ECONtribute
MARKETS & PUBLIC POLICY

ECONtribute
Discussion Paper No. 010

The Political Economy of a Diverse Monetary Union

Enrico Perotti Oscar Soons

June 2020 www.econtribute.de

UNIVERSITÄT BONN Universität zu Köln

Funding by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany´s Excellence Strategy – EXC 2126/1– 390838866 is gratefully acknowledged.

The Political Economy of a Diverse Monetary Union

Enrico Perotti*and Oscar Soons†‡

June 17, 2020

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 investment incentives, even under a stronger currency. Governments under weaker institutions spend more so must occasionally devalue. In a MU market prices and flows adjust quickly but institutional differences persist, so a diverse monetary union (DMU) has redistributive effects. The government in the weaker country expands spending, and investment may be reduced by the fiscal and common exchange rate effect. Strong country production benefits from the weaker currency but needs to offer fiscal support in a crisis. In equilibrium the required support is incentive compatible due to the devaluation gain. Some governments may join a DMU even if it depresses productive capacity to expand public spending. Even in a DMU beneficial for all countries, firms in weaker countries and savers in stronger countries may lose.

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

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

*University of Amsterdam, CEPR and Tinbergen Institute

†University of Amsterdam and Tinbergen Institute. Contact at o.soons@uva.nl.

‡We are grateful to Bauke Visser and Matteo Crosignani for their early contributions as well as seminar participants at the University of Amsterdam, the Tinbergen Institute, the DNB and ESM. Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germanys Excellence Strategy EXC 2126/1 390838866.

1 Introduction

We offer a political economy interpretation of the emergence and persistence of a monetary union among countries with very different institutional characteristics, such as the European Monetary Union (EMU).

In its first decade the EMU was considered a success, as it facilitated European trade and financial integration and supported growth. Its resilience has been tested in difficult times since 2008, revealing its fragility in the absence of a common fiscal framework, and leading to sharp contrasts between core and periphery economies.[1]

The Euro has clearly offered large efficiency gains in terms of trading, but as a currency area it never enjoyed key self correcting features such as labor mobility and burden sharing. With hindsight, differences in institutional quality across member countries were significant, and have emerged as a key challenge in the recent debate on the Euro future.

Countries differ in terms of their governance and enforcement 'rules of the game', the key infrastructure of economic system (North, 1991). Countries with better institutions support a more productive environment with better incentives to invest.

Institutional quality is very persistent, reflecting structural national features such as political culture, fiscal attitude and public governance. Such deep societal features do not adjust rapidly to changed circumstances. In constrast, market prices and quantities will adjust quickly, with some factors (eg nominal wages) lagging behind.

This paper offers a positive analysis of the aggregate and redistributive effects of a diverse monetary union (DMU) where members differ in institutional quality. Its goal is to model public and private choices in a reduced form macro 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. The focus is on productive incentives under a DMU, so we abstract from its general welfare implications.Our contribution is a realistic description of how institutional diversity in a DMU affects policy choices and productive incentives, reallocating fiscal and public spending capacity. The results on its impact on financial prices, capital flows and policy choices identify costs and benefits across and within countries, in good and bad times. We are able to define the conditions under which such a monetary union may be rationally agreed to, even when its fragility is anticipated, and why it may survive even if it requires transfers. Finally, the political decision to create a MU among diverse countries may not reflect a mutually beneficial outcome, since political motives may override economic welfare in some member countries.

A common currency is a fundamental change that affects economic and political choices, creating indirect transfers among and within countries. Our political economy analysis within a macro

[1] These terms have emerged since the crisis to differentiate countries in terms of fiscal capacity and competitiveness.

framing focuses on endogenous policy choices (spending and taxation, devaluing, joining and remaining in a DMU) to study how private investment decisions adjust to changes in taxation, interest and currency rates once the DMU is established. Redistributive effects (ex ante and ex post) are larger than in a traditional model as institutional variables do not adjust at the pace of market prices or quantities.

Our setup abstracts from well-known benefits of a MU (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) to focus on endogenous policy choices of member countries. Even without these benefits we show that DMU can be credible and mutually beneficial. We adopt a reduced form of exchange rate determination, defined by the notion that countries in financial surplus[2] have stronger currencies as they accumulate foreign reserves or gold, a plausible view consistent with European economic history. Our results on the equilibrium effects of a common currency depend only on this notion.

A key result is that a DMU produces a revaluation for weaker economies and a devaluation for stronger ones, an indirect redistribution of productive advantage from weaker to stronger economies. This effect is due to the lack of institutional adjustment within a rigid monetary framework, and shows a DMU is a transfer union from its very start, even before any fiscal transfers take place. While a DMU promotes production in the strong country, investment incentives may be reduced in weaker member countries.

Our key assumptions are quite transparent. We model public institutional quality as the government preference weight for productive efficiency vs political benefits. The exchange rate with the benchmark currency (dollar) reflects reserve accumulation, so countries with higher domestic absorption have weaker currencies.[3] Private investment in producing the tradeable good anticipates public policy and thus future currency and tax rates. When repayment requires extreme tax rates it triggers total tax evasion, so to avoid default highly indebted countries may need to devalue in adverse states to boost nominal revenues.

Weak countries at risk of devaluation lose access to international capital flows, as foreign investors are disadvantaged in any currency redenomination. Devaluation occurs when a weak government prints domestic currency to ensure ex post solvency, as the resulting inflation decreases real debt repayment as well as real wages. As a result, weak countries' cost of capital includes an inflation premium. Strong countries never devalue by printing currency, but by joining a DMU they experience an immediate devaluation.

In a credible DMU the weaker country relinquishes the valuable option to devalue, and benefits

[2] Financial surplus arise where national savings exceed domestic public and private funding needs.

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

from lower nominal interest rates and access to foreign funding. As a DMU relaxes its borrowing constraints it enables higher spending, leading to higher taxes and possibly a worse outcome in the bad state. The collapse of the DMU can then only be prevented by a transfer (or debt support) from the stronger country.[4]

We show that a DMU with an expected transfer is politically sustainable in equilibrium for a strong country when a lower external exchange rate boosts productive investment. The overall productive effect of a DMU can be positive for countries of intermediate institutional quality that do not expand public spending much, but is negative for countries with sufficiently weak institutions.

Even when the effect of DMU is positive, some economic groups benefit more than others. The exchange rate effect is positive in stronger countries and negative in weaker countries, favoring profits and employment (thought not wages) in stronger countries. Public employment in weaker countries benefits and savers in weaker countries may gain from a stable and stronger currency, while savers in strong economies lose purchasing power.[5]

Finally, a key result highlights a political driver for a DMU. Joining a MU is a structural choice made by politicians, not by voters (none of current EMU members held a referendum on the Euro). When institutions are good, political preferences internalize productive incentives better. A weak country may choose to join a DMU even though disadvantageous for its productive capacity, as it enables local politicians to fund more public spending, capturing some gains or boosting their chance of reelection.

A further conclusion is that a diverse monetary union without an explicit shift in spending authority creates instability, as member economies with structural weakness not amendable in the short term may shift to higher spending. As institutional quality is persistent, weak economies will make choices that leads to a binding fiscal constraint in a crisis, so a DMU requires an occasional transfer from the stronger to the weaker country. Critically, the general equilibrium analysis shows that such a fiscal transfer may in fact be justified by the redistributive effect of a permanent exchange rate shift.

The institutional approach suggests that common economic policies need to affect national discretion to ensure a more balanced and stable outlook. Sovereign states cannot credibly agree to future choices, so structural institutional changes (eg a shift in spending authority) are needed to counterbalance the required 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.

[4] We do not study the monetary policy decisions of a common central bank

[5] In reality, even retirees benefit from improved domestic productivity.

1.1 Discussion of the framework

Our goal is a positive rather than a normative view of how a diverse monetary unification may arise and persist given its impact on productive incentives, financial prices and wages. Our setup abstract from real and diffused benefits of a MU to identifies redistributive effects due to a diverse membership. We adopt a simple exchange rate model where a currency backed by rising reserves appreciates in value relative to other currencies. As a result economies with high resource absorption (lower net savings) have a weak real exchange rate, a view supported by the empirical evidence (Monacelli and Perotti, 2010; Kollmann, 2010; Ravn et al., 2012).

Our results (qualified by reasonable restrictions) 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 (possibly varying across economies), reflecting choices mediated at the political level. Institutional change requires a longer historical frame. Persistent differences in institutional quality across Euro countries (in the spirit of Douglas North's view (North, 1991)) have dominated the public debate since the crisis.

Our formulation is consistent with the notion that better institutions lead to more productivity and growth (Acemoglu et al., 2005; Barro, 1991; Alesina et al., 1996). Inefficient public policy choices may here describe not just excess spending (as it was the case for Portugal, Greece and Italy), but also excess private booms built on debt guarantees (as in Spain and Ireland).

We refrain from any ethical judgment on bad political 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. Cross-country evidence suggests weak accountability leads to excess spending and corruption, as well as higher instability (Acemoglu et al., 2003).

1.2 Motivating Evidence EMU

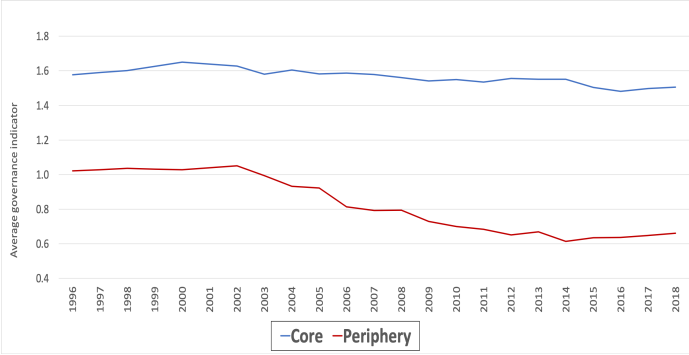
This section shows suggestive evidence for the effects described in our model of the Euro as a DMU.

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 that proxy for institutional quality in our model.[6]

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

Figure 1 depicts the average WGI measure for core (Germany, The Netherlands, Austria, Finland and France) and periphery countries (Italy, Spain, Portugal and Greece). 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).

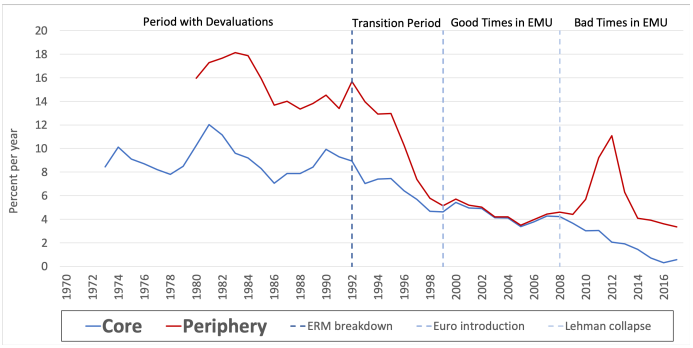
Figure 1: Persistently diverse institutional quality



Average WGI measure for core EMU (Germany, Netherlands, Austria, Finland and France) and periphery (Italy, Spain, Portugal and Greece) in 1996-2016. The Welch's unequal variances t-test shows that the means are statistically different. *Source:* Kauffmann and Kraay (2016)

European monetary unification lowered borrowing costs for periphery countries (see figure 2), 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 2: Long-term interest rate convergence



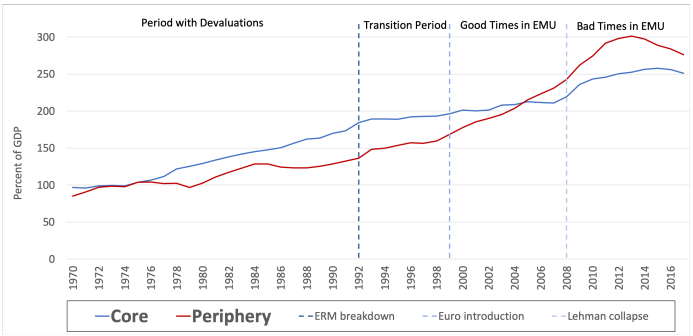
Average 10 year government bond yields on periphery and core EMU countries in 1970-2017. *Source:* IMF

The EMU provided periphery countries with greater access to capital markets but imposed

little fiscal discipline. The Maastricht fiscal rules were soon breached by both core and periphery countries. Foreign borrowing supported a high volume or real value of public spending (Greece, Italy) and massive private borrowing with a public backstop (Portugal, Spain).

Figure 3 shows the sum of private and public debt over GDP since the Euro. Periphery countries were able to sustain structurally higher debt, denominated in a stronger currency. These capital flows were inefficiently allocated, largely to non-tradables, deteriorating competitiveness (Brunnermeier and Reis, 2015; Gopinath et al., 2017). In our model the inefficient allocation of public spending and enlarged private indebtedness with a public backstop is represented in reduced form by excessive government spending.

Figure 3: Access to capital

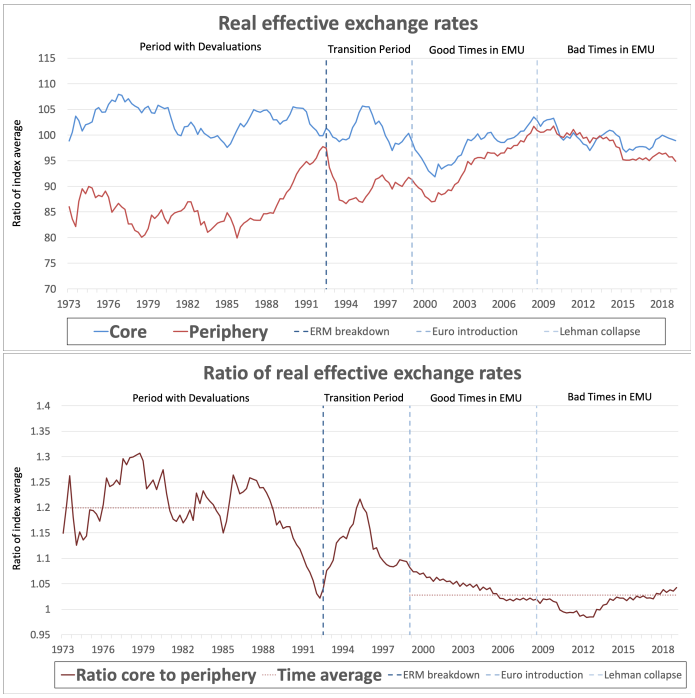


Average sum of public and private debt over GDP in 1970-2017. *Source:* IMF

The key prediction of our model is the effect of a common currency on competitiveness. Figure 4 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 a DMU in the model. The ratio of the core to periphery REER in the bottom figure filters out common factors. 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.

Figure 4: REER convergence

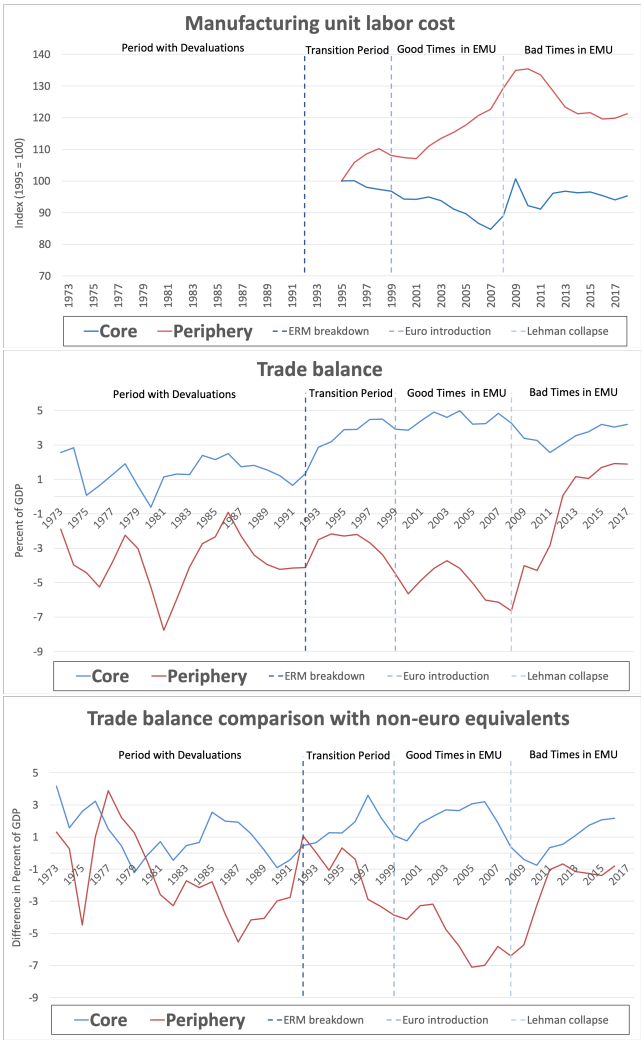


The level and ratio of the average real effective exchange rate index of core and periphery EMU countries in 1970-2017. *Source:* BIS and the The World Bank

Finally, figure 5 reports manufacturing labour costs and 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. 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. Stronger countries outperformed non-Euro OECD countries with comparable institutional quality.[7] 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.

[7]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 5: Trade

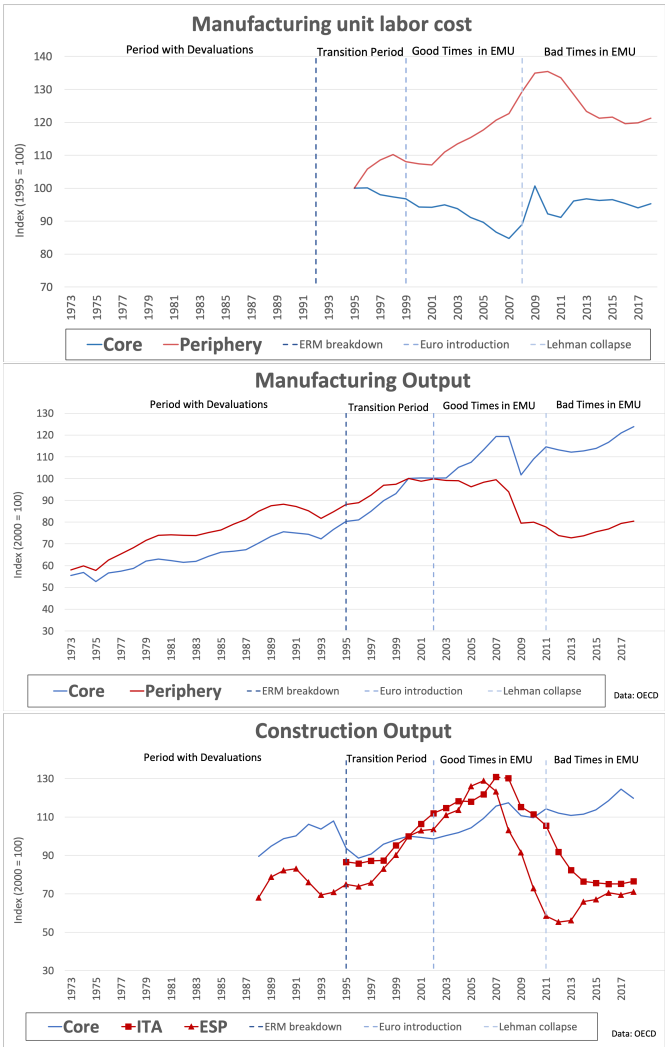


Net trade over GDP and trade balance difference between Euro and non-Euro OECD countries in 1973-2017.
Source: OECD, BIS and The World Bank

Clearly a key cause 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.[8] 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. Nontradables were temporarily boosted by capital inflows (figure 6).

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

Figure 6: Tradables and nontradables



Manufacturing unit labor costs, manufacturing output and construction output in 1973-2017.
Source: OECD, BIS and The World Bank

The rest of this paper is structured as follows. Section 2 describes the model setup, discusses its critical assumptions and solves for the equilibrium with independent currencies. Section 3 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. Section 4 contains a numerical simulation of the model and validates the analysis, illustrating the redistributive effects of a DMU. Section 5 places the work in the literature, and Section 6 concludes.

2 Model

Environment and timing

Consider an economy with two countries $j \in \{S, W\}$ and two dates $t = 0, 1$. Each country consist of an unit mass of households and firms, and a government. Initially each country has its own currency with an exchange rate with respect to a (third) reference country, which we will refer to as the dollar. We assume that the reference country can satisfy any riskless public demand for funding and can absorb all safety seeking private capital flows.

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. This defines a high β country as institutionally stronger ($j = S$), and a low β as institutionally weaker ($j = W$).

At $t = 0$ households start with an unit endowment of domestic currency. Households provide labor services elastically at the national wage level, and invest their cash in firm equity, domestic and foreign government bonds. First, firms decide on their desired productive capacity and raise the required funding from households. The government then chooses public spending, paid for by issuing government bonds. Labor is the only input employed to produce public goods and building the firm capital stock.

At $t = 1$ firms and governments pay labor for their initial work and firms hire new labor to operate their capital stock, producing a single traded good. 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 the numeraire currency of a reference country (which we will refer to as the dollar), 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 exchanged for domestic currency at the exchange rate. Firms pay wages for production. Net firm profits and total labor income are taxed by the government to repay public debt. Firms distribute their after tax profits to its equity holders, and households consume.

Households

There is a continuum of identical households of mass 1, who hold an unit endowment of domestic currency. At $t = 0$ they use their endowment to invest I^j in firm equity and to save B^j in domestic government bonds and F^j in foreign (dollar-denominated) government bonds.[9] Their budget constraint implies that $I^j + B^j + F^j = 1$.

[9] Households cannot invest in foreign firms.

Households also supply labor to the economy. The labor market is described in reduced form. Labor is paid the predetermined nominal wage w set in domestic currency. Labor supply is perfectly elastic at the nominal wage w 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.[10] Governments and firms use labor to transform money into real output. One unit of labor produces one unit of productive capital, one unit of the traded good or one unit of public goods. Unlike capital markets, labor markets are segmented at the national level, so households can only work for the domestic firms or government.

The risk neutral utility of households is given by

$$U^j = W_s^j + V(g^j)$$

where g^j denotes public goods provision with real social value $V(g^j)$. Households derive utility in the final period from public goods and from their real wealth (in dollars). Preferences over wealth have been used by Kumhof et al. (2015) and Francis (2009), motivated by the so called "Capitalist Spirit" argument that traces back to Max Weber (1905).

Household's state contingent real wealth at the final period consist of firm profit, savings in domestic and foreign government bonds and labor income. It is defined as

$$W_s^j = \pi_s^j(I^j) + \frac{B^j(1+i^j) + (1-\tau_s)w(L_0^j + L_1^j + L_G^j)}{\epsilon_s^j} + \frac{F^j}{\epsilon_0^j}(1+r) \ ,$$

Firm profits π_s^j are paid to the household in compensation for its equity investment I^j. Households receive a return i^j on savings B^j in domestic government bonds. Households provide L_0^j units of labor to build capital, L_1^j units of labor to operate it and L_G^j units of labor to produce public goods, all for the nominal wage w. Labor income and firm profits 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. At $t = 0$ households also convert a share F^j of their endowment into dollars, and invest in foreign government bonds that pay r.

Finally, to ensure a stationary environment we assume that households choose to consume all net surplus at $t = 1$, equal to the ex post value of production and return on government bonds, both net of their initial investment cost. Consumption is therefore elevated in good times and depressed in bad times. This ensures a stable money supply.

[10] In reality nominal wage levels reflect both national political decisions as well as economic conditions.

Government

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.[11]

The government chooses public spending G^j on public goods g^j by maximizing its expected utility subject to a fiscal solvency constraint (also called the debt repayment condition) in all states

$$\max_{G^j} \beta^j(E[\theta_s f(k^j, L_1^j) - \mathbb{1}C(\epsilon_{DEV}^j)] + V(g^j)) + (1-\beta^j)g^j,$$

subject to

$$\tau_s^j(\theta_s f(k^j, L_1^j)\epsilon_s^j - wL_1^j + w(L_0^j + L_1^j + L_G^j)) \geq G^j(1+i^j) \tag{1}$$

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

Here $\beta^j \in [0,1]$ measures institutional quality in country $j \in \{S, W\}$. The real value of firm production is $\theta_s f(k^j, L_1^j)$, where θ_s is the dollar price of the traded good that becomes known at time $t=1$. The indicator function equals 1 in case of devaluation, when the economy suffers a real non-monetary cost $C(\epsilon_{DEV}^j)$ where ϵ_{DEV}^j is the devalued exchange rate, $C' > 0$ and $C'' > 0$.[12] We will see that because of this costs no country would devalue except to avoid public debt default in case of a binding fiscal constraint.

Public spending G^j is used to hire $\frac{G^j}{w}$ units of labor to produce g^j public goods (equation 2). Public goods have a real social value $V(g^j)$, where $V(g^j)$ is increasing and concave with a maximum Γ:

$$V(g^j) = \begin{cases} V(g^j), & g^j < \Gamma \\ V(\Gamma), & \text{else.} \end{cases}$$

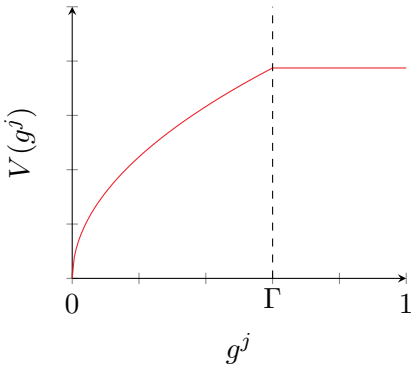
Here Γ is the maximum social value of public spending, and coincide with the socially optimal amount of public spending on public goods $G^{FB} = wg^{FB}$. Any spending in excess of G^{FB} is unproductive as it does not have social value. Figure 7 plots $V(g^j)$.

An imaginary country with perfect institutions ($\beta^j = 1$) chooses public spending $G^j = G^{FB}$ to produce g^{FB} public goods and maximize productive incentives. Any additional spending on

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

[12] The cost function is such that the cost to devaluation quickly rises once devaluation exceeds the necessary amount for debt repayment (and thus becomes unnecessary and expropriative).

Figure 7



public goods is unproductive, but may provide private or political benefits to the politicians in government.[13] Public spending affects productive incentives by raising the expected tax, and via its indirect effect on interest and exchange rates.

The government funds its spending by issuing public debt in its own currency (in case of MU, in the common currency). As no government ever chooses to default, the fiscal solvency constraint (equation 1) ensures nominal 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 condition defines the state contingent tax rate on labor income and firm profit required at $t = 1$ for fiscal solvency.

We assume that tax evasion becomes extreme above a threshold tax rate $\bar{\tau}$, with complete productive loss and no fiscal revenues. When this fiscal constraint is binding, the government can only avoid default by devaluing the currency in order to boost its (nominal) tax base.

We also assume that a government that may devalue loses access to foreign investors, so its spending is constrained by net domestic savings. A natural reason is discriminative treatment of foreign creditors after a devaluation, as in recent devaluation in Argentina and Russia. 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 be in general not be directly constrained by the public spending decision, though it's choices will be affected by the anticipated taxation.

Production

The economy consists of an unit mass of perfectly competitive identical firms run under a mandate to maximize profits. At $t = 0$ firms obtain cash by issuing equity to the households. Firms hire

[13] Excess spending may directly benefit politicians in a context of poor accountability, or be needed to maintain control in a diverse and conflictual society.

L_0^j units of labor to construct a productive capital stock k^j and invest the remaining $I^j - wL_0^j$ in domestic and foreign government bonds (that in expectation yield the same real return). At $t = 1$ firms hire L_1^j units of labor to operate their physical capital and produce the internationally traded good. Capital fully depreciates after being used in production.

Expected real firm profit consist of the after tax profit of producing the traded good plus the income from investing in government bonds, and is given by

$$E[\pi^j] = E[(1 - \tau_s^j)(\theta_s f(k^j, L_1^j)\epsilon_1^j - wL_1^j)]\frac{1}{E[\epsilon_1^j]} + (I^j - wL_0^j)\frac{1}{\epsilon_0^j}(1 + r)$$

All firms profits are distributed back to the equity holders (households) at the end of the final period.

The representative firm optimizes its productive capital k^j so as to maximize expected real profits subject to a budget constraint

$$\max_{k^j} E[\pi^j] \text{ subject to } wL_0^j \leq I_0$$

One unit of labor produces one unit of capital, so $k^j = L_0$ and $I^j = wk^j$. While labor is supplied with perfect elasticity at the preset nominal wage w, capital investment k^j depends on its expected profitability as firms anticipate the public spending, fiscal and devaluation choices.

We assume a Leontief production function:

$$f(k, L_1) = \min(\frac{k^\alpha}{\alpha}, \frac{L_1^\alpha}{\alpha}) \ ,$$

with $0 < \alpha < 1$. This production function results in positive but decreasing marginal returns to scale and a constant optimal ratio of capital and labor required for production.

Exchange Rate Determination

We adopt a reduced form model of nominal exchange rate determination, where the currency value depends on domestic reserves of the numeraire (dollar) currency.[14] A country's external exchange is given by (a function of) the ratio of its domestic money supply to its reserves. This is in contrast to standard New Keynesian models where the exchange rate is determined by the law of one price (Gali and Monacelli, 2005). While these models are used to study relative *changes* in exchange rates, we seek to explain the difference in equilibrium exchange rate *levels* in the medium- to long

[14] 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.

term.[15]

In our setting the country maintains a stable domestic currency supply, unless a fiscal crisis induces a devaluation to ensure solvency. Dollar reserves depend on the net current account position, so that a surplus country accumulate more reserves (at the rate r) and enjoys a stronger currency.

The exchange rate of country $j = S, W$ 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 its current account balance equals

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

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

The exchange rate determination can be understood as follows. At $t = 0$ all countries start with one unit of dollar reserves against and 1 unit of domestic currency (the endowment). The $t = 1$ exchange rate is set based on the remaining reserves backing the money supply. While the nominal money supply is fixed at 1, the stock of dollars depend on the current account balance. To obtain a constant nominal money supply we consider a stationary model where the household immediately consumes its profit net of the investment costs.

Households spend their cash on firm equity, domestic and foreign government bonds. Firms and the domestic government pay the household ex post in domestic currency. Thus the net foreign government bond holdings determine the dollar reserves of a country, and thus the exchange rate. In a surplus country the household buys foreign government bonds. The foreign government pays a *dollar* denominated return at $t = 1$. Thus a surplus country accumulates dollars compared to a deficit country, which depletes its reserves as it uses these to pay back the imported capital.

A country that may devalue is unable to obtain dollars internationally to fund its excessive spending desire. Firms and governments obtain the entire household endowment, and a devaluation is required to avoid sovereign default. A devaluation implies that the central bank prints domestic money (we abstract from seignorage profits and the study of optimal monetary policy), diluting

[15] It is not straightforward to mirror our exchange rate determination to the standard approach in New Keynesian models as households have preferences over wealth, firms face identical international prices and we do not explicitly model a nontradable sector. Future work could further develop the micro foundations of an exchange rate determination process that captures the persistent difference in exchange rate levels between institutionally stronger and weaker countries.

the dollar backing per unit of domestic currency and weakening the currency. A weaker currency means lower real wage cost, so it increases the tax base and supports debt repayment. The required devaluation ϵ_{DEV} to ensure solvency is determined by setting $\tau_L = \bar{\tau}$ in the debt repayment condition.

Interest Rate Determination

Savings invested abroad receive a safe dollar rate of return r. In the basic model domestic interest rates are set by risk neutral domestic investors who receive in expectation the same return as for lending internationally, with no additional risk premium. 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 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.

Monetary Union

The decision to join a monetary union is a political decision, so it requires the government to be better off. A credible MU 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. Once MU is decided the new currency is repriced vis-a-vis the dollar to reflect a common current account balance. We assume that the representative household in both countries receive their unit endowment in the common currency.[16]

The exchange rate of the common currency with the dollar is thus determined by:

$$\epsilon_0^{MU} = \epsilon_1^{MU} = \frac{2}{2 + r(CA^S + CA^W)}$$

For a monetary union to be credible to survive, any "fiscally challenged" country requires a transfer T_L in the low state to satisfy its fiscal solvency constraint:

$$\bar{\tau}(\theta_L f(k^j, L_1^j)\epsilon_1^{MU} - wL_1^j + w(L_0^j + L_1^j + L_G^j)) + T_L^j = G^j(1 + i^j),$$

Without this transfer the fiscally challenged country would need to leave the MU and devalue to

[16] 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 4.

ensure solvency.[17] 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.

Equilibrium under Reasonable Restrictions

We solve for the equilibrium choice of government spending G and firm production k in each country, where firm investment by profits maximizing firms anticipates government choices.

The firm chooses its stock of productive capital by maximizing its real profits. The first-order condition with respect to k determines firm investment and simplifies to:

$$E[(1-\tau^j)(\theta f'(k^j,k^j)\epsilon_1^j - w)] = w(1+i^j) \tag{3}$$

The left side of (3) is the expected marginal profit of capital investment, while the right hand side is the opportunity cost of investing in capital production. The firm sets its productive capacity so that the household is indifferent between investing in government bonds or in firm equity. Without loss of generality, we set the budget constraint to hold with equality.

Equation (3) shows that firm production differs across countries due to sovereign government spending, which has three direct effects: the tax rate 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 nominal borrowing cost $i^j > r$. Both these direct effects of public spending decrease firm incentives to invest.

Higher public spending increases domestic absorption, thus reducing the capital surplus and weakening the exchange rate. Since nominal wages are already set, real wage costs decrease. Thus the exchange rate effect has a positive direct effect on the incentive to invest that may counterbalance the negative effects. The indirect effects (contained in the appendix) are quite complex, so the impact of public spending on investment depends on the equilibrium value of all financial variables.

To be able to sign the general equilibrium effects in closed form we propose (plausible) restrictions on technology and the range of r and w. The international safe rate of return r determines

[17] In our model a policy alternative to a transfer could be for the common central bank to use (un)conventional monetary policy instruments to weaken the currency and decrease the required ex post transfer. We recommend the study of such (temporary) measures to counterbalance the structural imbalances within a DMU for future research.

the elasticity of exchange rates to the capital surplus as well as the sensitivity of the tax rate to public spending. The proposed restrictions rule out absurd cases.[18] As the restrictions affect the responses of endogenous variables, later we show they are satisfied in the simulation of the general equilibrium results for a wide range of plausible parameters.

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 k^j.

To rule out that excess public spending may pay for itself we impose an upper bound on r. The expected tax base cannot be increasing in inefficient public spending, so spending cannot boost investment by an exchange rate benefit above its direct fiscal cost. Uncontrolled public spending would presumably lead domestic savings to flee abroad, as it may be the case in emerging markets.

A lower bound on r is also necessary. While spending itself absorbs resources, this equilibrium restriction rules out the case that because of the tax rate effect productive investment falls more than one-for-one so as to boost the net surplus and strengthening the currency. A lower bound ensures that $\frac{\partial k^j}{\partial G^j} > -\frac{1}{w}$, so that the exchange rate rises (i.e. devalues) as government spending rises. The upper bound on w additionally ensures that when a devaluation is required, it is increasing in spending.

Assumption 1 could not be expressed fully in explicit form. Section 4 solves it numerically while the appendix derives the required restrictions. Section 4 shows that with reasonable parameters the zero lower bound is more restrictive than $\underline{r}$.

Finally, we assume that productive capacity is adequate to afford the first best amount of public spending G^{FB} in the low state. This allows to set $G^{FB} = 0$, simplifying the analysis. Henceforth public spending is thus interpreted as excess spending relative to the efficient choice under $\beta = 1$.

Assumption 2. $G^{FB} < \bar{\tau}(\theta_L f(k^j, L_1^j)\epsilon_s^j + w(L_0 + L^G))$

Using assumption 2, the optimal choice for any governments with $\beta^j < 1$ is given by:

$$1 - \beta^j = -\beta^j E[\theta_s \frac{\partial f(k^j, L_1^j)}{\partial G^j}] \tag{4}$$

where the marginal political benefit of unproductive spending equals the utility-weighted effect on productive capacity, which depends on the equilibrium response of investment. Next to the negative direct tax effect, spending has a beneficial direct effect via the exchange rate that boosts nominal fiscal revenues, and also indirect effects.

Under these conditions, proposition 1 summarizes the benchmark equilibrium without monetary

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

union. We verify later that assumption 1 and 2 are satisfied in equilibrium for a range of plausible parameter values.

Proposition 1. *If* $\beta^W < \beta^S$*, then* $G^W \geq G^S$ *and* $f(k^W, L_1^W) \leq f(k^S, L_1^S)$.

Proof: *See appendix.*

A government with imperfect institutions may derive political utility from spending either because of private gains (eg corruption) or of a political necessity to appease opposing interests to remain in power. Before monetary unification a government under weaker institutions will have more unproductive spending and higher tax rates. Firms will anticipate government choices and will raise less capital in weaker countries, resulting in a lower productive capacity. Households will satisfy the firm's demand for cash, save in government bonds and provide the requested labor.

3 Monetary Union Equilibrium

Homogeneous Monetary Union

We turn to describe a MU in our context. Monetary unification such as the Euro 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 real benefits to analyse purely financial motivations for its rise and persistence, where there is no obvious reason why two identical countries would benefit from forming an homogeneous MU.

A surprising result is that a MU without fiscal coordination induces more spending restraint. Under a common currency the exchange rate benefit of public spending is shared while its fiscal cost is not, 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, a benefit for their productive capacity. However, a MU is disadvantageous for the marginally weaker country as it induces a revaluation.

In contrast, a MU between weak (devaluing) countries does not produce a stable currency, as it would lead to a devaluation of the common currency in bad times. Finally, a MU among intermediate β countries close to the devaluation threshold can be mutually beneficial if it decrease public spending incentives. For some countries this effect may be so large that no transfer is required in the bad state, ensuring currency stability.

A Diverse Monetary Union

We now analyze the equilibrium conditional on institutionally diverse monetary unification. Later we verify that the DMU is indeed a stable equilibrium outcome.

The first step is a classification of countries with an own currency in terms of their exposure to devaluation risk.

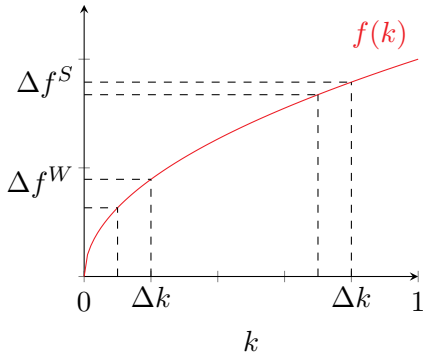
Lemma 1. *If β is sufficiently low, i.e. $\beta < \beta^*$, an unconstrained government will devalue in the low state of the economy.*

Proof: *See appendix.*

When institutions are sufficiently weak the unconstrained public choice results in a tax rate above the maximum tax rate $\bar{\tau}$ in the low state. In this case the productive benefits of a marginal devaluation will be balanced against its cost C, so some weak countries may choose to spend less and not devalue. When $\beta < \beta^*$ the spending benefits exceed the devaluation cost, and the country requires a devaluation in the low state.[19] We will refer henceforth to countries that would devalue an own currency in the low state as weak countries.

Why do stronger countries not devalue, since a devaluation also benefits their production? There are two reasons. First, their government internalizes more the real cost C, which is large for expropriatve devaluations. More interestingly, a weaker country is more inclined to devalue because for an equal devaluation they obtain a larger productive benefit due to the concavity of the production function. Figure 8 shows how for a given boost to private investment, a devaluation is more beneficial for a weaker country with lower investment.

Figure 8



Next, a sufficiently weak country will desire to spend more than its domestic savings.

[19] The convexity of the devaluation cost C is such that it will devalue exactly enough to avoid default

Lemma 2. *If β is sufficiently low, i.e. $\beta < \beta^{**}$, government spending exceeds net domestic savings.*

Proof: *See appendix.*

Consider now the public spending choice. Lemma 1 and 2 together define a government expected to devalue that cannot borrow on international capital markets, so its spending is constrained by net domestic savings $1-I^j$. We define a diverse monetary union as one where $\beta^W < \beta^{**} < \beta^* < \beta^S$. In other words, a DMU is defined 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.

Equilibrium choices

In equilibrium, in all weak countries with $\beta^W < \beta^{**} < \beta^*$ governments spend the same amount since they are equally constrained. As a result they all face the same expected exchange and interest rate, as they devalue by the same amount in the bad state. Once these weak countries join a credible DMU 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 and cannot devalue, weaker countries that increase spending after DMU will require a transfer to avoid default.

The key general equilibrium effect of a credible commitment to monetary unification is a common external exchange rate and interest rate. Thus domestic expected national tax rates alone determine the difference in productive capacity among DMU countries, where the country with the lower expected tax rate will induce more productive investment. Tax rates differ because governments spend distinct amounts, but also because of the expected tax-funded transfer in the adverse state. While in good times the tax rate is higher in the country with higher public spending, in bad times there are two cases. When the required transfer is small the expected tax rate in the weaker country is larger, else the transfer cost may be so high that ex ante productive investment is actually higher in the weaker country.

The required transfer is given by:

$$T_L^W = G^{W-MU}(1+r) - \bar{\tau}(\theta_L f(k,L_1)^{W-MU}\epsilon_1^{MU} + w(L_0^{W-MU} + L^{G-W-MU}))\ ,$$

which is decreasing in institutional quality of the weaker government. As a weaker country requires a larger transfer, productive capacity after DMU is larger in the stronger country when the institutional quality of the weaker government is not too low ($\hat{\beta} < \beta^W$).

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

Proposition 2. *After monetary unification, if $\hat{\beta} < \beta^W < \beta^{**} < \beta^* < \beta^S$, then $G^{W-MU} > G^{S-MU}$, $T_L^S \leq 0 \leq T_L^W$ and $f(k,L_1)^{W-MU} < f(k,L_1)^{S-MU}$.*

Proof: *See appendix.*

The government in the stronger country will spend less than in the weaker country. Now that the weaker country cannot devalue to repay its debt, it requires a transfer. In this case, when institutions are not too weak in the weaker country, productive capacity is larger in the stronger country.

The Effects of Diverse Monetary Unification

We have described the outcomes in strong and weak countries before and after DMU. Now we describe the effect of DMU on public spending and private investment conditional on diverse monetary unification and then solve for the conditions under which a credible DMU arises in equilibrium, and when it is mutually beneficial.

The DMU impact on public spending

Lemma 3 summarizes the effect of DMU on public spending, which is surprisingly different in stronger and weaker countries.

Lemma 3. *If* $\beta^W < \tilde{\beta} < \beta^{**} < \beta^* < \beta^S$*, then* $D^{W-MU} > D^W$ *and* $D^{S-MU} \leq D^S$*.*

Proof: *See appendix.*

As institutional quality is unaffected by unification, so is the direct political benefit of excess spending. Joining a DMU affects public spending only via the effect of spending has on productive capacity. The direct exchange rate effect of domestic spending after MU is smaller in a pooled trade balance. Its benefit is now shared with other countries, which increases the net effect on local tax rates. Thus the stronger country will unambiguously decrease its public spending after joining a DMU (unless it was already at the corner solution of no excessive spending).

For the weaker country the DMU lowers interest rates and relaxes the foreign borrowing constraint. Households in stronger countries and reference country investors are now willing to buy public debt, so the government can spend more after joining. A credible DMU allows them to commit to a higher real value of public debt. However, there are two counter-intuitive intermediate cases that we illustrate only briefly as they are not our main focus.

Consider a MU among two countries with $\beta^W = \beta^{**} - \epsilon$, with ϵ small and positive. 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 produces two possible scenarios. First, for a given interest rate the DMU lowers the exchange rate benefit of spending, so for some β^W close to β^{**} the weak country will not increase spending once it becomes unconstrained. Second, a weaker country may

devalue before DMU, but not require a transfer after. The DMU lowers borrowing costs, possibly allowing a (small) increase in public spending without requiring a transfer.

These interesting cases seem razor edge results as they rely on a fiscal disincentive induced by the DMU. As these cases are outside the main scope of this paper, we rule them out by imposing $\beta^W < \tilde{\beta} < \beta^{**} < \beta^*$. Any weak country with $\beta^W < \tilde{\beta}$ used to devalue before DMU, will increase spending after DMU, and will certainly require a transfer in the low state.

The DMU effect on productive capacity

The effect of a DMU on productive incentives depends on its impact on the external exchange rate, expected taxation and interest rates. The balance depends on the exogenous parameters of the model as well as the endogenous direct and indirect effects, and is too complicated to precisely characterize in closed form. Here we will give some intuition regarding our results, with supplemental equations in the appendix. We solve quantitatively the model to show the existence of our results.

As the common exchange rate is determined by the common current account balance, it may be 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 country without causing an appreciation. This implies that once the DMU is announced the stronger country experiences a weaker exchange rate, while the weaker country revalues.

A stronger country chooses to spend less after DMU (lemma 3) and the de facto currency devaluation lowers domestic real wages, both encouraging investment. The effect on expected tax rates depends on the required transfer relative to the exchange rate benefit. As the strong country experiences no interest rate effect, its investment rises after monetary unification provided:

$$\frac{\epsilon_1^{MU}}{\epsilon_1^S} > \frac{E[\theta(1-\tau^S)]}{E[\theta(1-\tau^{S-MU})]}\Gamma \tag{5}$$

where $\Gamma = \frac{1+r+E[1-\tau^{S-MU}]}{1+r+E[1-\tau^S]}$. Equation 5 compares the exchange rate effect against the net direct taxation effect and a second order indirect taxation effect Γ.

To assess when a DMU benefits productive capacity, first consider the case of unchanged tax rates. Equation 5 simplifies to $\frac{\epsilon_1^{MU}}{\epsilon_1^S} > 1$. This requires the common currency to be weaker than the stronger countries' own currency, which is the case in a DMU.

Now consider a change in tax rates. The expected tax rate in the strong country after monetary

unification is given by:

$$E[\tau^{S-MU}] = E[\frac{G^{S-MU}(1+r)}{\theta f(k,L_1)^{S-MU}\epsilon_1^{MU} + wk^{S-MU} + G^{S-MU}}] + (1-p)\frac{T_L^W}{f(k,L_1)^{S-MU}\epsilon_1^{MU}}$$

By rewriting equation 5 and plugging in for this expected tax rate, we can solve for a maximum transfer T^* (contained in the appendix) for which investment rises after DMU.

Each stronger country can bear a maximum transfer T^* below which monetary unification remains beneficial to its productive capacity. Comparative statics show that a stronger country with a stronger exchange rate before DMU can bear a larger maximum transfer inside the monetary union. Indeed, the exchange rate benefit $\frac{\epsilon_1^{MU}}{\epsilon^S}$ from equation 5 is increasing in β^S.

Suppose that if $\beta^S = \beta^{S-PC}$ a DMU with a weak country with β^W benefits production in the stronger country. If the weaker country would have worse institutions it will require a larger transfer (proved for proposition 2), but also provide a larger exchange rate benefit. If the effect of a larger transfer on productive investment is stronger, there must be a lower bound on institutional quality of the strong country, β^{W-PC}, at which $T^W = T^*$. If the increased exchange rate benefit outweighs the larger transfer, any DMU will benefit productive capacity in the stronger country ($\beta^{W-PC} = 0$).

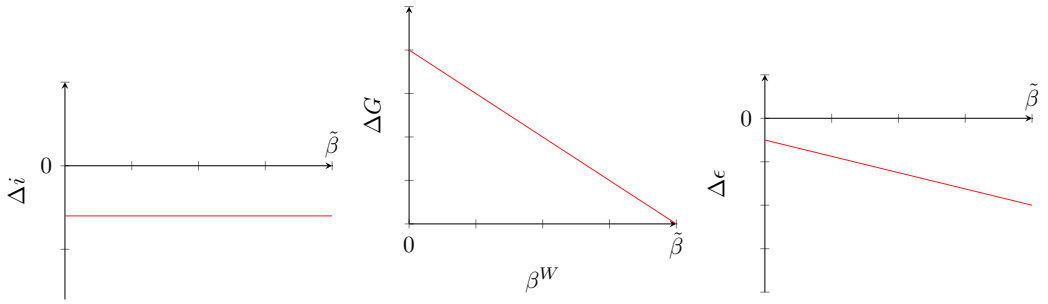
Lemma 4. If $\underline{\beta}^{W-PC} < \beta^W < \tilde{\beta} < \beta^* < \beta^{S-PC} < \beta^S$, then $f(k,L_1)^{S-MU} > f(k,L_1)^S$.

Proof: *See appendix.*

In contrast, in the weak country profitability is hurt by the stronger common currency, and the expected tax rate may also rise due to increased spending. Unless tempered by an interest rate effect, the weaker country is now less competitive as it faces higher real wages and public debt repayment in all states.

Figure 9 illustrates the three effects of DMU as a function of the institutional quality of the weak country.

Figure 9: The effects of DMU in the weaker country



The productive benefit of DMU is a lower interest rate (left figure). Governments in weak countries with $\beta^W < \tilde{\beta}$ were constrained before DMU. Because of their preferences the corner solution for all such countries was to spend all domestic savings, and all devalue by the same amount in the bad state. A credible DMU provides them monetary credibility and, all else equal, lowers their debt costs, decreasing taxes. Lower interest rates also makes government bonds, the alternative to productive investment, a less attractive option.

Productive capacity is hurt because after the introduction of the common currency the government can spend more, and will choose to do so (middle figure). This increases taxes. As a weaker country expands spending more, the common trade balance deteriorates, the common currency weakens and the (negative) exchange rate effect is dampened (right figure).

The balance between these three effects determines the effect of DMU on productive capacity. Consider the effects displayed in figure 9. If the devaluation premium (left figure) on interest rates Δi is small, clearly production never rises in the weaker country. Such a DMU will only have productive costs for the weaker country.

Suppose the devaluation premium is not small. If now the exchange rate response displayed in the right figure is minimal, production rises in all weaker countries that are not too weak. The weaker the country, the more it will increase spending (middle figure) and thus the larger the debt repayment must be. Once this increase in spending outweighs the interest rate gain, tax rates will increase sufficiently for DMU to hurt productive capacity. Re-introducing the negative exchange rate effect will decrease the range of countries for which the interest rate effect outweighs the increase in public spending to a lower bound $\underline{\beta}$.

Lemma 5. If $\underline{\beta} < \beta^W < \tilde{\beta} < \beta^* < \beta^S$, and there is a sufficient devaluation premium on interest rates, then $f(k, L_1)^{W-MU} > f(k, L_1)^W$.

Proof: *See appendix.*

In words, lemma 5 shows that in general the financial effects of a DMU have a negative impact on productive capacity for the weaker country. A credible DMU commits them to a higher real value of public debt and wages in all states, 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.

However, productive capacity could benefit under certain conditions. Productive capacity in weak countries may only increase after DMU when the devaluation premium is sufficiently important compared to the exchange rate effect and domestic institutional quality is intermediate. In

this case the increase in excess spending will be modest, and the interest rate benefit outweighs the exchange rate revaluation.

DMU as an equilibrium outcome

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

Proposition 3.
If $\underline{\beta}^{W-PC} < \beta^{W} < \bar{\beta}^{W-PC} < \tilde{\beta} < \beta^{*} < \beta^{S-PC} < \beta^{S}$ 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.*

The key to this result is that when β^S is sufficiently high, productive capacity in the stronger country increases (lemma 4). A strong government weighs productive capacity enough to choose to join the DMU ex ante. The government in the weaker country values its political benefits more. Thus when DMU would enable a large enough increase in government spending in a weak country, its government will choose to join even though its productive capacity may be reduced. When institutional quality is below $\bar{\beta}^{W-PC}$ the government values the political benefit of additional spending more than the productive costs.

Depending on the the models calibration, the size of the devaluation premium can be such that $\tilde{\beta}$ may be the binding constraint instead of $\bar{\beta}^{W-PC}$. Suppose the devaluation premium is such that productive capacity benefits in the weaker country when $\underline{\beta} < \beta^{W}$ (lemma 5). Then $\bar{\beta}^{W-PC}$ is not restrictive as any government with $\underline{\beta}^{W-PC} < \beta^{W} < \tilde{\beta}$ will opt for a common currency as even without the political benefit of additional public spending the interest rate benefit outweighs the revaluation loss.

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 because of its long term benefits. Assume for simplicity that the game is infinitely repeated each period in its current form, and that each stage game is identical.[20] The DMU emerges as a credible equilibrium when the discounted repeated expected 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 will verify this condition later in the model simulation.

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

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 total spending to choose for a DMU because it will be politically advantageous, even though it is disadvantageous for domestic productive capacity.

Proposition 4.
If $\underline{\beta}^{W-PC} < \underline{\beta} < \beta^{W} < \tilde{\beta} < \beta^{*} < \beta^{S-PC} < \beta^{S}$, $T_L^W \leq \bar{T}$ and there is a sufficiently large devaluation premium on interest rates, institutionally diverse monetary unification is a credible and mutually beneficial equilibrium outcome.

Proof: *See appendix.*

A DMU is mutually beneficial only for a subset of the credible DMU's defined by proposition 3. Crucially, a mutually beneficial DMU requires a sufficiently large devaluation premium compared to the exchange rate effect. Depending on the models calibration $\underline{\beta}$ may be a more restrictive constraint then β^{W-PC}: the weaker country cannot be too weak. The first determines the minimum institutional quality of the weaker country for which its productive investment increases, the second the minimum institutional quality of the weaker country for which the transfer is bearable by the stronger country.

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 DMU equilibrium may arise, but on balance the weaker economy suffers.

4 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 formal analysis.

Input parameters

Table 1 presents the values we assume for the exogenous parameters of the model. We set the production function as $f(k) = \frac{k^{\alpha}}{\alpha}$, with $\alpha = 0.5$. 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.[21] Finally, we set the discount rate δ used to calculate the maximum bearable transfer at 0.95.

Table 1: 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

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 capital choice 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 firms investment is increasing.[22] 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 productive investment in stronger countries have interior solutions.

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

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

Figure 10: Stronger countries

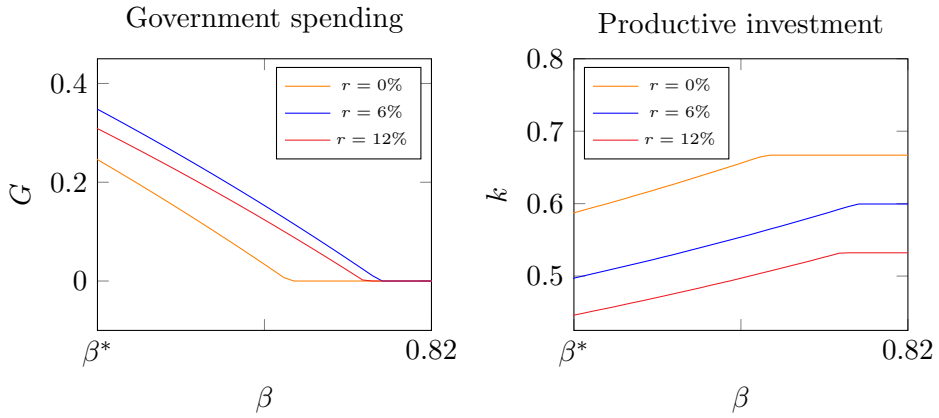
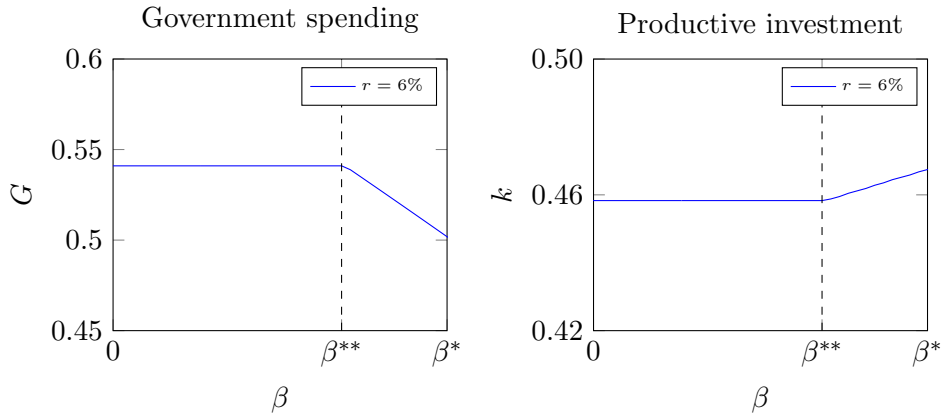


Figure 11 shows the equilibrium choice variables for countries with weaker governments when $r = 6\%$. All sufficiently weak governments with $\beta^W < \beta^{**}$ spend and devalue equally. These governments can only spend the corner solution of domestic savings since they cannot obtain funding on international capital markets. Countries with $\beta^{**} < \beta^W < \beta^*$ devalue, but are unconstrained.[23]

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.

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

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 $\beta^W < \tilde{\beta} < \beta^{**} < \beta^* < \beta^S$). We have set $r = 6\%$.

Table 2 shows the equilibrium outcomes of government spending and private investment 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 2: 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
k	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 4 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 3: 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
k	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%				

Redistributive Effects

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 in DMU redistributes productive incentives from weaker to stronger economies, making it a transfer union from the start, ahead of any fiscal flows.

Redistributive effects occur in equilibrium as well within countries. The setup does not lend itself to an full assessment, as the representative household includes both productive agents (workers and investors) and retired savers. Consider now their separate individual payoffs. Workers 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. Excess public spending is here seen in reduced form as a dead weight productive loss as it has no real benefit, though it does support public employment.

Let the real payoffs to investors Π_I^j, labor Π_L^j and savers Π_S^j in country $j \in [S, W]$ be as follows:

$$\Pi_I^j = \pi_s^j(I^j)$$
$$\Pi_L^j = \frac{1}{\epsilon_s^j}(1-\tau_s^j)w(L_0^j + L_1^j + L_G^j)$$
$$\Pi_S^j = \frac{1}{\epsilon_s^j}B^j(1+i^j) + \frac{1}{\epsilon_0^j}F^j(1+r)$$

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. Consider a DMU as simulated earlier, and ignore any inflation premium.[24] Such a DMU is a credible arrangement as productive capacity in the stronger country benefits as well as public spending in the weaker country. Tables 4 and 5 show the redistributive effect within each country as the percentage change in real payoffs.

A weaker common currency contributes to expected gains for the stronger country productive incentives, 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 the higher tax rates caused by more public spending. In bad times the loss of competitiveness is attenuated by a gain in real value of their payoffs as there is no devaluation. So they "benefit" from a transfer in bad times, but in expectation productive incentives decrease.

Productive employment in both countries is affected similarly as production, while unproductive public employment depends on the change in public spending. In stronger country productive employment benefits from the gain in productive incentives. Public employment decreases as the government is less inclined to spend. The net employment effect is positive in expectation and in good times. In weaker country the net effect on employment is also positive, but for opposite reasons. Productive employment decreases due to the loss of competitiveness, while public employment benefits from the increase in government spending.

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 currency endowment. 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 devaluation. After DMU they get a safe return and benefit from a higher real valuation, so they 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

[24] We refer to the simulation with $\beta^S = 0.80$ and $\beta^W = 0.795$.

once the DMU is announced.

Table 4: Redistribution in the stronger country

	θ_H	θ_L	Expected
Investors	22%	-32%	18%
Employment	4%	-40%	2%
Savers	-17%	-17%	-17%

Table 5: Redistribution in the weaker country

	θ_H	θ_L	Expected
Investors	-22%	-6%	-20%
Employment	1%	319%	17%
Savers	-0.1%	176%	9%

5 Related Literature

Mundell (1961) defined the 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.[25]

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 the MU 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). Differences in (private) institutions have been studied by Jaccard and Smets (2017), who show how poor legal enforcement undermines access to credit in the periphery of the MU. We focus on political institutions, reflecting public attention on the effect of diversity since the crisis. A key

[25] 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.

result of a positive approach is the recognition that joining a diverse union is largely a political choice (no Euro country held a referendum on this matter). We are able to show that countries will join a DMU even when fully aware of its general equilibrium redistributive effects, especially on a revised common exchange rate and potential fiscal transfers.

A country's real exchange rate certainly has an impact on its trade and growth (Levy-Yeyati and Sturzenegger, 2003; Rodrik, 2009). There are multiple mechanisms that could explain this relationship. In our setup undervaluation benefits firm profitability (at least in the medium term), while overvaluation harms it. Intuitively, a higher exchange rate raises costs and decreases exports. As wages are downward rigid lower demand depresses profits and incentives to invest, reducing producer income.

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.

Generally, societies with more diversity suffer internal struggles, but diversity becomes an asset above some level of economic development (Alesina and Ferrara, 2005), suggesting a benefit from specialization among complementary resources. A pooled economy with strong and weak areas may thus support more gains from trade, conditional on institutional convergence that ensures adequate fiscal governance. Diversity in a MU may be an asset instead of a liability (Schelkle, 2017; Boffa et al., 2016).

6 Conclusion

After 20 years of the Euro it is clear that structural imbalances may arise in a monetary union between institutionally diverse countries. We study how persistent institutional diversity affects political choices and economic outcomes in a credible monetary union via extensive cross and within country redistribution.

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. Though at the time the exchange rate implications were neglected, it was recognized that the price for this enhanced commitment to a hard debt constraint would have implied painful real adjustment costs in weaker member countries.

Our work analyses how structural differences limiting or distorting the adjustment process create significant redistributive effects, such that a DMU becomes a de facto transfer union before any fiscal transfers are ever decided. The common exchange rate creates gains for producers and employment in core countries and savers in periphery countries, balanced by an indirect transfer

from producers in periphery countries and savers in core countries.

Institutionally weaker countries benefit from access to more funding at a lower price. This alters the public spending decision and results in enlarged levels of indebtedness. In the past a devaluation could have solved the economic issues regarding debt overhang and a lack of competitiveness, but this option is no longer available. The institutionally stronger countries gain international competitiveness through a de facto devaluation of their exchange rate. While this gives a boost to their economy, in times of crisis they may face fiscal pressure from a transfer needed to avoid a default of the institutionally weaker country. So far the EMU matches this description of the effects of diverse monetary unification.

Interestingly, in our setup a weaker government may opt for monetary unification even when this is disadvantageous to domestic economic performance, as it gains fiscal credibility and spending capacity. A diverse monetary union is sustainable if the exchange rate benefit for the stronger country outweighs occasional re-distributive transfers in crisis times, while the government in the weaker country benefits from increased public spending.

We show that a DMU is redistributive from the start. On aggregate, economic benefits disproportionally accrue to the institutionally stronger country, while politicians benefit in the institutionally weaker country. Within each country gains are not equally shared. Savers in stronger countries and firms and producers in the periphery will suffer from a common currency. In times of crisis, producers in stronger countries may resent supporting the monetary union by a fiscal transfer, but on average they stand to benefit.

The approach may be promising for a finer assessment of financial adjustment across Euro countries. We intend to explore a positive interpretation of a banking union among diverse countries, to complement normative work on the subject by Farhi and Tirole (2017). Finally we intend to study how country variation in labor market flexibility affects redistributive effects from monetary rigidity.

References

Acemoglu, D. and S. Johnson (2000): "The colonial origins of comparative development: An empirical investigation," *Review of Financial Studies*, 91, 1369–1401.

Acemoglu, D., S. Johnson, J. Robinson, and Y. Thaicharoen (2003): "Institutional causes, macroeconomic symptoms: volatility, crises and growth," *Journal of monetary economics*, 50, 49–123.

Acemoglu, D., S. Johnson, and J. A. Robinson (2005): "Institutions as a fundamental cause of long-run growth," *Handbook of economic growth*, 1, 385–472.

Alesina, A. and E. L. Ferrara (2005): "Ethnic diversity and economic performance," *Journal of economic literature*, 43, 762–800.

Alesina, A., S. Özler, N. Roubini, and P. Swagel (1996): "Political instability and economic growth," *Journal of Economic growth*, 1, 189–211.

Arpaia, A., A. Kiss, B. Palvolgyi, and A. Turrini (2016): "Labour mobility and labour market adjustment in the EU," *IZA Journal of Migration*, 5.

Baele, L., A. Ferrando, P. Hordahl, E. Krylova, and C. Monnet (2015): "Measuring financial integration in the Euro area," *European Central Bank*, 14.

Barro, R. J. (1991): "Economic growth in a cross section of countries," *The Quarterly Journal of Economics*, 106, 407–443.

Bayoumi, T. and B. Eichengreen (1992): "Shocking aspects of European monetary unification," Tech. rep., National Bureau of Economic Research.

Boffa, F., A. Piolatto, and G. A. Ponzetto (2016): "Political centralization and government accountability," *Quarterly Journal of Economics*, 131, 381–422.

Brunnermeier, M. K. and R. Reis (2015): "A Crash Course on the Euro Crisis," *Princeton University and Columbia University manuscript*.

Casella, A. (2005): "Redistribution policy: A European model," *Journal of Public Economics*, 89, 1305–1331.

Cesarano, F. (1997): "Currency Areas and Equilibrium," *Open Economies Review*, 51–59.

Driessen, J. and E. C. Perotti (2004): "Confidence building on euro convergence: theory and evidence from currency options," .

Eichengreen, B. (1992): "Should the Maastricht Treaty Be Saved?" *Princeton Studies in International Finance*, 74, 1–82.

Farhi, E. and J. Tirole (2017): "Deadly Embrace: Sovereign and Financial Balance Sheets Doom Loops," *The Review of Economic Studies*, 85, 1781–1823.

Farhi, E. and I. Werning (2017): "Fiscal unions," *American Economic Review*, 107, 3788–3834.

Feldstein, M. (2012): "The failure of the euro," *Foreign Affairs*, 91, 105–116.

Fernández-Villaverde, J., L. Garicano, and T. Santos (2013): "Political Credit Cycles: The Case of the Eurozone," *Journal of Economic Perspectives*, 27, 145–166.

Foarta, D. (2018): "The limits to partial banking unions: A political economy approach," *American Economic Review*, 108, 1187–1213.

Francis, J. L. (2009): "Wealth and the capitalist spirit," *Journal of Macroeconomics*, 31, 394–408.

Frieden, J. (1998): "The euro: Who wins? Who loses?" *Foreign Policy*, 25–40.

Gali, J. and T. Monacelli (2005): "Monetary policy and exchange rate volatility in a small

open economy," *The Review of Economic Studies*, 72, 707–734.

Giavazzi, F. and M. Pagano (1988): "The advantage of tying one's hands: EMS discipline and central bank credibility," *European Economic Review*, 32, 1055–1075.

Glaeser, E. L., R. La Porta, F. Lopez-de Silanes, and A. Shleifer (2004): "Do institutions cause growth?" *Journal of Economic Growth*, 9, 271–303.

Goodhart, C. A. (1998): "The two concepts of money: Implications for the analysis of optimal currency areas," *European Journal of Political Economy*, 14, 407–432.

Gopinath, G., Ş. Kalemli-Özcan, L. Karabarbounis, and C. Villegas-Sanchez (2017): "Capital allocation and productivity in South Europe," *The Quarterly Journal of Economics*, 132, 1915–1967.

Gourinchas, P.-O. and H. Rey (2007): "From world banker to world venture capitalist: US external adjustment and the exorbitant privilege," in *G7 current account imbalances: sustainability and adjustment*, University of Chicago Press, 11–66.

Greenspan, A. (2011): "Europes crisis is all about the north-south split," *Financial Times*, 6.

Grossman, G. M. and E. Helpman (1994): "Protection for Sale," *The American Economic Review*, 84, 833–850.

Jaccard, I. and F. Smets (2017): "Structural asymmetries and financial imbalances in the eurozone," *ECB Working Paper Series*, 1–51.

Kalemli-Ozcan, S., E. Papaioannou, and J.-L. Peydró (2010): "What lies beneath the euro's effect on financial integration? Currency risk, legal harmonization, or trade?" *Journal of International Economics*, 81, 75–88.

Kauffmann, D. and A. Kraay (2016): "Worldwide Governance Indicators (WGI)," *The Worldwide Governance Indicators(WGI) Project*.

Kollmann, R. (2010): "Government purchases and the real exchange rate," *Open Economies Review*, 21, 49–64.

Kumhof, M., R. Rancière, and P. Winant (2015): "Inequality, leverage, and crises," *American Economic Review*, 105, 1217–45.

Lane, P. R. (2015): "The Real Effects of European Monetary Union," *Journal of Economic Perspectives Volume*, 20, 47–66.

Levy-Yeyati, E. and F. Sturzenegger (2003): "To Float or to Fix: Evidence on the Impact of Exchange Rate Regimes on Growth," *The American Economic Review*, 93, 6.

Maggiori, M. (2017): "Financial intermediation, international risk sharing, and reserve currencies," *American Economic Review*, 107, 3038–71.

Monacelli, T. and R. Perotti (2010): "Fiscal Policy, the real exchange rate and traded goods," *Economic Journal*, 120, 437–461.

Mundell, R. A. (1961): "A Theory of Optimum Currency Areas," *The American Economic Review*, 51, 657–665.

North, D. C. (1991): "Institutions," *Journal of Economic Perspectives*, 5, 97–112.

Persson, T. and G. Tabellini (1996): "Federal fiscal constitutions: Risk sharing and moral hazard," *Econometrica: Journal of the Econometric Society*, 623–646.

Ravn, M. O., S. Schmitt-Grohé, and M. Uribe (2012): "Consumption, government spending, and the real exchange rate," *Journal of Monetary Economics*, 59, 215–234.

Rodrik, D. (2009): "The Real Exchange Rate and Economic Growth," *Brookings Papers on*

Economic Activity, 2008, 365–412.

Schelkle, W. (2017): *The political economy of monetary solidarity: understanding the euro experiment*, Oxford University Press.

Weingast, B. R., K. A. Shepsle, and C. Johnsen (1981): "The political economy of benefits and costs: A neoclassical approach to distributive politics," *Journal of political Economy*, 89, 642–664.

7 Appendix

7.1 Assumption 1

Assumption 1 restricts the endogenous behavior of the key variables to rule out absurd cases.

To derive the upper bound on r, we take the derivative of the tax base with respect to G and set it smaller than 1:

$$\frac{\partial k}{\partial G}E[\theta f'(k,k)\epsilon + w] + E[\theta f(k,k)\frac{\partial \epsilon}{\partial G} + 1] < 1$$
$$\frac{\partial k}{\partial G}E[\theta f'(k,k)\epsilon + w] + p\theta_H f(k,k)\frac{\partial \epsilon_H}{\partial G} + (1-p)\theta_L f(k,k)\frac{\partial \epsilon_L}{\partial G} < 0$$

Rearranging and plugging in for $\frac{\partial \epsilon_H}{\partial G} = \frac{r(w\frac{\partial k}{\partial G}+1)}{(1+rCA)^2}$ gives:

$$r < \frac{(\frac{\partial k}{\partial G}E[\theta f'(k,k)\epsilon + w] + (1-p)\theta_L f(k,k)\frac{\partial \epsilon_L}{\partial G})(1+r(1-wk-G))^2}{-p\theta_H f(k,k)(w\frac{\partial k}{\partial G}+1)} = \bar{r}$$

To derive the lower bound on r, we solve for when the current account surplus decreases in public spending:

$$\frac{\partial CA}{\partial G} < 0$$
$$\frac{\partial k}{\partial G} > -\frac{1}{w}$$

To characterize $\frac{\partial k}{\partial G}$, we have to solve for the firm's capital choice k. This is done by taking the firm's first-order condition with respect to k:

$$E[(1-\tau)(\theta f'(k,k)\epsilon - w)] = w(1+i)$$
$$k = (\frac{w(1+i+E[1-\tau])}{E[\theta(1-\tau)\epsilon]})^{\frac{1}{\alpha-1}}$$

The capital choice depends on the interest rate and the expected tax and exchange rates. We next take a derivative of k with respect to public spending G:

$$\frac{\partial k}{\partial G} = \frac{1}{\alpha-1}(\frac{w(1+i+E[1-\tau])}{E[\theta(1-\tau)\epsilon]})^{\frac{2-\alpha}{\alpha-1}}\frac{w(\frac{\partial i}{\partial G} - E[\frac{\partial \tau}{\partial G}])E[\theta(1-\tau)\epsilon] + w(1+i+E[1-\tau])E[\theta\epsilon\frac{\partial \tau}{\partial G} - \theta(1-\tau)\frac{\partial \epsilon}{\partial G}]}{[E[\theta(1-\tau)\epsilon])^2}$$
$$= \frac{1}{\alpha-1}(\frac{\Omega}{\Theta})^{\frac{2-\alpha}{\alpha-1}}\frac{\Theta w(\frac{\partial i}{\partial G} - E[\frac{\partial \tau}{\partial G}]) + \Omega E[\theta\epsilon\frac{\partial \tau}{\partial G} - \theta(1-\tau)\frac{\partial \epsilon}{\partial G}]}{\Theta^2} \quad (6)$$

where $\Omega = w(1+i+E[1-\tau]) > 0$ and $\Theta = E[\theta(1-\tau)\epsilon] > 0$.

Plugging in for $\frac{\partial \epsilon_H}{\partial G} = \frac{r(w\frac{\partial k}{\partial G}+1)}{(1+rCA)^2}$, we now find that

$$\frac{1}{\alpha-1}(\frac{\Omega}{\Theta})^{\frac{2-\alpha}{\alpha-1}}\frac{\Theta w(\frac{\partial i}{\partial G}-E[\frac{\partial \tau}{\partial G}])+\Omega E[\theta\epsilon\frac{\partial \tau}{\partial G}-\theta(1-\tau)\frac{\partial \epsilon}{\partial G}]}{\Theta^2} > -\frac{1}{w}$$

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

These bounds on r can be further solved by subbing in for the following terms, which will results in an expression that only depends on all the exogenous parameters and the choice variables G and k:

$$\epsilon_H = \frac{1}{1+rCA}$$

$$\epsilon_L = \begin{cases} \frac{1}{1+rCA} & \text{, in normal times} \\ \frac{G(1+i)-\bar{\tau}(wk+G)}{\bar{\tau}\theta_L f(k,k)} & \text{, when a country devalues} \end{cases}$$

$$\tau_H = \frac{G(1+i)}{\theta_H f(k,k)\epsilon_H+wk+G}$$

$$\tau_L = \begin{cases} \frac{G(1+i)}{\theta_L f(k,k)\epsilon_L+wk+G} & \text{, in normal times} \\ \bar{\tau} & \text{, when a country devalues} \end{cases}$$

$$i = E[\tfrac{1}{\epsilon}](1+r)E[\epsilon]-1$$

$$\frac{\partial \epsilon_H}{\partial G} = \frac{r(w\frac{\partial k}{\partial G}+1)}{(1+rCA)^2}$$

$$\frac{\partial \epsilon_L}{\partial G} = \begin{cases} \frac{r(w\frac{\partial k}{\partial G}+1)}{(1+rCA)^2} & \text{, in normal times} \\ \frac{(1+i+G\frac{\partial i}{\partial G}-\bar{\tau}(w\frac{\partial k}{\partial G}+1))\bar{\tau}\theta_L f(k,k)-(G(1+i)-\bar{\tau}(wk+G))\bar{\tau}\theta_L f'(k,k)\frac{\partial k}{\partial G}}{(\bar{\tau}\theta_L f(k,k))^2} & \text{, when a country devalues} \end{cases}$$

$$\frac{\partial \tau_H}{\partial G} = \frac{(1+i+G\frac{\partial i}{\partial G})(\theta_H f(k,k)\epsilon_H+wk+G)-G(1+i)(\theta_H f'(k,k)\frac{\partial k}{\partial G}\epsilon_H+\theta_H f(k,k)\frac{\partial \epsilon_H}{\partial G}+w\frac{\partial k}{\partial G}+1)}{(\theta_H f(k,k)\epsilon_H+wk+G)^2}$$

$$\frac{\partial \tau_L}{\partial G} = \begin{cases} \frac{(1+i+G\frac{\partial i}{\partial G})(\theta_L f(k,k)\epsilon_L+wk+G)-G(1+i)(\theta_L f'(k,k)\frac{\partial k}{\partial G}\epsilon_L+\theta_L f(k,k)\frac{\partial \epsilon_L}{\partial G}+w\frac{\partial k}{\partial G}+1)}{(\theta_L f(k,k)\epsilon_L+wk+G)^2} & \text{, in normal times} \\ 0 & \text{, when a country devalues} \end{cases}$$

$$\frac{\partial i}{\partial G} = (1+r)(E[\frac{\partial \epsilon}{\partial G}]E[\tfrac{1}{\epsilon}]-E[\epsilon]E[\tfrac{1}{\epsilon^2}\frac{\partial \epsilon}{\partial G}])$$

Finally, a weaker country that spends more should require a larger devaluation. A sufficient

condition on w can be derived:

$$\frac{\partial \epsilon_L}{\partial G} > 0$$
$$\frac{(1+i+G\frac{\partial i}{\partial G}-\bar{\tau}(w\frac{\partial k}{\partial G}+1))\bar{\tau}\theta_L f(k,k)-(G(1+i)-\bar{\tau}(wk+G))\bar{\tau}\theta_L f'(k,k)\frac{\partial k}{\partial G}}{(\bar{\tau}\theta_L f(k,k))^2} \geq 0$$
$$w \leq \frac{G(1+i-\bar{\tau})}{\bar{\tau}k}$$

7.2 Direct and indirect effects

Equation 6 (p37) contains the effect of public spending on private investment through its effects on the interest, tax and exchange rates. Each of these total effects can be written out as the sum of direct and indirect effects:

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

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

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

where the boxed parts of the equations are the direct effects of public spending and the indirect effects are unboxed.

7.3 Proposition 1

The upper bound of assumption 1 is such that

$$\frac{\partial k}{\partial G}E[\theta f'(k,k)\epsilon + w] + E[\theta f(k,k)\frac{\partial \epsilon}{\partial G}] < 0$$

As assumption 1 implies that $\frac{\partial \epsilon_s}{\partial G} > 0$, it follows that $\frac{\partial k}{\partial G} < 0$ must be true.

Furthermore, from the first order condition of the government (equation 4), we find:

$$\frac{1-\beta}{w\beta} = -E[\theta f'(k,k)\frac{\partial k}{\partial G}]$$

which implicitly defines the government spending choice. We know from equation 6 that investment is (a complicated) function of government spending. Suppose k can be approximated by $k = aG+b$, with $a \leq 0$ and $b > 0$ Plugging this in and solving for G gives:

$$\frac{1-\beta}{w\beta} = -aE[\theta](aG+b)^{\alpha-1}$$
$$G = \frac{1}{a}(\frac{1-\beta}{-aE[\theta]w\beta})^{\frac{1}{\alpha-1}} - \frac{b}{a}$$

with

$$\frac{\partial G}{\partial \beta} = \frac{1}{a}\frac{1}{\alpha-1}(\frac{1-\beta}{-aE[\theta]w\beta})^{\frac{2-\alpha}{\alpha-1}}\frac{aE[\theta]w}{(-a\beta E[\theta]w)^2} \leq 0$$

Since $\frac{\partial G}{\partial \beta} \leq 0$, we find that $G^S \leq G^W$, $k^S \geq k^W$, and thus $f(k,L)^W \leq f(k,L)^S$.

7.4 Lemma 1

Using assumption 1 we can sign $\frac{\partial \tau_s}{\partial G}$:

$$\tau_s = \frac{G(1+i)}{\theta_s f(k,k)\epsilon_s + wk + G} \tag{7}$$

$$\frac{\partial \tau_s}{\partial G} = \frac{(1+i+G\frac{\partial i}{\partial G})(\theta_s f(k,k)\epsilon_s + wk + G) - G(1+i)(\frac{\partial k}{\partial G}(\theta_s f'(k,k)\epsilon_s + w) + \theta_s f(k,k)\frac{\partial \epsilon_s}{\partial G} + 1)}{(\theta_s f(k,k)\epsilon_L + wk + G)^2} \tag{8}$$

First, since $\frac{1}{\epsilon}$ is strictly convex for $\epsilon > 0$, it holds that $E[\frac{1}{\epsilon}] > \frac{1}{E[\epsilon]}$ (Jensen's inequality), and thus $E[\frac{1}{\epsilon}]E[\epsilon] > 1$ and $i > r$. Also, $\frac{\partial(E[\frac{1}{\epsilon}]-\frac{1}{E[\epsilon]})}{\partial(\epsilon_L-\epsilon_H)} > 0$, so $\frac{\partial i}{\partial G} \geq 0$ and thus $1+i+G\frac{\partial i}{\partial G} > 1$.

Next, from the upper bound of assumption 1 we know that $\frac{\partial k}{\partial G}E[\theta f'(k,k)\epsilon + w] + E[\theta f(k,k)\frac{\partial \epsilon}{\partial G} + 1] < 1$. As also $G(1+i) \leq \theta_s f(k,k)\epsilon_s + wk + G$ (debt repayment cost is less than or equal to the tax base), it follows that $\frac{\partial \tau_s}{\partial G} > 0$. 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 spends more and sets a higher tax rate in any state.

It follows that a country with sufficiently weak institutions will be constrained by the maximum tax rate. However, a government that marginally hits this constraint may not devalue yet as this will mean enduring the devaluation cost C. A weaker government will choose for a devaluation once the productive cost is smaller than the political benefit:

$$-\beta(\Delta(\theta\epsilon f(k)) - C) \leq (1-\beta)\frac{\Delta G}{w},$$

where $\Delta G > 0$ is the additional spending when choosing to devalue and $\Delta(\theta\epsilon f(k)) < 0$ is the productive cost of the additional spending (taking into account the required devaluation).

To prove the existence of a β^* below which a country will choose to devalue, remember that a country that is anticipated to devalue loses access to international markets. Thus the additional spending is constrained by domestic savings and the productive loss is constrained by the maximum devaluation that is required to repay domestic savings. Suppose that the $L > 0$ is the maximum productive loss and $B > 0$ is the maximum additional spending.

A weaker government that will maximally devalue will choose for such a devaluation when:

$$-\beta(-L - C) \leq (1 - \beta)B$$

The right side (political benefit of devaluation) is decreasing in institutionally quality. The left side (internalized cost of devaluation) is increasing in institutional quality. It follows that there must be a β^* such that $-\beta^*(-L - C) = (1 - \beta^*)B$, below which a country will choose to devalue maximally. This solves to $\beta^* = \frac{B}{L+C+B}$, which is increasing in B and decreasing in L.

7.5 Lemma 2

From proposition 1 we know that $\frac{\partial G}{\partial \beta} \leq 0$: a weaker government will spend more. As there are limited domestic resources, public spending will exceed domestic savings when institutional quality is sufficiently low.

7.6 Proposition 2

Monetary unification leaves government objectives 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 and it must be the case that $T_L^W > 0$ to avoid default.

Since the weaker government spends more, it may be expected that $k^W < k^S$. However, the stronger country has to increase ex post taxes in the low state to pay the required transfer, which decreases the incentives to invest. A maximum transfer $\hat{T}$ is a necessary condition for which expected tax rates are higher in the weaker country and thus $f(k, L)^{W-MU} < f(k, L)^{S-MU}$:

$$E[\tau^{S-MU}] < E[\tau^{W-MU}]$$

$$T_L^W < \hat{T} = p\frac{G^{W-MU}(1+r)(E[\theta]f(k,k)^{S-MU}\epsilon_1^{MU} + wk^{S-MU} + G^{S-MU})}{(1-p)E[\theta]f(k,k)^{W-MU}\epsilon_1^{MU} + wk^{W-MU} + G^{W-MU})} + ...$$

$$\bar{\tau}(E[\theta]f(k,k)^{S-MU}\epsilon_1^{MU} + wk^{S-MU} + G^{S-MU}) - \frac{G^{S-MU}(1+r)}{(1-p)}$$

The required transfer equals:

$$T_L^W = G^{W-MU}(1+r) - \bar{\tau}(\theta_L f(k,k)^{W-MU}\epsilon_1^{MU} + wk + G)$$

which the derivative with respect to G is

$$\frac{\partial T_L^W}{\partial G} = (1+r) - \bar{\tau}(\theta_L f'(k,k)^W \frac{\partial k^W}{\partial G}\epsilon^{MU} + \theta_L f(k,k)^W \frac{\partial \epsilon^{MU}}{\partial G} + w\frac{\partial k^W}{\partial G} + 1)$$

Per the upper bound of assumption 1 the right term is less than 1 (the exchange rate benefit of spending is actually smaller after DMU). Thus the required transfer in increasing in public spending, thus decreasing in institutional quality of the weak government: $\frac{\partial T_L^W}{\partial \beta^W} < 0$: a weaker country needs a larger transfer. It follows that for each stronger country there must be a weaker country with $\hat{\beta} < \beta^W$ that requires a sufficiently small transfer $T_L^W < \hat{T}$ such that $f(k,L)^{W-MU} < f(k,L)^{S-MU}$

7.7 Lemma 3

The spending choice of the government in the stronger country is given by equation 4. Since the marginal political benefit of public spending is the same before and after DMU, it will spend less if the marginal productive cost of public spending is larger. The marginal cost of public spending is determined by its effect on the interest, tax and exchange rates.

There is no change in the impact of spending on the interest rate as the stronger country already paid the international rate. However, it now faces a smaller impact of its spending on the exchange rate:

$$\frac{\partial \epsilon_1^{MU}}{\partial G^S} = \frac{2r(w\frac{\partial k^{S-MU}}{\partial G^S}+1)}{(2+r(CA^W+CA^S))^2} < \frac{r(w\frac{\partial k^S}{\partial G}+1)}{(1+rCA^S)^2} = \frac{\partial \epsilon^S}{\partial G^S}$$

After MU the monetary benefit of increasing spending on the exchange rate is attenuated, while its fiscal cost is still fully internalized. Thus an increase in spending triggers a larger increase in the expected tax rate. Because of this, the government in the stronger country will choose to spend less after MU.

The effect is quite different for the government in the weaker country, which was previously constrained in its spending. Joining a credible DMU relaxes its borrowing constraint, while also increasing the marginal fiscal cost of spending (as in the stronger country). As explained in text, the weaker country is chosen to be sufficiently weak ($\beta^W < \tilde{\beta}$ such that the gained monetary credibility, attenuated by the higher marginal cost of spending, result in an increase in spending. In other words, we rule out the intermediate special cases.

7.8 Lemma 4

Productive investment before and after DMU is given by:

$$k^S = (\frac{w(1+r+E[1-\tau^S])}{E[\theta(1-\tau^S)\epsilon^S]})^{\frac{1}{\alpha-1}}$$
$$k^{S-MU} = (\frac{w(1+r+E[1-\tau^{S-MU}])}{E[\theta(1-\tau^{S-MU})\epsilon_1^{MU}]})^{\frac{1}{\alpha-1}}$$

$k^{S-MU} > k^S$ if and only if

$$\frac{w(1+r+E[1-\tau^{S-MU}])}{E[\theta(1-\tau^{S-MU})\epsilon_1^{MU}]} < \frac{(w1+r+E[1-\tau^S])}{E[\theta(1-\tau^S)\epsilon^S]}$$
$$\frac{w(1+r+E[1-\tau^{S-MU}])}{w(1+r+E[1-\tau^S])} < \frac{\epsilon_1^{MU}}{\epsilon^S}\frac{E[\theta(1-\tau^{S-MU})]}{E[\theta(1-\tau^S)]}$$

$$\frac{\epsilon_1^{MU}}{\epsilon^S} > \frac{1+r+E[1-\tau^{S-MU}]}{1+r+E[1-\tau^S]}\frac{E[\theta(1-\tau^S)]}{E[\theta(1-\tau^{S-MU})]} \tag{9}$$

Equation 9 can be rewritten to solve for a maximum transfer a stronger country can bear while $k^{S-MU} > k^S$:

$T_L^W < T^*$

$$T^* = (\theta_L f(k,k)\epsilon_1^{MU} + wk + G^{S-MU})(E[\theta] - \frac{p\theta_H G^{S-MU}(1+r)}{\theta_H f(k,k)\epsilon_1^{MU} + wk + G^{S-MU}} - \Gamma E[\theta(1-\tau^S)]\frac{\epsilon^S}{\epsilon_1^{MU}})...$$
$$- (1-p)\theta_L G^{S-MU}(1+r)$$

where $\Gamma = \frac{1+r+E[1-\tau^{S-MU}]}{1+r+E[1-\tau^S]}$ and we plugged in for $E[\tau^{S-MU}]$.

Also, The left hand side of equation 9, the exchange rate benefit of DMU, is decreasing in G^S:

$$\frac{\partial \frac{\epsilon_1^{MU}}{\epsilon^S}}{\partial G^S} = \frac{\frac{\partial \epsilon_1^{MU}}{\partial G^S}\epsilon^S - \frac{\partial \epsilon^S}{\partial G^S}\epsilon_1^{MU}}{(\epsilon^S)^2} < 0$$

The signing follows since the common exchange rate is weaker (larger) than the initial exchange rate and less sensitive to changes to public spending. Together with $\frac{\partial G^S}{\partial \beta^S} \leq 0$ this means that $\frac{\partial \frac{\epsilon_1^{MU}}{\epsilon^S}}{\partial \beta^S} \geq 0$: a stronger country has a larger exchange rate benefit of DMU.

It is shown in the proof of proposition 2 that the required transfer is decreasing in institutional quality of the weaker government, and we showed that the exchange rate benefit is larger for stronger countries so that a stronger country with lower ϵ^S can bear a larger maximum transfer. Thus, although we are unable to sign a full characterization of $\frac{\partial T^*}{\partial \beta^S}$, we argue that if β^S is large enough, above β^{S-PC} and β^W is not too low, above β^{W-PC} then $k^{S-MU} > k^S$. We quantitatively verify this result with the simulation, where we find that $\beta^{W-PC} = 0$ for the parameters chosen.

7.9 Lemma 5

Productive investment before and after DMU is given by:

$$k^W = \left(\frac{w(1+i^W+E[1-\tau^W])}{E[\theta(1-\tau^W)\epsilon^W]}\right)^{\frac{1}{\alpha-1}}$$
$$k^{W-MU} = \left(\frac{w(1+r+E[1-\tau^{W-MU}])}{E[\theta(1-\tau^{W-MU})\epsilon_1^{MU}]}\right)^{\frac{1}{\alpha-1}}$$

$k^{W-MU} > k^W$ if and only if

$$\frac{1+r+E[1-\tau^{W-MU}]}{1+i^W+E[1-\tau^W]} < \frac{E[\theta(1-\tau^{W-MU})\epsilon_1^{MU}]}{E[\theta(1-\tau^W)\epsilon^W]} \tag{10}$$

The left hand side contains the interest rate effect and the second order indirect effect of tax rates on firms' wage bill (which moderates any tax rate effect). The right hand said contains the exchange rate and first order taxation effect on production.

Suppose there is no devaluation premium ($r = i^W$) and disregard the second order taxation effect. Equation 10 then becomes:

$$1 < \frac{E[\theta(1-\tau^{W-MU})\epsilon_1^{MU}]}{E[\theta(1-\tau^W)\epsilon^W]}$$

which never holds as an increase in public spending increases tax rates and the common exchange rate is stronger after DMU.

Suppose there is no exchange rate effect (for example $\epsilon^W = \epsilon_1^{MU} = 1$) and disregard the second order taxation effect. Equation 10 now becomes:

$$\frac{1+r}{1+i^W} < \frac{E[\theta(1-\tau^{W-MU})]}{E[\theta(1-\tau^W)]}$$

for some devaluation premium on interest rates this holds if tax rates don't increase too much, i.e. if public spending doesn't increase too much after DMU. This is the case for weaker countries that are not too weak.

Taken all together, whether equation 10 holds depends on the relative magnitudes of the interest rate, exchange rate and tax rate effects. The two conditional statements together show that there must exist an $\underline{\beta}$ above which equation 10 holds, if there is a sufficient devaluation premium before DMU. We quantitatively verify the existence in the section containing the simulation.

7.10 Proposition 3

A strong government will choose for a common currency if this increases productive capacity. From lemma 4 we know that this is the case when $\underline{\beta}^{W-PC} < \beta^W < \tilde{\beta} < \beta^* < \beta^{S-PC} < \beta^S$. Lemma 5 tells us that with such an institutional configuration productive capacity may increase in the weaker country when its institutions are not too weak and there is a sufficient devaluation premium on interest rates. If this is the case the weaker government will certainly join the DMU since it can

spend more and productive capacity benefits. When the conditions for lemma 5 are not satisfied and productive investment decreases in the weaker country, weaker governments will still join if the political benefits of the additional spending, which it values more than the stronger country, outweighs the productive costs.

From lemma 3 we know that any weaker country with $\beta^W < \tilde{\beta}$ will increase spending. However for some of these countries the drop in investment will outweigh the political benefit of the improved ability to spend. Because the additional spending and exchange rate effect are decreasing in β^W, when institutions are sufficiently weak ($\beta^W < \bar{\beta}^{W-PC}$) the spending benefit is large enough to outweigh the drop in investment and a government will introduce a common currency.

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. However, after the productive benefit of DMU is realized the stronger country could refuse to pay the transfer necessary to sustain the monetary union. 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:

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

The left side of the inequality is the government utility in the low state within 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^T_{gov}, the one-time political benefit derived from not paying the transfer. The discount rate is $\delta < 1$.

This can be rewritten as

$$\sum_{t=1}^{\infty} E[\delta^t U^{MU}_{gov-t}] \geq (1-\beta^S)\frac{T^W_L}{w} + \sum_{t=1}^{\infty} E[\delta^t U^{NoMU}_{gov-t}]$$
$$\frac{\delta}{1-\delta}\Delta E[U_{gov}] \geq (1-\beta^S)\frac{T^W_L}{w}$$

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

In words, the discounted (constant) gain from monetary unification must be larger than the private benefit derived from not paying the transfer. This defines a maximum transfer for which a monetary union is credible: $\bar{T} = \frac{\delta}{1-\delta}\frac{w\Delta E[U_{gov}]}{1-\beta^S}$. This maximum transfer depends on the standard parameters of the model as well as the discount rate δ.

7.11 Proposition 4

From proposition 3 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.