International Macroeconomics - Term Paper

Monetary Union and Financial Integration - Debt Denominated in Borrower Currency

Christof Bischofberger and Shahnawaz Akhtar

July 2, 2020

Abstract

This paper modifies the model of financial integration linked to exchange rate regimes from Fornaro (2019), by assuming that debt is denominated in the borrower country's currency rather than lender countries currency. This altered assumption changes the findings of the original model immensely: first, we show that at substantially high levels of debt and elasticity of substitution, the borrower country will always choose to honour its debt, but simultaneously devalue their currency. Therefore, the borrower country never defaults and there are no lending limits imposed by the lender country. Lastly, we show that forming a monetary union is not optimal for a borrower country who can borrow money in local currency. A monetary union will also not lead to higher levels of financial integration and lending capacities. However, we argue that this two-stage game is not realistic, as defaulting or devaluing has no negative impacts on future lending capacities of the borrower country under these assumptions. Therefore, future research could concentrate on adopting the set-up of this model to a multi-stage game in order to allow for credit "reputation" to play a role in borrowing and lending decisions.

1 Introduction

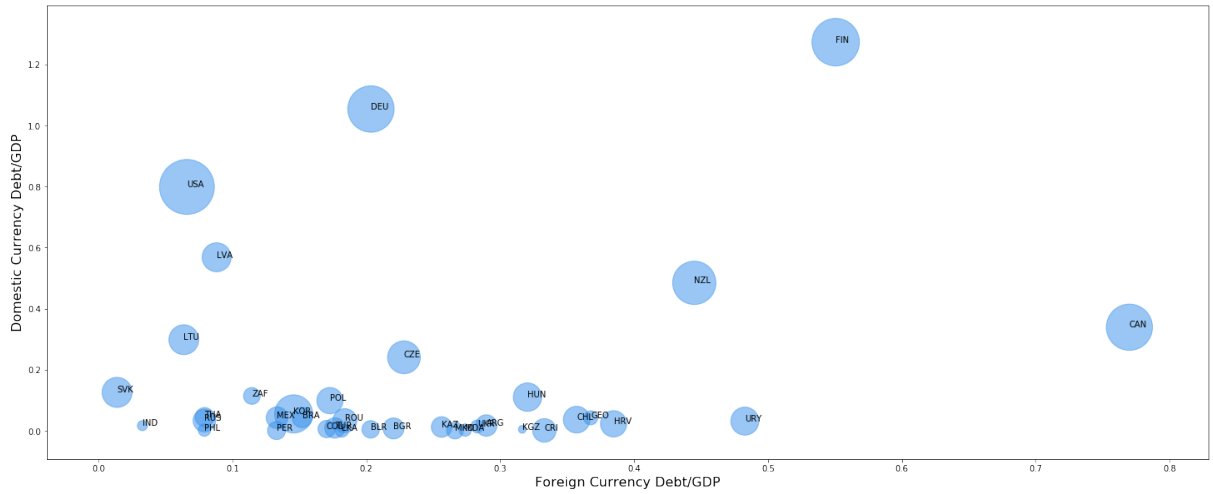
One of the strongest monetary tools a central bank has, is to influence real exchange rates. The real exchange rate is especially important when repaying foreign debt. In his working paper, Fornaro (2019) proposes a theoretical model that connects a country's exchange rate regime to financial integration. The real exchange rate has an influence on the value of collateral that foreign creditors seize in case of default. He shows that under flexible exchange rates, home-country governments can depreciate their real exchange rate, such that the value of collateral for foreign creditors diminishes. Therefore, foreign creditors impose lending limits, that exclude the chance of default. However, when the lender and borrower country join a monetary union, this exchange rate risk disappears, as a central monetary authority maximises welfare of the union as a whole. Under the assumption that debt is denominated in the lending country's currency, forming a monetary union increases financial integration between the lender and the borrower country.

While this assumption is most realistic for the majority of countries, there are a range of countries, whose external debt position is mostly denominated in local currency. In Figure 1, one can see the external debt to GDP ratios in local and foreign currency of all countries who provide data to the Quarterly External Debt Statistics (QEDS) of the World Bank. In Q4 2019, we can see that the USA and Germany both have comparatively high external debt positions in local currency. Presumably this is because of the important role the USD plays in global financial markets, and the fact that both Bundesbank bonds and US T-bonds are considered closest to risk-free investments. The majority of countries however, have relatively low external debt positions in local currency, and differ only in their level of foreign currency debt. Hungary, Croatia, and Uruguay have high levels of debt in foreign currency, while India, the Philippines and Russia have lower levels. Therefore, this figure shows us for which countries the original model proposed by Fornaro (2019) is most applicable to. For all countries with very low levels of debt denominated in local currency, the model along with its assumptions fits very well. However, for countries like Germany or the USA, the assumption that debt is denominated in foreign currency is rather unrealistic, as they have 5 and 12 times as much debt denominated in local currency than foreign currency respectively[1]. Therefore, this paper will lift the assumption that debt is denominated in foreign currency and see how the derivations of the model change when we assume that debt is denominated in local currency. This will be especially relevant for countries with high debt levels in local currencies such as Germany and the USA.

The rest of the paper will be structured as follows: first, we will provide a quick review of existing

[1] Germany and USA's external debt position denominated in local (foreign) currency is 4,684,169 (903,936) and 17,126,059 (1,412,896) Million USD respectively)

Figure 1: External debt position to GDP ratio in local and foreign currency [Circle size indicates per Capita GDP]



literature in this field. Second, we will summarise the original model with the assumptions of foreign currency denominated debt. Third, we will present the novel derivations under the assumption of debt denominated in local currency. Lastly, we conclude by providing policy implications and limitations of the model.

2 Literature Review

This paper builds on Fornaro (2019), and thus contributes to the optimal currency area literature. While Fornaro (2019) investigates the optimality conditions when issued debt is denominated in lenders's currency, our modified model investigates optimality dynamics when debt is denominated in borrower's currency. Maggiori et al. (2018) establishes that currency is one of the most important factors in shaping global portfolios. They demonstrate that investor holdings are biased toward lending in their own currencies, thereby not directly accessing the foreign exchange market. However, they also show that this pattern does not hold for United States, which further provides motivation for this paper.

Amstad et al. (2018) on the other hand, look into sovereign debt, which is typically considered safer when denominated in local currency. However, since two decades, the ratio of local debt has diminished. The authors find that this is not due to differences in inflation, but rather due to the banking sector's vulnerabilities to sovereign debt. Therefore, our paper also optimises Fornaro (2019)'s model to countries with highly vulnerable banking sectors. Artus (2003) concentrates on emerging economies and aims to depict whether it is better for these economies to have debt in local or in foreign currency. He finds that when emerging countries have debt in foreign currency, devaluation risk is minimised when interest rates are

high. Therefore, this paper contributes by theoretically offering additional insight to emerging economies, as devaluation risk is ultimately also integrated into the model.

3 Model

In the original model of Fornaro (2019), the author assumes that debt is denominated in units of the tradable good. This implicitly assume that debt is to be repaid in the lender country's currency. When we change this assumption, and assume that debt is repaid in the borrower country's currency, this implies that in this model, debt is denominated in non-tradable goods of the borrower country.

Our model starts theoretically parallel to Fornaro (2019), and we make necessary modifications along the way to reach our result.

3.1 Original model setup

In his model, he assumes that the home country is populated by a continuum of identical households which consume and work in period 1 only, and their utility is

$$C_T + \frac{C_N^{1-\eta}}{1-\eta} - L$$

and have two investment options which transfer C_T from period 0 to 1

$$\text{Domestic Technology : 1 unit } C_T \rightarrow \text{A units of } C_T$$

$$\text{International Real Bonds : 1 unit } C_T \rightarrow R \text{ units of } C_T$$

the main variables of the model are

C_T = Consumption of Tradable

C_N = Consumption of Non-Tradable

P_T = Price of Tradable

P_N = Price of Non-Tradable

L = Labour Effort

W = Nominal wage

N = Tradable goods endowment in Period 0

I = Investment in Domestic Technology in period 0

D = Debt denominated in tradable goods to be settled in period 1

$\bar{D}$ = Borrowing Limit

$\mathcal{R}$ = Loan Repayment in Period 1

The period 0 budget constraint of home households is thus given by

$$I = N + \frac{D}{R}$$

and households' optimal investment strategy is then

$$I = \begin{cases} N + \frac{\bar{D}}{R} & \text{if } A > R \\ \left[0, N + \frac{\bar{D}}{R}\right] & \text{if } A = R \\ 0 & \text{if } A < R \end{cases}$$

In period 1 households receive the return from period 0 investment, work and consume. Their period 1 budget constraint in terms of the nominal home currency is

$$\underbrace{P_T C_T + P_N C_N}_{Household\quad Expenditure} = \underbrace{P_T Y_T - P_T \mathcal{R} + WL}_{Household\quad Income}$$

Note that Y_T denotes the output of tradable goods produced by the home country in period 1, given by

$$Y_T = AI$$

In period 1, households have two decisions to make. First, each household chooses whether to honor its debt or default. In case of default, creditors appropriate a fraction κ of the household's income, so that the household is left with the complement fraction $1-\kappa$. Clearly, households default if the value of the debt owed to foreign investors exceeds the value of the collateral that is repossessed upon default. This implies that

$$\mathcal{R} = \min\left[D, \kappa\left(Y_T + \frac{W}{P_T}L\right)\right] \tag{1}$$

Second, households allocate expenditure between the two consumption goods. This leads to the demand function for non-tradable goods

$$C_N = \left(\frac{P_N}{P_T}\right)^{-\frac{1}{\eta}} \tag{2}$$

Demand for non-tradables is thus decreasing in their relative price P_N/P_T

Non-traded output Y_N is produced by a large number of competitive firms. Labor is the only factor of production, and the production function is $Y_N = L$. Profits are given by $P_N Y_N - WL$. The zero profit condition implies that in equilibrium $P_N = W$. The real exchange rate of the home economy, denoted by p, can thus be written as

$$p = \frac{P_N}{P_T} = \frac{W}{P_T}$$

Notice that, since the nominal wage is rigid, changes in the nominal price of the tradable good affect the real exchange rate. In fact, this is the channel through which monetary policy affects the real economy. Market clearing for the non-tradable consumption good requires that domestic consumption is equal to domestic production. Combining this condition with equation (2) gives

$$Y_N = C_N = p^{-\frac{1}{\eta}}$$

Hence the real exchange rate, through its impact on demand, effectively determines production of non-tradable goods. In equilibrium, tradable consumption must be equal to tradable output less the payment made to foreign creditors

$$C_T = Y_T - \min\left[D, \kappa\left(Y_T + pY_N\right)\right]$$

Substituting for Y_N we get the expression for payment under default in terms of tradable goods as

$$\kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)$$

Under given conditions, Fornaro (2019) demonstrates that the optimal level of debt ceiling is more in case these two countries form a monetary union than in case of flexible exchange rate regime.

$$\bar{D}_{flex} \leq \bar{D}_{mu}$$

3.2 Modification : Debt denominated in terms of borrower's non-tradable goods

3.2.1 Under Flexible Exhange Rate

In the original model, household's chooses whether to honour its debt or default. In case of default, creditors appropriate a fraction κ of the household's income, where non-tradable goods are converted into tradable goods with the real exchange rate p. In case of non-default, the owed debt, D would be repaid in tradable goods (lender country currency). However, we now assume that D is repaid in non-tradable goods (borrower country currency). This ultimately means that D also needs to be converted into tradable goods with the real exchange rate p. Therefore $\mathcal{R}$ in equation (2) can be rewritten as:

$$\mathcal{R} = \min\left[pD, \kappa\left(Y_T + pY_N\right)\right]$$

As in the original model, the home government chooses p, Y_N and C_T to maximize home households' utility

$$C_T + \frac{Y_N^{1-\eta}}{1-\eta} - Y_N$$

subject to our new budget constraints

$$Y_N = p^{-\frac{1}{\eta}}$$

$$C_T = Y_T - \min\left[pD, \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)\right]$$

Substituting the constraints in the objective function, the government problem reduces to choosing p to maximize

$$Y_T - \min\left[pD, \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)\right] + \frac{p^{1-\frac{1}{\eta}}}{1-\eta} - p^{-\frac{1}{\eta}}$$

Default. In this context, when we assume that the borrower country does not honour its debt (defaults), the outcomes of the original model of the paper do not change. We assume that: $pD > \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right)$. We therefore need to maximise the following utility function:

$$Y_T - \kappa\left(Y_T + p^{1-\frac{1}{\eta}}\right) + \frac{p^{1-\frac{1}{\eta}}}{1-\eta} - p^{-\frac{1}{\eta}}$$

The first order condition when maximising with respect to p is:

$$-\left(1-\frac{1}{n}\right)\kappa p^{-\frac{1}{n}}+\frac{(1-\frac{1}{n})p^{-\frac{1}{n}}}{1-n}+\frac{1}{n}p^{-\frac{1}{n}-1}=0 \tag{3}$$

Therefore, even if debt is denominated in non-tradables (borrower's currency), p_d is also equal to:

$$p=(1+\kappa(\eta-1))^{-1}\equiv p_d$$

No default. The main difference arises when the borrowing country does not default. Here we assume $pD\leq\kappa\left(Y_T+p^{1-\frac{1}{\eta}}\right)$. The utility function under this assumption becomes:

$$Y_T-pD+\frac{p^{1-\frac{1}{\eta}}}{1-\eta}-p^{-\frac{1}{\eta}}$$

The first order condition when maximising with respect to p is:

$$\frac{1-p}{np^{\frac{1+\eta}{\eta}}}=D \tag{4}$$

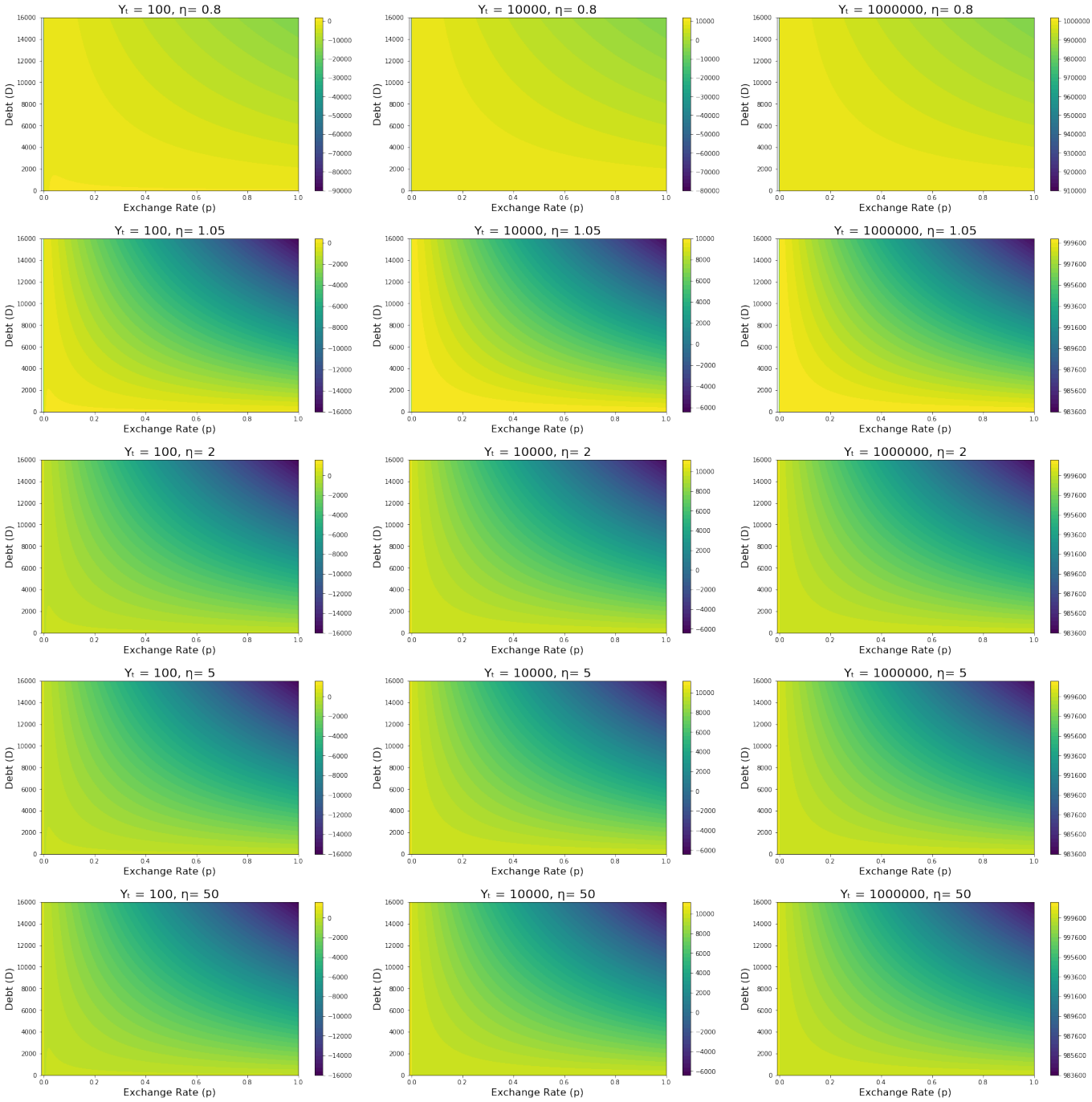
This first order condition has no closed form solution for p. However, we find that for every debt level D, we can find a real exchange rate p that maximizes utility. This relationship however is not defined for $p=0$. We can therefore explore the relationship between D and p at different values of η. Table 1 compares the optimal real exchange rate for different values of η and D.

Table 1: Optimal real exchange rate (p), given certain values of debt (D) and elasticities of substitution (η)

	D	P
$\eta=1$	1	0.6180
	100	0.0951
	1000	0.0311
$\eta=2$	1	0.4320
	100	0.0287
	1000	0.0063
$\eta=10$	1	0.1108
	100	0.0018
	1000	0.0002

Notes: Values are calculated using equation (4)

Figure 2: Utility of Home Country at different combinations of p, D, Y_T, η



When taking an intuitive approach, a possible solution can be estimated. When the borrowing country does not default, the country's government under flexible exchange rates has the possibility to affect the real exchange rate p such that non-tradables become so cheap so that there is no debt to repay anymore once this debt is converted into tradable goods. When the assumption, that this is a two period game, holds, it makes sense that the borrowing country would attempt to do this. It implies that they will push $p \to 0$. In this case, in the limit, the borrower country's utility converges to:

$$\lim_{p_{nd} \to 0} U(C_T) = Y_T$$

We can visualize this phenomenon using contour plot of utility function under no-default condition. Figure 2 demonstrates utility levels for different combinations of D and η. It is also evident from Figure 2 above that p and D are inversely related for a given utility level. This means that with substantially high levels of debt, countries will try to push $p \to 0$ even more. Similarly, the higher the elasticity of substitution between tradables and non-tradables, the more convex the inverse relationship between p and D becomes. Intuitively, when the substitution effect between non-tradables and tradables is very high, countries will have an even greater incentive to devalue their debt. For every effort of devaluation, the country will reap even higher levels of utility.

Level where debt is avoided. Analogously, we would try to find the level of debt for which default is avoided. Defaulting, in our case, gives higher utility compared to repaying pD whenever:

$$Y_T - p_{nd}D + \frac{p_{nd}^{1-\frac{1}{\eta}}}{1-\eta} - p_{nd}^{-\frac{1}{n}} < Y_T - \kappa(Y_T + p_d^{1-\frac{1}{\eta}}) + \frac{p_d^{1-\frac{1}{\eta}}}{1-\eta} - p_d^{-\frac{1}{\eta}}$$

This equation is satisfied when:

$$D > \frac{1}{p_{nd}} \left[(p_{nd}^{1-\frac{1}{\eta}} - p_d^{1-\frac{1}{\eta}}) + (p_d^{-\frac{1}{\eta}} - p_{nd}^{-\frac{1}{\eta}}) + \kappa(Y_T + p_d^{1-\frac{1}{\eta}}) \right]$$

Although we have no closed form solution for an optimal p_{nd}, similarly to before, we can take the limit of D when $p \to 0$ and show that:

$$\lim_{p_{nd} \to 0} \frac{1}{p_{nd}} \left[(p_{nd}^{1-\frac{1}{\eta}} - p_d^{1-\frac{1}{\eta}}) + (p_d^{-\frac{1}{\eta}} - p_{nd}^{-\frac{1}{\eta}}) + \kappa(Y_T + p_d^{1-\frac{1}{\eta}}) \right] = \infty < D \equiv \bar{D}_{flex}$$

Intuitvely, this means that there is no upper bound of debt level that would avoid a default, because the borrowing country would never default. As reasoned above, this is because the government always has the option to increase money supply to the extent that non-tradables are worthless when compared to tradables ($p \to 0$), such that repayable debt, pD tends to zero.

3.2.2 Monetary union

When we move from a flexible exchange rate regime to a monetary union, similar to Fornaro (2019) we find that the central bank in the monetary union maximises the combined objective function:

$$Y_T + Y_T^* + 2\left(\frac{Y_N^{1-\eta}}{1-\eta} - Y_N\right)$$

subject to $Y^N = p^{\frac{1}{\eta}}$. The solution is also $p = Y_N = 1$. The home country therefore does not default if and only if

$$D \leq \kappa\left(Y_T + 1\right) \equiv \bar{D}_{mu}$$

If we compare the upper bound of debt under the monetary union, $\bar{D}_{mu}$, to the upper bound of debt under a flexible exchange rate regime, $\bar{D}_{flex}$, we can clearly see that

$$\bar{D}_{flex} > \bar{D}_{mu}$$

as we assume that there is no upper bound of debt in case of a flexible exchange rate regime. Therefore, we have shown that when debt is denominated in non-tradables (borrower country's currency), forming a monetary union does not lead to higher amounts of foreign debt and lending capacity.

4 Conclusion

The findings of the model, assuming debt is denominated in the borrower country's currency, is threefold. First, we show that at substantially high levels of debt and elasticity of substitution, the borrower country will always choose to honour its debt, but simultaneously devalue their currency. Second, because of this, the borrower country never defaults, which denies the lender country the opportunity to set lending limits, such that default is avoided. Therefore, there are no lending limits with local currency debt. Thirdly, forming a monetary union is not optimal for a borrower country who can borrow money in local currency. A monetary

union will also not lead to higher levels of financial integration and lending capacities.

Linking back to the introduction, we can therefore conclude that countries like the USA or Germany who have the vast majority of their debt denominated in local currency, should not join monetary unions. This is at least what the findings of this altered model suggests. However, a possible critique of this model under the assumption that debt is denominated in the borrower country's currency, is its two period dimension. The model predicts that a country borrowing in its own currency would devalue non-tradables, such that the actual amount the country needs to repay, converges to 0. In a two stage game, this makes sense, as there is no reputation factor. This means that lender countries do not take into consideration a borrower country's historical credit rating. The lender country decides to lend at any level, as it bases this decision on the probability of default. Whilst this makes sense in the case of debt denominated in lender country's currency, this makes less sense when debt is denominated in the borrower country's currency, as the borrower country would never default anyhow. This does not imply, however, that the value of repayment will be close to the value of the initial loan. Therefore, the set-up of this model is not ideally applicable to the real world, although this could be argued for in the case of the USA and the important role the USD plays in global financial markets.

A possible extension to this paper, in order to make it more applicable to countries other than the USA, would be to introduce a multi-period game of lending and borrowing. Here, the decision of whether to default or not, would affect not only the value of current repayment of debt or seizure by creditors, but also the probability of access to debt in future. In this way, the government maximises household consumption over an infinite time horizon, such that the borrower country would be more reluctant to devalue their currency as their credit reputation would be severely impaired. Under multiple periods, the set-up of the model would allow for a more realistic comparison to real life lending and borrowing decisions between countries.

References

Marlene Amstad, Frank Packer, and Jimmy Shek. Does sovereign risk in local and foreign currency differ? Bis working papers, Bank for International Settlements, March 2018. URL https://ideas.repec.org/p/bis/biswps/709.html.

Patrick Artus. Local Currency or Foreign Currency Debt? *Revue économique*, 54(5):1013–1031, 2003.

Luca Fornaro. Monetary union and financial integration. Economics working papers, Department of Economics and Business, Universitat Pompeu Fabra, November 2019. URL https://ideas.repec.org/p/upf/upfgen/1677.html.

Matteo Maggiori, Brent Neiman, and Jesse Schreger. International Currencies and Capital Allocation. Nber working papers, National Bureau of Economic Research, Inc, May 2018. URL https://ideas.repec.org/p/nbr/nberwo/24673.html.