarizes the discussion on the effect of DMU on production in the strong country.

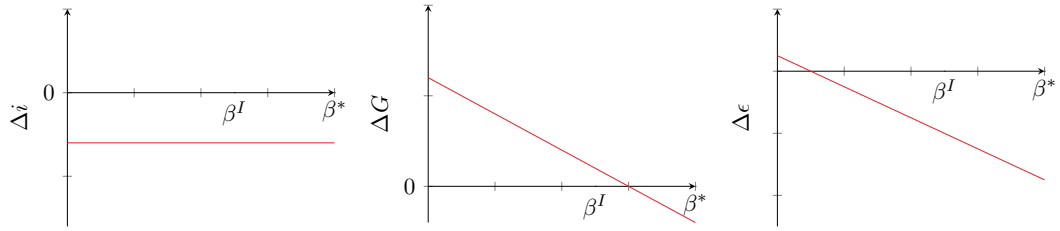
Lemma 6. *If $\beta^W < \beta^* < \underline{\beta}^{S-PC} < \beta^S < \bar{\beta}^{S-PC}$, then production in the stronger country benefits from diverse monetary unification.*

Proof: *In text.*

Next, consider the change in tax rate in the weaker country. Compared to in the stronger country, in the weaker country the exchange rate effect is opposite, there is an additional interest rate effect and its government may increase spending. Figure 2 illustrates the three effects of DMU

on productive incentives in weaker countries after monetary unification with a given strong country.

Figure 2: The effects of DMU in the weaker country



All governments in weak countries before DMU were constrained by domestic savings, and all had the same exchange rate and devalued by the same amount in the bad state. As a result governments paid a devaluation premium on their sovereign debt. The productive benefit of DMU is a lower interest rate (left figure). A credible DMU provides monetary credibility which, all else equal, lowers debt costs, decreasing tax rates.

Productive capacity may be hurt because after the introduction of the common currency the government can spend more (middle figure), and higher spending means higher taxes. Only a weak country with intermediate institutions may not increase spending (lemma 5). Additionally, the common exchange rate reflects the common trade balance, so is revalued (right figure). This negative exchange rate revaluation is dampened by the increase in spending as this deteriorates the common trade balance.[15]

The balance between these three effects determines the impact of DMU on productive capacity in the weak country. We proceed with explaining range of institutional diversity for which production benefits in the weak country caused by a revalued exchange rate.

First, suppose there was no devaluation premium Δi (left figure) on interest rates. In that case production clearly never rises in the weaker country with $\beta^W < \beta^I$. Such a DMU will only result in productive losses for the weaker country caused by the exchange rate revaluation. When $\beta^W > \beta^I$ lower public spending will attenuate this effect, and production may benefit.

Now, suppose that in a DMU between a weak country with $\beta^W < \beta^*$ and some stronger country with $\beta^S > \beta^*$ the productive benefit coming from no more devaluation premium and lower public spending is larger than the exchange rate cost. In that case, the weaker the weak country, the more it will increase spending (middle figure) and thus the larger the debt repayment must be, but the common currency will also be weaker. If combined these two effects lead to an increase in tax rates, there must be a lower bound β^{W-PC} for which productive capacity benefits from DMU with this

[15] In an extreme case a weak country increases spending to such an extent that the common currency may be weaker than its initial currency, when it was constrained to domestic savings and devalued. We choose not to consider this case in detail.

particular stronger country.

The lower bound β^{W-PC} on institutional quality of the weaker country for which production benefits from DMU with the given stronger country depends on foreign institutional quality. In a DMU with a stronger country the negative exchange rate effect is larger. So, the stronger the strong country, the smaller the range of weak countries for which the interest rate benefit outweighs the exchange rate revaluation, moderated by the change in public spending. Thus, the lower bound β^{W-PC} is increasing in the institutional quality of the strong country. Furthermore, there is no guarantee that the interest rate benefit is sufficiently large to begin with. It may be the case that even when $\beta^S = \beta^*$ it holds that $\beta^{W-PC} > \beta^*$, so that production is hurt in all weaker countries.

Lemma 7 summarizes the discussion of the DMU effect on production in the weaker country.

Lemma 7. *If $\beta^{W-PC} < \beta^W < \beta^* < \beta^S$, then production in the weaker country benefits from diverse monetary unification.*

Proof: *In text.*

In words, lemma 6 and 7 show that in general the financial effects of a DMU have a negative impact on productive capacity for the weaker country, and a positive impact in the stronger country. A credible DMU allows the weak government to commit to a higher real value of public debt in all states and real wages increase due to a stronger currency, hurting productive incentives even if a transfer is received in the bad state. Thus, while the fiscal transfer validates excess spending by the weaker country, it may be legitimized by the implicit productive transfer made by the weaker country joining the common exchange rate, which contributes to an improved productive outlook for the strong country. Furthermore, when DMU harms productive incentives in the weak country, its fiscal capacity deteriorates. The need for a transfer is not only the result of its own institutional weakness, but also caused by the common currency.

However, productive capacity in the weak country could also benefit under certain conditions. Productive capacity in weak countries increase after DMU only when when the devaluation premium is sufficiently large, domestic institutional quality is intermediate and institutional quality of the strong country is not too high. In this case excess spending will decrease, or increase only modest, and the interest rate benefit outweighs the exchange rate revaluation effect.

DMU as a credible equilibrium outcome

Since joining a DMU is a political choice, it will happen only if the government benefits. To establish DMU as a credible equilibrium outcome we also need to establish under what conditions it can withstand bad times that require a transfer.

Proposition 4.
If $\beta^W < \bar{\beta}^{W-J} < \beta^* < \underline{\beta}^{S-J} < \beta^S < \bar{\beta}^{S-J}$, *or if* $\underline{\beta}^{W-J} < \beta^W < \beta^* < \underline{\beta}^{S-J} < \beta^S < \bar{\beta}^{S-J}$ *a common currency will be introduced by the governments. When also* $T_L^W \leq \bar{T}$ *institutionally diverse monetary unification is a credible equilibrium outcome.*

Proof: *See appendix.*

When β^S is within its participation bounds, productive capacity in the stronger country increases, but also public spending and thus political benefits decrease. Still, the stronger government weighs productive capacity enough to choose to join the DMU ex ante.[16]

After DMU all weaker governments do not incur the political cost of devaluation. When DMU enables a sufficiently large increase in public spending in a weak country, its government will choose to join even though its productive capacity may be reduced. The weaker its institutions are, the more governments will increase spending after DMU (figure 2), which they also increasingly value. Thus, when institutional quality is below $\bar{\beta}^{W-J}$ the government values the political benefit of additional spending more than the productive costs to its economy.

The government in an intermediate country may lower public spending, and production may benefit from DMU. Whether the government will join depends on how it values the loss of political benefits compared to the productive gain, scaled by the utility gain from no more devaluation. It will join if institutional quality is above $\underline{\beta}^{W-J}$.[17]

An additional requirement for a credible DMU equilibrium is that for the stronger country it must be ex post incentive compatible to indeed pay the transfer. Assume for simplicity that the game is infinitely repeated each period in its current form, and that each stage game is identical.[18] The DMU emerges as a credible equilibrium when the discounted repeated expected government benefits are larger than the one time cost of the transfer, or $T_L^W \leq \bar{T}$, as shown in the appendix. Whether this condition is satisfied in equilibrium depends on the exogenous parameters. We verify this condition in the model simulation.

Clearly, not all credible equilibrium DMU's are mutually beneficial in productive terms, which requires that productive capacity increases in both countries. A government subject to weak institutions may place so much weight on its spending benefit to choose for a DMU even though it is disadvantageous for domestic productive capacity. Thus, a DMU is mutually beneficial only for a subset of the credible DMU's defined in proposition 4.

Proposition 5.

[16] The lower participation bound $\underline{\beta}^{S-J}$ may be more restrictive than $\underline{\beta}^{S-PC}$, the lower bound at which productive capacity benefits.

[17] The bounds $\bar{\beta}^{W-J}$ and $\underline{\beta}^{W-J}$ can be above or below β^I.

[18] Formally this requires that any surplus be consumed each period.

If $\underline{\beta}^{W-J} < \underline{\beta}^{W-PC} < \beta^{W} < \beta^{*} < \underline{\beta}^{S-J} < \beta^{S} < \bar{\beta}^{S-J}$ *and* $T_L^W \leq \bar{T}$*, then institutionally diverse monetary unification is a credible and mutually beneficial equilibrium outcome.*

Proof: *The bounds follow by combining lemma 7 and proposition 4.*

The key to this result is that a DMU can only be beneficial if institutional quality is not too diverse. However, remember that the distance between $\underline{\beta}^{S-J}$ and $\bar{\beta}^{S-J}$ may be decreasing in institutional quality in the weaker country. Thus institutions must also be sufficiently diverse for production in the strong country to benefit.

Clear beneficiaries of a DMU are the constrained government in a weak country, as it is able to increase spending, and production in the stronger country. Under intermediate institutional quality the increase in public spending is not too large, so that in the balance private investment could benefit from a lower interest rate. Thus even when institutions are quite poor a credible and mutually beneficial DMU equilibrium may arise, but on balance the weaker economy benefits less.

5 Redistributive Effects of DMU

Our DMU equilibrium analysis points to ex ante and ex post redistributive effects between countries. In the first place, productive capacity in strong countries may benefit more. Because a DMU is a political decision, it may even be the case that the productive capacity in the weaker country is hurt in equilibrium. Generally, the equilibrium effect of a common exchange rate redistributes productive incentives and thus fiscal capacity from weaker to stronger economies making it a transfer union from the start, ahead of any explicit fiscal flows.

Redistributive effects also occur in equilibrium within countries. The setup does not lend itself to a full assessment as the representative household includes productive workers, public workers, investors and retired savers. Still, consider the individual payoffs to investors Π_I^j, firm workers Π_L^j, government workers Π_G^j and savers Π_S^j in country $j \in [S, W]$.

$$\begin{aligned}
\Pi_I^j &= \pi_s^j(I^j) \\
\Pi_F^j &= \frac{1}{\epsilon_s^j}(1-\tau_s^j)wL_F^j \\
\Pi_G^j &= \frac{1}{\epsilon_s^j}(1-\tau_s^j)wL_G^j \\
\Pi_S^j &= \frac{1}{\epsilon_s^j}B^j(1+i^j) + \frac{1}{\epsilon_0^j}F^j(1+r)
\end{aligned}$$

Productive and public employees care about total real labor income and employment as work is supplied elastically, so workers may collectively gain from a lower exchange rate via higher

employment even though real wages fall. Firm investors care about after tax real profits, while nominal savers care about the real value of their savings.

Ex ante, before any investment decisions are made, the immediate exchange rate adjustment after DMU already redistributes through real wages and wealth. The scale and direction of ex post redistributive effects depend on the state of the economy.

A weaker common currency contributes to expected gains for productive incentives in the stronger country, with large gains in good times that benefit investor returns. In bad times the required transfer increases the tax rate, reducing the productive benefit of DMU. In the weaker country firm investment is hurt by reduced competitiveness, and by the higher tax rates caused by more public spending.

In stronger country productive employment benefits from the gain in productive incentives, while public employment decreases as the government is less inclined to spend. Also, real wages are lower because of the common currency and taxation in the low state increases. All combined, public employment is worse off, while the effect on productive employment is ambiguous, but certainly worse in the low state.

In the weaker country the opposite is the case. Productive employment decreases due to the loss of competitiveness, while public employment benefits from the increase in government spending. Real wages increases because of the revaluation. In bad times the loss of competitiveness is additionally attenuated by a gain in real value of their payoffs as there is no devaluation. So employment may "benefit" from the transfer in bad times, even when productive incentives decrease. Public labor certainly benefits from DMU, while the effect on productive labor can be positive or negative.

A final observation is that savers with a nominal claim are affected differently than producers ex ante. Savers in the stronger country receive the same real interest rate as before DMU, but the weaker common currency hurts the real value of their wealth. Savers in the weaker country used to get a high real return in good times and a low real return in bad times because of the devaluation. After DMU they get a safe return and benefit from a higher real valuation, so they may benefit from DMU in expectation. Recall that households exchange their original endowment for a unit endowment in the common currency, but the weak currency appreciates to the new parity once the DMU is announced.

Table 2 and 3 provide an overview of the discussed direction of the redistributive effects within countries for a credible DMU that may not be mutually beneficial.

Table 2: Redistribution in the stronger country

	θ_H	θ_L	Expected
Investors	+	≈	+
Productive labor	≈	-	≈
Public labor	-	-	-
Savers	-	-	-

Table 3: Redistribution in the weaker country

	θ_H	θ_L	Expected
Investors	-	-	-
Productive labor	≈	≈	≈
Public labor	+	+	+
Savers	-	+	+

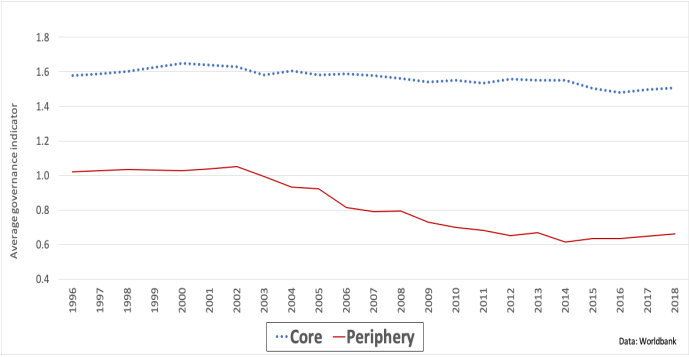
6 The European Monetary Union

In this section we present suggestive evidence for the European Monetary Union of the effects described in our model.

The European Monetary Union is an institutionally diverse monetary union. Measuring quality of political institutions is difficult (Glaeser et al., 2004). We use the indicators published by the Worldwide Governance Indicators (WGI) project to map institutional differences among EMU member countries. These indicators reflect measures of political governance and public sector efficiency.[19]

Figure 3 depicts the average WGI measure for core (Germany, The Netherlands, Austria, Finland and France) and periphery countries (Italy, Spain, Portugal and Greece).[20] This measure appears both diverse and quite persistent. Institutional quality did not converge after the creation of the euro, and in fact appears to diverge (Fernández-Villaverde et al., 2013).

Figure 3: Persistently diverse institutional quality



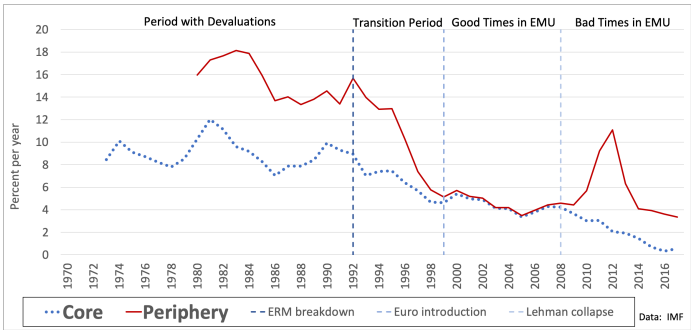
Average WGI measure for core EMU (Germany, Netherlands, Austria, Finland and France) and periphery (Italy, Spain, Portugal and Greece). The Welch's unequal variances t-test shows that the means are statistically different. *Source:* Kauffmann and Kraay (2016)

[19] The WGI measure averages six dimensions of political governance: Voice and Accountability, Political Stability, Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Corruption.

[20] Ireland and Belgium may be seen as intermediate cases.

European monetary unification lowered borrowing costs for periphery countries (see figure 4), whose sovereign yield have been well below pre-euro level even since the crisis. Currency risk evaporated and the devaluation premium in the transition to the EMU fell, anticipating a full convergence to a common safe asset (Driessen and Perotti, 2004; Kalemli-Ozcan et al., 2010; Baele et al., 2015).

Figure 4: Long-term interest rate convergence



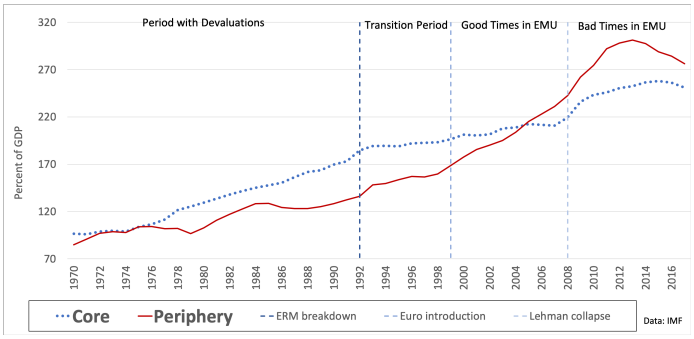
Average 10 year government bond yields in periphery and core EMU countries. *Source:* IMF

The EMU provided periphery countries with greater access to capital markets at a lower cost, but imposed little fiscal discipline. The Maastricht fiscal rules were soon breached by both core and periphery countries. Figure 5 shows the sum of private and public debt over GDP since the euro. The euro supported a high volume of public spending denominated in a stronger currency and massive private borrowing with a public backstop. Inefficient public policy choices in the euro area did not only describe excess spending (as in the model and as was arguably the case for Portugal, Greece and Italy), but also excess private booms built on public debt guarantees (as in Spain and Ireland). These capital flows were inefficiently allocated, largely to non-tradables, deteriorating competitiveness (Brunnermeier and Reis, 2015; Gopinath et al., 2017).

The key prediction of our model is the impact of a common currency on competitiveness through its effect on real wages. Figure 6 displays core and periphery real effective exchange rate (REER), a good indicator of relative competitiveness.

Since the start of the euro the average core REER fell while at the periphery it rose in the good years before the crisis, the predicted effect of DMU. The ratio of the core to periphery REER in the bottom figure filters out common factors and the effect of an arbitrary choice of the index year. The euro clearly decreased real exchange rate uncertainty, but the series also shows a large drop in average core currency rates relative to the ERM parity, suggesting a gain in competitiveness for core countries, while the periphery lost ground. This exchange rate effect is consistent with the evidence on exchange rate misalignment in the euro area (Jeong et al., 2010; Duwicquet et al.,

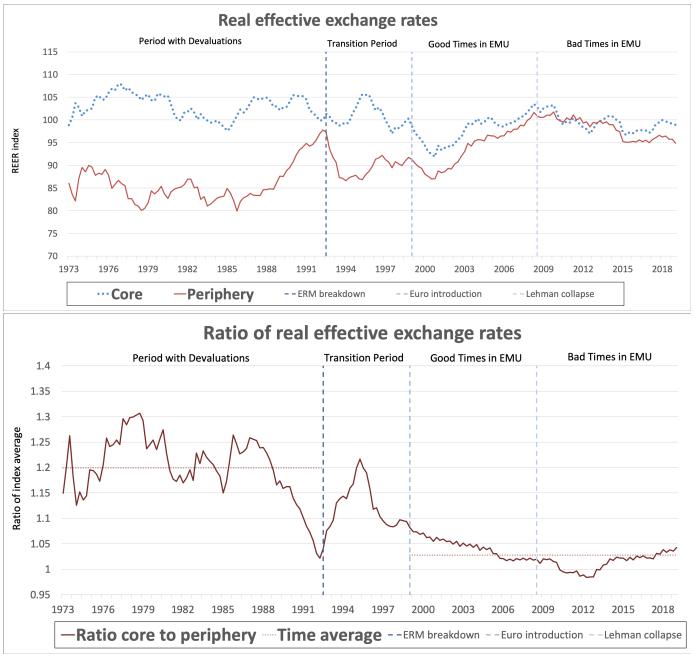
Figure 5: Access to capital



Average sum of public and private debt over GDP. *Source:* IMF

2012; El-Shagi et al., 2016).

Figure 6: REER convergence

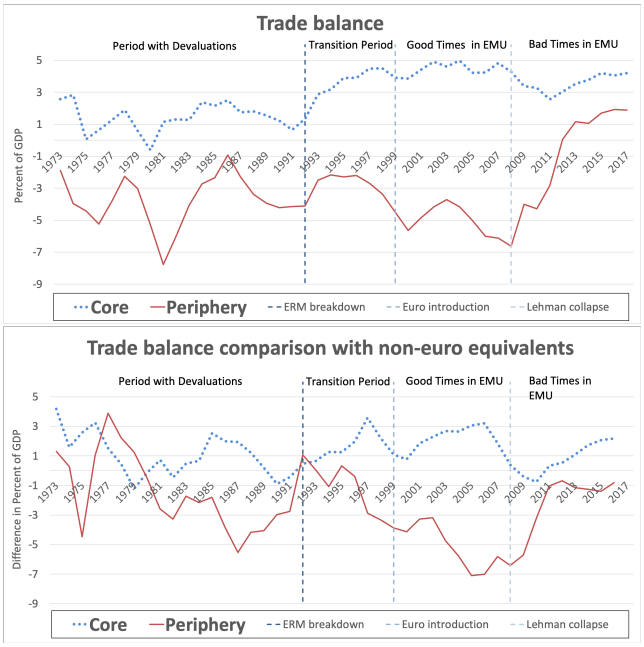


The level and ratio of the average real effective exchange rate index of core and periphery EMU countries. *Source:* BIS and the The World Bank

Figure 7 reports net trade positions of EMU member countries. While core countries had historically on average a better trade position, it has steadily improved since the euro while the

performance of the periphery deteriorated markedly.[21] The bottom figure compares net trade balances of core and periphery countries with their non-euro OECD peers. Between 1999 and the recent crisis periphery countries lost competitiveness while stronger countries outperformed non-euro OECD countries with comparable institutional quality.[22] A similar pattern of exchange rate convergences and trade divergences appears during the past currency realignment attempts in the 1980's. These past attempts failed, while the euro succeeded thus far.

Figure 7: Trade



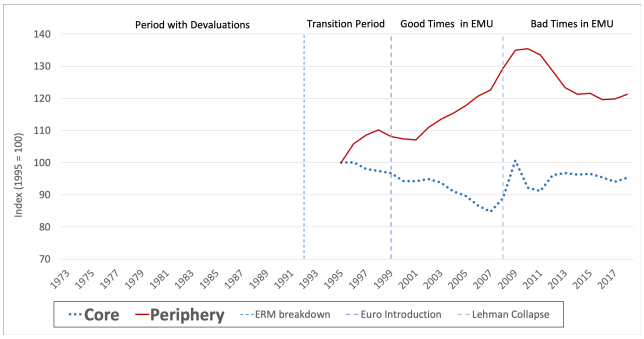
Net trade over GDP and trade balance difference between euro and non-euro OECD countries. *Source:* OECD, BIS and The World Bank

Figure 8 suggest that a key cause of the trade divergence has been the rise in real unit labor costs in periphery countries after the introduction of the euro, while it decreased in core countries, consistent with an exchange rate revaluation. Countries with weak institutions and a significant manufacturing sectors suffered most from the revaluation effect, and were less able to adjust when the recession forced ever-higher taxation. Non-tradables were temporarily boosted by capital inflows (figure 9).

[21] The difference in net trade is driven by low periphery export rather than by high periphery imports.

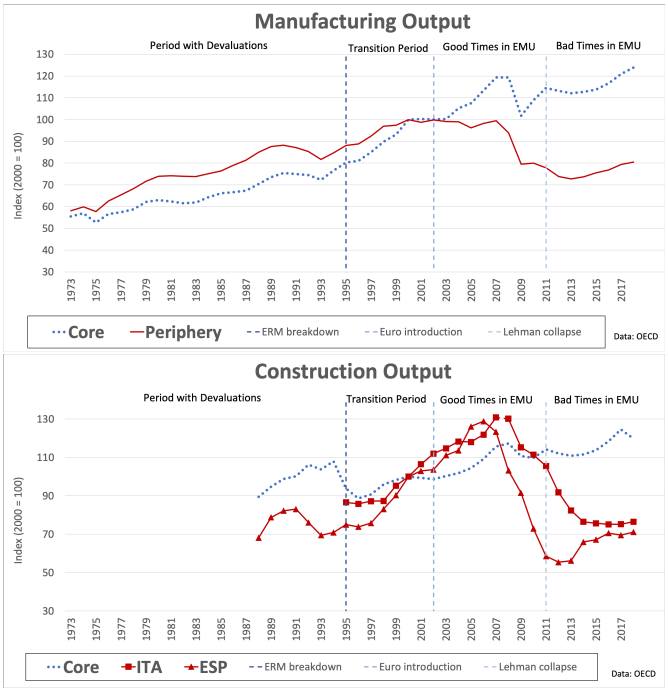
[22] Non-euro institutionally stronger OECD countries are Japan, US, UK, Australia, Iceland, Canada, Norway, Sweden, Switzerland, New Zealand and Denmark. institutionally weaker non-euro OECD countries are Turkey, Mexico, Israel, South Korea, Poland, Hungary, Czech Republic and Chile.

Figure 8: Manufacturing unit labor cost



Manufacturing unit labor cost in core and periphery EMU countries. *Source:* OECD

Figure 9: Tradable and non-tradable output



Manufacturing and construction output in core and periphery EMU countries. *Source:* OECD

7 Related Literature

Mundell (1961) defined his normative theory of optimal currency area (OCA) at a time of limited capital flows. Our approach studies the political choice for monetary unification among diverse countries. In the spirit of our approach, the creation of common currencies has reflected political

rather than only economic factors (Goodhart, 1998; Cesarano, 1997).

Our structural model relates to the popular distinction between a Eurozone "core" and "periphery" countries struggling with fiscal discipline. Greenspan (2011) interpreted the eurozone crisis as "not just about labor costs and prices but culture. There remains the question of whether .. the south would ever voluntarily adopt northern prudence." Yet culture seems an imprecise shorthand. In fact, France and Germany were the first euro members to breach the Maastricht fiscal rules, and the long term inflationary history of core and periphery countries was not markedly different until recent decades.[23]

While the euro compared unfavorably as an OCA to the US (Bayoumi and Eichengreen, 1992; Eichengreen, 1992) it was expected (or in any case hoped) that after monetary unification all euro member countries would adjust as required. Indeed markets and trade adjusted quickly, and even cross border labor mobility rose (Baele et al., 2015; Lane, 2015; Arpaia et al., 2016). But adjusting to a structural monetary rigidity for weaker countries requires deep structural shifts that cannot be implemented at will, and most institutional differences will never be fully resolved. The euro experience has shown that diverse institutions do not converge, and confirmed they structurally shape productive incentives and financial stability (North, 1991; Acemoglu and Johnson, 2000; Acemoglu et al., 2005).

Institutional diversity among EMU countries was always seen as its key challenge (Feldstein, 2012). Jaccard and Smets (2017) show how differences in legal institutions undermine access to credit in the EMU periphery. Our focus is on political institutions, reflecting public attention since the crisis. Importantly, institutions such as political accountability are weaker in more diverse societies with internal struggles. Yet some diversity allows to benefit from specialization among complementary resources, and becomes an asset above some level of economic development (Alesina and Ferrara, 2005). Thus in principle a pooled economy with strong and weak areas can support large gains from trade (Schelkle, 2017; Boffa et al., 2016).

The result that a DMU redistributes fiscal capacity from weaker to stronger economies may legitimize occasional fiscal transfers, to ameliorate the long term effects of a structural revaluation. Historical evidence show persistent negative effects of revaluation on competitiveness, even after favorable fiscal shocks. The discovery of natural gas in the Netherlands led to a large real appreciation in the Dutch guilder, and to an increase in real public spending and the price of non-traded goods. Notwithstanding the positive wealth effect, the country registered a rare trade deficit and unemployment quadrupled, followed by partial deindustrialization widely attributed to hysteresis effects (Van Wijnbergen, 1984; Krugman, 1987; Frankel, 2010).[24] Revaluations driven by political

[23] In the XX century Germany and Austria had the most extreme hyperinflation episodes in Europe, while Finland and France had high inflationary phases comparable to Italy and Spain.

[24] Economist (1977) coined the term "Dutch disease" to describe the associated decline of Dutch manufacturing

decisions, such as the UK return to gold parity in 1921 have also had prolonged negative economic effects. Keynes (1925) pointed out that the higher exchange rate boosted the real value of public debt payments, transferring resources from taxpayers to rentiers. The difficult path of Eastern Germany after reunification, even with a transfer program estimated at over 1.5 trillion, points to the extreme challenge of achieving structural adjustment under an overvalued currency.

A related line of work concerned fiscal unification, where a dominant issue is the balance of diversification and political risk. Persson and Tabellini (1996) study moral hazard in risk sharing, while Casella (2005) considers optimal fiscal transfer in a diverse union. Farhi and Werning (2017) find that the optimal monetary policy in a currency union involves self-enforcing transfers. Ultimately, financial balance in a DMU may require a mix of institutional convergence and fiscal transfers, matched by some loss of sovereign powers to avoid moral hazard.

8 Conclusion

After 20 years of the euro it is clear that persistent imbalances may arise in a monetary union between institutionally diverse countries. At the time of the euro creation the mainstream view was that next to considerable real benefits from enhanced trade, a DMU may serve member countries with low credibility as a commitment technology to a safer real repayment, reducing interest rates. It was also recognized that an enhanced commitment to a harder constraint implied painful adjustment in weaker member countries. However, institutional change proved harder and slower than market adjustments, leading to a permanent shift in competitiveness and fiscal capacity across countries.

Our work analyses how structural differences limit or distort the adjustment process. A diverse monetary union is a fundamental change that affects economic and political choices, creating significant redistributive effects among and within countries, such that a DMU becomes a de facto transfer union before any fiscal transfers are ever decided.

Institutionally weaker countries benefit from access to more funding at a lower rate. Yet the model points out that lower rates reflect a higher real debt burden. Member economies with structural weakness not amendable in the short term may shift to higher spending that leads to a binding fiscal constraint in a crisis. While in the past a devaluation could have solved public debt overhang and reduced competitiveness, in a DMU this option is no longer available. So while stronger countries gain competitiveness through a de facto devaluation, in times of crisis they may need to make some fiscal transfer to avoid a sovereign default that would break the DMU.

Our setup enable to focus on political rather than efficiency considerations. A weaker government may opt for monetary unification even when this is disadvantageous to domestic economic

industry.

performance, as it gains fiscal credibility and spending capacity. When this choice implies a need for a transfer or devaluation in some states, the DMU is sustainable if the permanent exchange rate benefit for the stronger country justifies an occasional re-distributive transfers. The productive effect may also be positive for countries of intermediate institutional quality that do not expand public spending much, but is certainly negative for countries with weak institutions.

Thus a DMU is redistributive from the start. On aggregate, productive benefits dis-proportionally accrue to the institutionally stronger country while politicians benefit in weaker countries. Also within each country gains from a common currency are not equally shared. Producers and private employment in core countries and savers and public employment in periphery countries gain, balanced by an indirect transfer from producers in periphery countries and savers in core countries.

In conclusion, a diverse monetary union without a rebalancing mechanism and/or a shift in spending authority tends to create instability. As sovereign states cannot credibly commit, deeper institutional changes (such as a shift in spending authority away from nation states) are needed to alleviate any moral hazard associated with fiscal solidarity. As Farhi and Tirole (2017) state in the context of a banking union, "all (countries) can be made better off by combining a commitment to solidarity .. with an externalization of supervision". More generally, the analysis legitimizes compensating common policies to redistribute the productive costs and benefits of a DMU.

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9 Appendix

9.1 Assumption 1

Assumption 1 restricts the endogenous behavior of the key variables.
Firm production is determined by its labor demand. From equation (4) we find

$$L_F = (\frac{E[\theta(1-\tau)\epsilon](1-\alpha)AK^{\alpha}}{w(2+r)})^{\frac{1}{\alpha}}$$

Its change in excess public spending equals

$$\frac{\partial L_F}{\partial G} = \frac{(1-\alpha)AK^{\alpha}}{\alpha w(2+r)}(L_F)^{\frac{1-\alpha}{\alpha}}E[\theta(\frac{\partial \epsilon}{\partial G}(1-\tau) - \frac{\partial \tau}{\partial G}\epsilon)]$$

Labor demand is decreasing in excess public spending when

$$E[\theta\frac{\partial \epsilon}{\partial G}(1-\tau) < E[\theta\epsilon\frac{\partial \tau}{\partial G}]$$

so when the exchange rate effect is not too large compared to the tax rate effect. After plugging in for the exchange rate derivative in good times, we obtain the upper bound on r

$$r < \frac{(E[\theta\epsilon\frac{\partial \tau}{\partial G}] - (1-p)\theta_L\frac{\partial \epsilon_L}{\partial G}(1-\tau_L))(1+rCA)^2}{p\theta_H(1-\tau_H)(w\frac{\partial L_F}{\partial G}+1)} = \bar{r}$$

The lower bound on r implies that in normal times the exchange rate is increasing (depreciates) in excess public spending.

$$\frac{\partial \epsilon}{\partial G} > 0$$

This is the case when

$$\frac{\partial L_F}{\partial G} > -\frac{1}{w}$$

so when

$$\frac{(1-\alpha)AK^{\alpha}}{\alpha w(2+r)}(L_F)^{\frac{1-\alpha}{\alpha}}E[\theta(\frac{\partial \epsilon}{\partial G}(1-\tau) - \frac{\partial \tau}{\partial G}\epsilon)] > -\frac{1}{w}$$

which means that the exchange rate effect cannot not be too weak compared to the tax rate effect. Again, after plugging in for the exchange rate derivative in good times, we obtain the lower bound on r

$$r > \frac{(E[\theta\epsilon\frac{\partial \tau}{\partial G}] - (1-p)\theta_L\frac{\partial \epsilon_L}{\partial G}(1-\tau_L))(1+rCA)^2 - \frac{1}{\Omega w}}{p\theta_H(1-\tau_H)(w\frac{\partial L_F}{\partial G}+1)} = \underline{r}$$

where $\frac{1}{\Omega w}$ determines the distance between $\bar{r}$ and $\underline{r}$, with $\Omega = \frac{(1-\alpha)AK^{\alpha}}{\alpha w(2+r)}(L_F)^{\frac{1-\alpha}{\alpha}} > 0$.

Finally, a weaker country that spends more should require a larger devaluation. A sufficient condition on w can be derived:

$$\frac{\partial \epsilon_L}{\partial G} > 0$$
$$\frac{(1+i+G\frac{\partial i}{\partial G} - \bar{\tau}(w\frac{\partial L_F}{\partial G}+1))\bar{\tau}\theta_L f(K,L_F) - (G(1+i)-\bar{\tau}(wL_F+G))\bar{\tau}\theta_L f'(K,L_F)\frac{\partial L_F}{\partial G}}{(\bar{\tau}\theta_L f(K,L_F))^2} > 0$$

The left part of the numerator is positive, even when $\bar{\tau} = 1$ and $\frac{\partial L_F}{\partial G} = 0$. Thus, a sufficient condition is when also the right part of the numerator is positive. This is the case when

$$w \leq \frac{G(1+i-\bar{\tau})}{\bar{\tau}L_F}$$

These bounds can be further solved in terms of exogenous parameters by subbing in for the following terms

$$\epsilon_H = \frac{1}{1+rCA}$$
$$\epsilon_L = \begin{cases} \frac{1}{1+rCA} & \text{, in normal times} \\ \frac{G(1+i)-\bar{\tau}(wL_F+G)}{\bar{\tau}\theta_L f(K,L_F)} & \text{, if devaluation} \end{cases}$$
$$\tau_H = \frac{G(1+i)}{\theta_H f(K,L_F)\epsilon_H + wL_F + G}$$
$$\tau_L = \begin{cases} \frac{G(1+i)}{\theta_L f(K,L_F)\epsilon_L + wL_F + G} & \text{, in normal times} \\ \bar{\tau} & \text{, if devaluation} \end{cases}$$
$$i = E[\tfrac{1}{\epsilon}](1+r)E[\epsilon] - 1$$

and their derivatives with respect to excess public spending

$$\frac{\partial \epsilon_H}{\partial G} = \frac{r(w\frac{\partial L_F}{\partial G}+1)}{(1+rCA)^2}$$
$$\frac{\partial \epsilon_L}{\partial G} = \begin{cases} \frac{r(w\frac{\partial L_F}{\partial G}+1)}{(1+rCA)^2} & \text{, in normal times} \\ \frac{(1+i+G\frac{\partial i}{\partial G}-\bar{\tau}(w\frac{\partial L_F}{\partial G}+1))\bar{\tau}\theta_L f(K,L_F) - (G(1+i)-\bar{\tau}(wL_F+G))\bar{\tau}\theta_L f'(K,L_F)\frac{\partial L_F}{\partial G}}{(\bar{\tau}\theta_L f(K,L_F))^2} & \text{, if devaluation} \end{cases}$$
$$\frac{\partial \tau_H}{\partial G} = \frac{(1+i+G\frac{\partial i}{\partial G})(\theta_H f(K,L_F)\epsilon_H + wL_F + G) - G(1+i)(\theta_H f'(K,L_F)\frac{\partial L_F}{\partial G}\epsilon_H + \theta_H f(K,L_F)\frac{\partial \epsilon_H}{\partial G} + w\frac{\partial L_F}{\partial G}+1)}{(\theta_H f(K,L_f)\epsilon_H + wL_F + G)^2}$$
$$\frac{\partial \tau_L}{\partial G} = \begin{cases} \frac{(1+i+G\frac{\partial i}{\partial G})(\theta_L f(K,L_F)\epsilon_L + wL_F + G) - G(1+i)(\theta_L f'(K,L_F)\frac{\partial L_F}{\partial G}\epsilon_L + \theta_L f(K,L_F)\frac{\partial \epsilon_L}{\partial G} + w\frac{\partial L_F}{\partial G}+1)}{(\theta_L f(K,L_f)\epsilon_L + wL_F + G)^2} & \text{, in normal times} \\ 0 & \text{, if devaluation} \end{cases}$$
$$\frac{\partial i}{\partial G} = (1+r)(E[\tfrac{\partial \epsilon}{\partial G}]E[\tfrac{1}{\epsilon}] - E[\epsilon]E[\tfrac{1}{\epsilon^2}\tfrac{\partial \epsilon}{\partial G}])$$

9.2 Direct and indirect effects

The text describes the direct effects of public spending on production through its effects on the interest, tax and exchange rates. There are also indirect interaction effects. Below, the direct effects of excess public spending are boxed, while the indirect effects are unboxed.

$$\frac{\partial \tau_s}{\partial G} = \begin{cases} \boxed{\frac{1+i}{(\theta_s f(K,L_F)\epsilon_s + wL_F + G)^2}} + \frac{G\frac{\partial i}{\partial G}}{(\theta_s f(K,L_F)\epsilon_s + wL_F + G)^2} - \frac{G(1+i)(\theta_s f'(K,L_F)\frac{\partial L_F}{\partial G}\epsilon_s + \theta_s f(K,L_F)\frac{\partial \epsilon_s}{\partial G} + w\frac{\partial L_F}{\partial G} + 1)}{(\theta_s f(K,L_F)\epsilon_s + wL_F + G)^2} & \\ 0 \text{ , when a country devalues} & \end{cases}$$

$$\frac{\partial \epsilon}{\partial G} = \begin{cases} \boxed{\frac{r}{(1+rCA)^2}} + \frac{rw\frac{\partial L_F}{\partial G}}{(1+rCA)^2} & \text{, in normal times} \\ \boxed{\frac{1+i}{\bar{\tau}\theta_L f(K,L_F)}} + \frac{G\frac{\partial i}{\partial G}}{\bar{\tau}\theta_L f(K,L_F)} - \frac{(G(1+i) - \bar{\tau}(wL_F+G))(\bar{\tau}\theta_L f'(K,L_F)\frac{\partial L_F}{\partial G}}{(\bar{\tau}\theta_L f(K,L_F))^2} & \text{, when a country devalues} \end{cases}$$

$$\frac{\partial i}{\partial G} = \begin{cases} 0 & \text{, in normal times} \\ \boxed{(1+r)(E[\frac{\partial \epsilon}{\partial G}]E[\frac{1}{\epsilon}] - E[\epsilon]E[\frac{1}{\epsilon^2}\frac{\partial \epsilon}{\partial G}])} & \text{, when a country devalues} \end{cases}$$

9.3 Proposition 1

The first order condition of the government (equation 3) gives

$$\frac{1-\beta}{\beta} = -E[\theta f'(K,L_F)\frac{\partial L_F}{\partial G}] + \frac{V'(g)}{w}$$

which implicitly defines the government spending choice.

Production is determined by labor demand, which is a function of government spending. Suppose it can be approximated by $L_F = b + dG$, with $b > 0$ and $d \leq 0$ (implied by assumption 1). Plugging in and solving for G gives:

$$\frac{1-\beta}{\beta} = -E[\theta]AK^{\alpha}(1-\alpha)d(b+dG)^{-\alpha} + \frac{V'(g)}{w}$$

$$G = \frac{1}{d}\left(\frac{-d\beta\Psi}{1-\beta(1+\frac{V'(g)}{w})}\right)^{\frac{1}{\alpha}} - \frac{b}{d}$$

where $\Psi = E[\theta]AK^{\alpha}(1-\alpha)$

The change in institutional quality is given as

$$\frac{\partial G}{\partial \beta} = \frac{1}{d}\frac{1}{\alpha}\left(\frac{-d\beta\Psi}{1-\beta(1+\frac{V'(g)}{w})}\right)^{\frac{1-\alpha}{\alpha}} \frac{-d\Psi}{(1-\beta(1+\frac{V'(g)}{w}))^2} \leq 0$$

Since $\frac{\partial G}{\partial \beta} \leq 0$, it follows that $G^S \leq G^W$. Furthermore, assumption 1 implies that

$$\frac{\partial L_F}{\partial G} < 0$$

so $f(K, L_F)^W \leq f(K, L_F)^S$.

9.4 Lemma 1

We know from assumption 1 that

$$E[\theta \frac{\partial \epsilon}{\partial G}(1-\tau) < E[\theta \epsilon \frac{\partial \tau}{\partial G}]$$

and that

$$\frac{\partial \epsilon}{\partial G} > 0$$

Thus, it must be true that (without a devaluation)

$$\frac{\partial \tau_s}{\partial G} > 0$$

From proposition 1 we know that $\frac{\partial G}{\partial \beta} \leq 0$, and so $\frac{\partial \tau_s}{\partial \beta} \leq 0$: a weaker government needs to set a higher tax rate. It follows immediately that a country with sufficiently weak institutions will be constrained by the maximum tax rate, if such a limit exists.

Firms ex post compare their after-tax profits with profits in case of tax evasion. They evade taxation when

$$(1-\tau_s)\pi_s < (1-c)\pi_s \tag{10}$$

so if

$$\tau_s > c$$

Constrained governments compare the devaluation cost C with their utility benefit of the additional excess spending and the expected effect on production. A weaker government chooses to spend as desired and devalue when

$$(1-\beta)\Delta G - C(\Delta \epsilon_L) > -\beta(E[\theta \epsilon f'(K, L_F)\Delta L_F] + \frac{V'(g)}{w}\Delta G) \ ,$$

where $\Delta G > 0$ is the additional spending when choosing to devalue, and ΔL_F is the impact on

labor demand. Governments will choose to devalue when

$$\beta^W < \frac{\Delta G - C(\Delta\epsilon_L)}{\Delta G(1-\frac{V'(g)}{w}) - E[\theta\epsilon f'(K,L_F)\frac{\partial L_F}{\partial G}\Delta L_F]} = \beta^*$$

9.5 Proposition 3

Monetary unification leaves institutional quality unaffected such that, as in proposition 1, the weaker government will spend more than the stronger government. Since we are considering diverse countries, a weaker government will spend strictly more.

As $\beta^W < \beta^{**} < \beta^*$ the maximum tax rate is binding before DMU, so that after DMU $T_L^W \geq 0$. The required transfer equals:

$$T_L^W = \max(0, G^{W_{MU}}(1+r) - \bar{\tau}(\theta_L f(K, L_F^{W_{MU}})\epsilon^{MU} + wL_F^{W_{MU}} + G^{W_{MU}}))$$

which is increasing in excess government spending as without a devaluation $\frac{\partial \tau_s}{\partial G} > 0$ (Lemma 1)[25].

In a DMU the taxation in the stronger country has to fund the required transfer, which decreases incentives to invest ex ante. A maximum transfer $\hat{T}$ is a necessary condition for which expected tax rates are higher in the weaker country so that $f(K, L_F^{W_{MU}}) < f(K, L_F^{S_{MU}})$:

$$E[\tau^{S_{MU}}] < E[\tau^{W_{MU}}]$$

$$\frac{G^{S_{MU}}(1+r) + (1-p)T_L^W}{E[\theta]f(K, L_F^{S_{MU}})\epsilon^{MU} + wL_F^{S_{MU}} + G^{S_{MU}}} < p\frac{G^{W_{MU}}(1+r)}{E[\theta]f(K, L_F^{W_{MU}})\epsilon^{MU} + wL_F^{W_{MU}} + G^{W_{MU}}} + (1-p)\bar{\tau}$$

$$T_L^W < \hat{T} = p\frac{G^{W_{MU}}(1+r)(E[\theta]f(K, L_F^{S_{MU}})\epsilon^{MU} + wL_F^{S_{MU}} + G^{S_{MU}})}{(1-p)E[\theta]f(K, L_F^{W_{MU}})\epsilon^{MU} + wL_F^{W_{MU}} + G^{W_{MU}})} + ...$$

$$\bar{\tau}(E[\theta]f(K, L_F^{S_{MU}})\epsilon^{MU} + wL_F^{S_{MU}} + G^{S_{MU}}) - \frac{G^{S_{MU}}(1+r)}{(1-p)}$$

For each stronger country there exists a weaker country with $\beta^W = \hat{\beta}$ that requires a transfer $T_L^W = \hat{T}$ such that $f(K, L_F^{W_{MU}}) = f(K, L_F^{S_{MU}})$.

9.6 Lemma 5

The spending choice of the government is implicitly defined by

$$\frac{1-\beta}{\beta} = -E[\theta f'(K, L_F)\frac{\partial L_F}{\partial G}] + \frac{V'(g)}{w}$$

[25] Additionally, the exchange rate benefit of public spending is smaller

As the political benefit of public spending is the same after DMU, excess spending will decrease if its productive costs are larger:

$$\frac{\partial L_F^{j_{MU}}}{\partial G} < \frac{\partial L_F^{j}}{\partial G}$$

which is determined by its effect on the interest, tax and exchange rates:

$$\frac{\partial L_F}{\partial G} = \frac{(1-\alpha)AK^{\alpha}}{\alpha w(2+r)}(L_F)^{\frac{1-\alpha}{\alpha}}E[\theta(\frac{\partial \epsilon}{\partial G}(1-\tau) - \frac{\partial \tau}{\partial G}\epsilon)]$$

where

$$\frac{\partial \tau_s}{\partial G} = \frac{(1+i+G\frac{\partial i}{\partial G})(\theta_s f(K,L_F)\epsilon_s + wL_F + G) - G(1+i)(\theta_s f'(K,L_F)\frac{\partial L_F}{\partial G}\epsilon_s + \theta_s f(K,L_F)\frac{\partial \epsilon_s}{\partial G} + w\frac{\partial L_F}{\partial G} + 1)}{(\theta_s f(K,L_f)\epsilon_s + wL_F + G)^2}$$

In the stronger country the exchange rate benefit of public spending is smaller (see proposition 2), and it already paid the international safe rate. Thus a spending increase results in a larger expected tax rate increase, so the government in the stronger country will choose to spend less after DMU.

In weaker countries the exchange rate benefit of public spending is also smaller. However, the effect on tax rates depends on its institutional quality. All weaker countries used to be equally constrained, so they have an equal marginal interest rate benefit. Additionally, joining a credible DMU relaxes the governments' borrowing constraint. Ceteris paribus, a weaker government will wish to increase spending more. While in an intermediate country the net effect of public spending on the tax rate and the exchange rate is ambiguous, a sufficiently weak government with $\beta^W < \beta^I$ will increase spending.

9.7 Proposition 4

For a strong government to choose for a common currency it must benefit:

$$\beta^S(E[\theta\epsilon^{MU}f(K,L_F^{S_{MU}})] + V(g^{S_{MU}})) + (1-\beta)G^{S_{MU}} > \beta^S(E[\theta\epsilon^S f(K,L_F^S)] + V(g^S)) + (1-\beta)G^S$$

which is true when

$$\beta^S > \frac{-\Delta G}{E[\theta\Delta(\epsilon f(K,L_F))] + \Delta V(g) - \Delta G} = \underline{\beta}^{S-J}$$

where $\Delta(\epsilon f(K,L_F)) > 0$ (lemma 6) and $\Delta G < 0$ (lemma 5).

When $\beta > \bar{\beta}^{S-J}$ production does not benefit (lemma 6), so the stronger government will never choose to join.

Depending on whether $\beta^W \gtrless \beta^I$, productive capacity and government spending in the weaker country may in or decrease (always with opposite signs). The weaker government benefits from

DMU when

$$\beta^W(E[\theta\epsilon^{MU}f(K,L_F^{W_{MU}})]+V(g^{W_{MU}}))+(1-\beta)G^{W_{MU}}>...$$
$$\beta^W(E[\theta\epsilon^{S}f(K,L_F^{W})]+V(g^{W}))+(1-\beta)G^{W}-\mathbb{1}C(\Delta\epsilon_L^j)$$

which is true when

$$\beta^W\begin{cases}<\frac{-\Delta G-\mathbb{1}C(\Delta\epsilon_L^j)}{E[\theta\Delta(\epsilon f(K,L_F))]+\Delta V(g)-\Delta G}=\bar{\beta}^{W-J}, & \text{if } E[\theta\Delta(\epsilon f(K,L_F))]+\Delta V(g)-\Delta G<0\\ >\frac{-\Delta G-\mathbb{1}C(\Delta\epsilon_L^j)}{E[\theta\Delta(\epsilon f(K,L_F))]+\Delta V(g)-\Delta G}=\underline{\beta}^{W-J}, & \text{else}\end{cases}$$

To sustain the DMU there must be a transfer from the stronger to the weaker country in times of crisis. We assumed that such a transfer occurs. Now we show when this expectation will indeed be honored in equilibrium.

Consider our model as an infinitely repeated stationary game. The stronger country joins the DMU because it expects to benefit from joining. Suppose the low state reveals itself at $t=1$ and the weaker country needs a transfer to avoid default. If the stronger country does not pay the transfer it could use these funds as a source of private benefit (there is no safe storage).

The stronger country will pay the transfer if paying the transfer and thus saving the monetary union will benefit the economy more then not paying the transfer and not be in a monetary union for all of the following time periods:

$$U_{gov-L}^{MU}+\sum_{t=1}^{\infty}E[\delta^t U_{gov-t}^{MU}]\geq U_{gov-L}^{MU}+\sum_{t=1}^{\infty}E[\delta^t U_{gov-t}^{NoMU}]+U_{gov}^{T}$$

The left side is the government utility in the low state inside the DMU plus the expected discounted utility of being in the DMU in the future. The right side of the inequality is again the government utility in the low state within the DMU plus the expected discounted utility of not being in the DMU in the future plus U_{gov}^T, the one-time political benefit derived from not paying the transfer. The discount rate is $\delta<1$.

This can be rewritten as

$$\frac{\delta}{1-\delta}\Delta E[U_{gov}]\geq(1-\beta^S)\frac{T_L^W}{w}$$

where we subbed in for $U_{gov}^T=(1-\beta)\frac{T_L^W}{w}$, and $\Delta E[U_{gov}]=E[U_{gov}^{MU}-U_{gov}^{NoMU}]$ is the benefit from monetary unification.

In words, the discounted (constant) gain from monetary unification must be larger than the one-time private benefit derived from not paying the transfer. This defines a maximum transfer for which a monetary union is credible

$$\bar{T}=\frac{\delta}{1-\delta}\frac{w\Delta E[U_{gov}]}{1-\beta^S}$$

.

9.8 Proposition 5

From proposition 4 we know that if $\underline{\beta}^{W-PC} < \beta^W < \bar{\beta}^{W-PC} < \tilde{\beta} < \beta^* < \beta^{S-PC} < \beta^S$ and $T_L^W \leq \bar{T}$ institutionally diverse monetary unification is a credible equilibrium outcome.

Any DMU that is a credible equilibrium outcome benefits productive capacity in the stronger country as the government does not increase spending. However, not all credible DMU's benefit productive capacity in the weaker country. From lemma 5 we know that productive capacity in the weaker country only benefits when $\underline{\beta} < \beta^W < \tilde{\beta} < \beta^* < \beta^S$, and there is a sufficient devaluation premium on interest rates.

With a sufficient devaluation premium, productive capacity in intermediately weak countries benefits from DMU and $\beta^W < \bar{\beta}^{W-PC}$ is not a restrictive constraint.

9.9 Simulation

We numerically simulate the model in order to assess the technological assumptions required for our equilibrium analysis and verify the existence of our results. We first discuss the simulation outcomes without monetary union, then with a diverse monetary union. Under reasonable parameters the simulation validates our analysis.

Input parameters

Table 1 presents the values we assume for the exogenous parameters of the model. We set $\alpha = 0.5$. We assume a 5% chance that at $t = 1$ the economy under performs with a need for a devaluation in the weaker country, so $p = 0.95$. When the economy under performs the world price for the traded good θ drops by 40%. Wages are set at 0.6, which means approximately 50% of expected firm revenue is allocated to labor costs. The maximum tax rate $\bar{\tau}$ is set at 25%, so that a sufficiently weak country will devalue in equilibrium before MU.[26] Finally, we set the discount rate δ used to calculate the maximum bearable transfer at 0.95.

Table 4: Input parameters

Parameter	Value
α	0.5
p	0.95
θ_H	1.0
θ_L	0.6
w	0.6
$\bar{\tau}$	0.25
δ	0.95

[26] A higher maximum tax rate may avoid a devaluation, but some governments will still be constrained.

Model outcomes without DMU

We estimate the governments spending choice and firms capital decision in institutionally different countries. Figures 10 and 11 present the equilibrium values for government spending and the firms labor demand as a function of institutional quality. Government spending before monetary unification is restricted to $G \in [0, 1]$: a stronger government cannot be a lender as it does not have an endowment and a weaker government cannot spend more than the entire domestic endowment.

For different values of r, the international safe rate of return, figure 10 shows how government spending (of countries that never devalue) is decreasing in institutional quality, while firm labor demand is increasing.[27] For different values of r, the same government will choose different public spending as the exchange rate and tax rate effects of spending are altered. As the figure shows, the effect of r on spending is not a simple linear relationship. There is an intermediate parameter space for β, which depends on r, for which government spending and labor demand in stronger countries have interior solutions.

Figure 10: Stronger countries

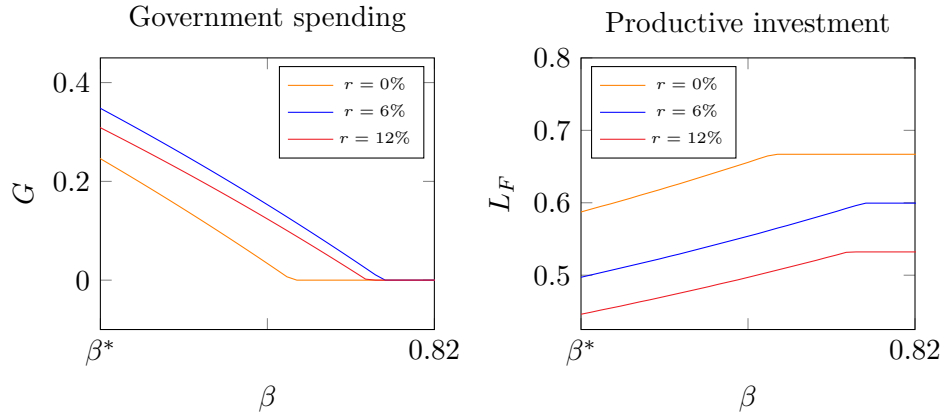
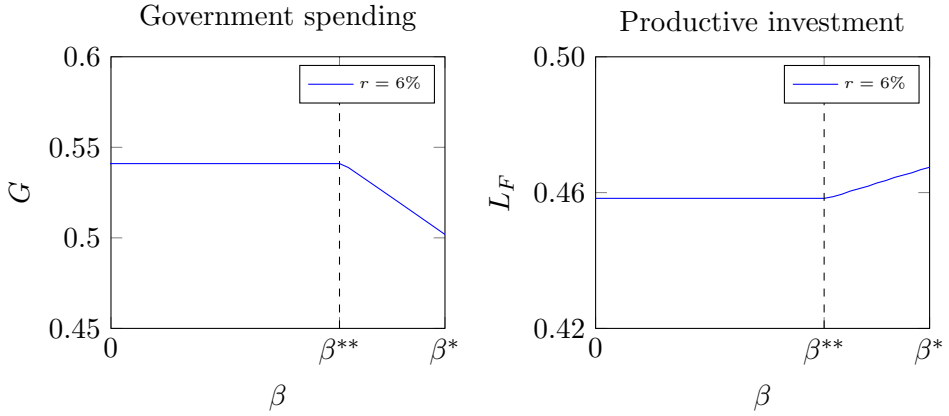


Figure 11 shows the equilibrium choice variables for countries with weaker governments when $r = 6\%$. All sufficiently weak governments with $\beta^W < \beta^{**}$ spend and devalue equally. These governments can only spend the corner solution of domestic savings since they cannot obtain funding on international capital markets. Countries with $\beta^{**} < \beta^W < \beta^*$ devalue, but are unconstrained.[28]

[27] In figure 10 β^* is conditional on $r = 6\%$. Depending on r, β^* is also slightly different

[28] Both β^* and β^{**} are increasing in r

Figure 11: Weaker countries



Under these parameters, assumption 1 translates to $0 \leq r \leq 0.145$, so the lower bound implied by assumption 1 is not restrictive, and $w < 2.3$. When $r > 14.5\%$ a government with very high spending may boost the tax base by further increasing excess spending, leading to discontinuities in the simulation.

Diverse monetary union equilibrium

This section illustrates how diversity in a DMU affects equilibrium outcomes for parameter values consistent with our earlier assumptions. To illustrate the validity of our results we compute the equilibrium of a DMU between a strong country that never devalues (directly) and a second country with intermediately weak or very weak institutions (all such that $\beta^W < \beta^{**} < \beta^* < \beta^S$). We have set $r = 6\%$.

Table 2 shows the equilibrium outcomes of government spending and firm labor demand as well as the required transfer to sustain the DMU and the maximum transfer for which it is credible. In these specifications the stronger country has an exchange rate benefit that outweighs the cost of a possible transfer, even when the combination with a country with very weak institutions (DMU 1) requires a large transfer. The main benefit for the weaker economy is a fall in interest rates after MU, which benefits its productive capacity. However, this benefit is outdone by the endogenous exchange rate revaluation and higher public spending such that in total productive investment decreases in both DMU's.

Strikingly, it can be shown that the government of both weaker countries gains enough from increased public spending to choose to join a monetary union against the interest of the productive capacity and economic welfare of the economy.

Table 5: Equilibrium outcomes

	No DMU			DMU 1		DMU 2	
	Strong	Weak 1	Weak 2	Strong	Weak 1	Strong	Weak 2
β	0.800	0.795	0.775	0.800	0.795	0.800	0.775
G	0.41	0.54	0.54	0.180	0.66	0.182	0.96
L_F	0.48	0.46	0.46	0.556	0.40	0.562	0.32
T	0	0	0	-0.28	+0.28	-0.56	+0.56
$\bar{T}$				0.35		0.75	

Proposition 5 states that an institutionally diverse monetary union can be mutually beneficial if the weaker country is of intermediate strength and there is a sufficiently large devaluation premium on interest rates. In that case the benefit of a lower interest rate after monetary unification outweighs the cost of a stronger exchange rate and an increase in excessive public spending.

So far the devaluation premium to interest rates has been endogenously determined only by the size of the devaluation and the curvature of the exchange rate function. This results in a small devaluation premium of 2%. So far the interest rate benefit from DMU was too small compared to the exchange rate effect to show the existence of a mutually beneficial DMU.

Our aim has been to focus on the exchange rate effect, so we assumed households to be risk neutral. A motivation for a larger interest rate effect would be that households are risk averse such that governments who may devalue would have to compensate their creditors with an additional risk premium. Table 3 shows the simulated effect of DMU on productive capacity when including a devaluation risk premium of 6%. This risk premium implies a more realistic interest rate effect as constrained devaluing countries pay approximately 17.5% interest on their government debt, which is similar to the average interest rate on 10 year government bonds of periphery countries before the euro.

When including these risk premia both weaker countries would still join the DMU because the government can increase spending. The intermediately weak country now also benefits sufficiently from lower debt costs after DMU such that the productive capacity increases, as in proposition 4.

Table 6: Equilibrium outcomes with devaluation premium

	No DMU			DMU 1		DMU 2	
	Strong	Weak 1	Weak 2	Strong	Weak 1	Strong	Weak 2
β	0.800	0.795	0.775	0.800	0.795	0.800	0.775
G	0.41	0.62	0.62	0.180	0.66	0.182	0.96
L_F	0.48	0.38	0.38	0.556	0.40	0.562	0.32
T	0	0	0	-0.28	+0.28	-0.56	+0.56
$\bar{T}$				0.35		0.75	
Dev prem.		6%	6%				