Welfare Gains of Joining a Union for Latin America

Fabrizio Ardiles Decker
The University of Nottingham

September 1, 2022

Abstract

I present a set of scenarios that analyze the intention of a union for the case of Latin America countries by developing a calibrated DSGE model with heterogeneous union. The model accounts for both a monetary and a fiscal union that controls for real and financial frictions with the implementation of different monetary and macroprudential policy regimes. Preliminary results suggests that in general countries are better off (until some extent) with a monetary and a fiscal union that controls for macroprudential policies, but it seems that these gains comes exclusively from the weighted gains of peripheral countries rather than for core countries as well, i.e. in almost all scenarios core countries are better off without any type of union. The scenario with no monetary but just fiscal union is the only one that reports welfare losses (-0.0028), while the scenario with a monetary union and heterogeneous macroprudential policies, just for peripheral countries, accounts for the greatest welfare gains in the analysis (+0.0258).

Keywords: Currency Union, Macroprudential Policies, Welfare, Latin America

1 Introduction

The idea for Latin America to adopt not only a single currency but also provide a certain degree of regional coordination regarding fiscal and/or macroprudential policies continues to be a topic of debate, even after the continuous tries over the years. For example: i) The idea of having one single country with the creation of La Gran Colombia in 1888, ii) The implementation of numerous trade agreements such as MERCOSUR, ALADI and ALCA, iii) the implementation of custom unions such as the case of the CAN for south american countries, iv) The idea of having a single currency for all trade movements just among Latin American countries, among others.

The study focus on two types of union. First the idea of a monetary union that uses a single currency and thus a common Central Bank for that purpose. Second a fiscal union that controls for different regimes of macroprudential policies with the premise of dampen credit growth. In that vein, I believe it is important to point out the main advantages and disadvantages of both regimes according to the existing literature and based on the experience of other regions that have already adopted one of the mentioned union regimes such as the case of the Eurozone perhaps.

There are two notorious benefits for countries that implement a currency union. First, is the is the abolition of any type of costs associated with currency conversion as well as any possible collateral coming from exchange rate disturbances. Recall that a country might achieve a better integration in a situation with lower transactional costs (see Mundell, 1961). In that same line, Mundell suggested that a region that adopted an optimal currency union might experience lower levels of speculation and thus a certain degree of volatility in the foreign exchange market. Moreover, this situation might induced a greater value of money in the region. Second, is the fact a currency union might enhanced a better control of key variables for monetary policies such as inflation, i.e. the common central bank would be in a better position to conduct optimal rules, as described in Alesina (2002).

On the other hand, as an "important to consider disadvantage", a monetary union usually leads to a loss in the monetary policy independency in the sense that in the union, monetary policies might not be able to attend country specific needs. On the other hand, it might follow a tailor policy according to the countries with the greatest economic size, as it might occur with Brazil for the case of the Latinzone. This situation arrives the need of having a certain degree of homogeneity for country members, in order to achieve the Optimum Currency Area (OCA) criteria, described in Mundell's studies.

The OCA criteria holds three main pillars that are: i) Domestic price stability, ii) Full employment and iii) Balance of payments equilibrium. In that line, in order to have achieve these criteria, it is crucial for country members to have a clear level of economic co-movement, as this situation enhance a better suited monetary policy for the

common monetary authority. Also, it is important for members to enhance capital and labor mobility, specially to achieve full employment and reduce the need of country-tailor monetary policies (see Mundell, 1961). Under the same scope, as described in Kenen (1969), country members with a high level of fiscal integration that allows for regional transfers, might be able to dampen exogenous shocks disturbances.

Following Mundell (1973), and Buiter & Sibert (2008), it is also important to have a settled capital market integration, as it permit country members to smooth consumption behaviour through the channel of idiosyncratic shocks. In the same line, by letting members operate in a sectoral diversification environment, it might help them to have a better control of shocks and also avoid possible exchange rate distortions (see Kenen, 1969). Last but not least, as described in McKinnon (1963), in a currency union a small open economy with flexible trade prices might be better suited, as for this particular situation exchange rates usually are not efficient as a tool to affect trade (specially for the case of terms of trade).

Regarding macroprudential measures, evidence shows the effectiveness of macroprudential policies in the increase of banks and borrower's resilience and as a countercyclical measure for credit growth (see Boniolo, 2020). However, some authors have argue that it might caused some inaction bias when these policies are not implemented in the precise moment with the specific amount and/or are not well communicated by central banks, so it can appear a bias in the transmission mechanism channel (see Viñals, 2013).

In that regard, the purpose of the study consists on evaluate the welfare gains for Latin American countries under two different union regimes (monetary and fiscal union that only operates with macroprudential policies). For that matter, I used a calibrated DSGE model for a heterogeneous union - core and peripheral countries, in the same line as Quint and Rabanal (2014). The premise is to find the optimal union structure that enhance the greatest welfare gains among country members.

The analysis shares some common features with Poutineau and Vermandel (2017) regarding the model's characteristic. Perhaps, the study of Quint and Rabanal (2014) provides the seminal point of departure for this analysis, as it develops a DSGE model that accounts for regional differences among countries that belongs to the Eurozone. The latter study finds that the coordination of monetary and macroprudential policies aims to stabilize the effect of price dispersion and financial shocks. The study also concludes that having a fiscal authority that accounts for regional or union needs will not affect the final outcome.

The methodology implemented in this study consists on three main steps: (i) I used a calibrated two-region DSGE model that accounts for a monetary union with a common central bank that implements monetary policies for the Latinzone and a fiscal union that operates with homogeneous/heterogeneous macroprudential policies to control for credit growth; (ii) Next, I estimate the optimal policy rules for both monetary and macropru-

dential policies; (iii) I present a welfare analysis by combining both regimes (monetary and fiscal union) with a benchmark scenario that considers neither both regimes.

One of the main findings of the study shows that in general macroprudential policies operated through the fiscal union authority are better suited only when a currency union is being implemented. On the other hand, peripheral countries (Bolivia, Colombia, Peru and Paraguay) are the main winners in a scenario with a monetary and fiscal union with heterogeneous macroprudential policies. Welfare improvements for core countries (Brazil, Chile, Argentina and Uruguay) are rather limited just for some particular cases.

The study is organized as follows: Section 2 presents a review literature of both union regimes - currency unions with special emphasis on Latam countries feasibility to implement a Latinzone, and fiscal union with particular interest of macroprudential policies that control for credit growth disturbances. Section 3 describes the model's framework as well as the general equilibrium of it. Section 4 illustrates the data collection and estimation of the model. Section 5 discusses the welfare analysis for a set of scenarios under both union regimes. Section 6 concludes. Appendix 1, illustrates some complementary graphics and Appendix 2, presents a complementary model that aims to estimate if Latam countries are feasible to implement a currency union.

2 Related Literature

The idea of a currency union was early presented by Mundell (1961), Kenen (1969) and McKinnon (1963). They both first introduced the concept of the OCA criteria. Initially, the criteria suggests that by having a high degree of labor market flexibility and factor mobility, monetary policies can be avoid it. Additionally, the OCA criteria indicates some potential features of adopting a currency union. Among the benefits, the authors concludes that a monetary union is associated with an increase on trade due to the reduction of any sort of transactional costs as well as by the absence of any risk related to exchange rate disturbances. Moreover, an OCA might: i) improve the main ingredient variables of production, such as the case of consumption and investment, ii) abolish price distortions and iii) increase credibility, specially coming by peripheral countries with currencies that are highly devaluated. Concerning the costs of a currency union, they highlighted: i) the loss of monetary policies that reacts by the country needs, ii) the absence of self-financing government deficits with money issuance and iii) the loss of national sovereignty by implementing a common currency for all country members (this last feature can be seen in Obstfeld and Rogoff 1996).

A good contribution for the literature is the one of Alesina et al. (2002). They suggested that the cost of losing monetary policy at a country level might be lower if country members that belongs to a currency union have a higher correlation of shocks among each other. In that line Frankel and Rose (1997) concluded that a correct implementation of

a OCA might be associated with symmetric cycles among country members, i.e. a high correlation of business cycles. Finally, Frankel (1999) suggested that a country member in a OCA should not experience more costs than benefits. If that is the case, then the union is not considered an OCA. However, this feature can appear in the case of a country member candidate in the understanding that by adopting a OCA, the country might change its economic performance (more benefits than costs), though a greater trade integration and thus output. In other words, a country member candidate that currently does not meet the criteria to enter a currency union, might possibly meet later on.

Currently, there are 16 currency unions already formed for all over the 5 continents in the world, being the Eurozone, one of the most cited examples as case study. Also there is a continuous debate for whether this union is considered an OCA or not. The Eurozone was implemented in 2002, by 12 european countries. They both agreed to adopt the euro as a single common currency. Later on, countries such as Slovakia, Malta, Cyprus and Slovenia joined the euro as well as the micro-states of Monaco, Montenegro, Andorra, Kosovo, San Marino and Vatican City. It is important to point out that Romania, Hungary and Bulgaria are currently in the process of adopting the Eurozone and also The United Kingdom, Denmark, and Iceland are still on debate for whether adopting the union or not.

Moving to the Arabian Peninsula, there are 6 countries from the Gulf Cooperation Council that already set the idea of a single currency (denominated as "The khaleeji") on the table, but unfortunately, in 2010 the intention was postponed due to the financial crisis. Concerning Africa, currently there are 2 forming currency unions: The West African CFA franc, composed by Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo; and the Central African CFA franc single currency for Cameroon, Central African Republic, Chad, Republic of the Congo, Equatorial Guinea and Gabon. Important to note that there is a more ambitious intention to adopt a single currency for west african countries, denominated as the ECO currency, however it has experienced some failed attempts over the years but it seems that it will finally come to light by the year 2027.

For the case of Latin American countries, the idea of a currency union seems to be far away from becoming a reality. One of the main problems seems to be the lack of integration among potential country members as well as the tradeoff of giving up the country's sovereignty.

Regarding the literature that analyzes the role of macroprudential policies, the most important contributions are the following. Angelini et al. (2011), Bean (2010), and Roger and Vlcek (2011) suggest that macroprudential policies are associated with welfare gains if these measures are correctively implemented in the sense that aims to target long run disturbances on credit growth. In a scenario that considers real business-cycle models with financial frictions, Gruss and Sgherri (2009) conclude that in a small open economy

with occasional borrow constraints, the implementation of value-limits for banking loans might enhance a decrease on credit cycles (or at least reduce its volatility). In the same vein, Bianchi and Mendoza (2011) analyzes the implication of macroprudential policies through the implementation of fixed taxes, as a potential tool to avoid overborrowing. Last, Borio and Shim (2008), highlight the importance of macroprudential policies as a tool for the financial system stability as well as a potential aligner measure for monetary policies optimal.

Concerning the case of the Eurozone, Angelini, Neri, and Panetta (2011) and Beau, Clerc, and Mojon (2012) analyze the impact of macroprudential policies in an estimated DSGE model with financial frictions and no distinguish between euro countries. Moreover, Lambertini, Mendicino, and Punzi (2013) describes the effect of lending risk financial indicators on welfare for the case of a closed economy model with financial frictions. In that vein, Medina (2014) and Unsal (2013), presents an analysis of the financial accelerator as a key tool for financial frictions. Among the main conclusions, the authors concludes that macroprudential policies are state dependent. Thus, if a productivity shock is causing credit disturbances, then the macroprudential measure has to react to the entire effect of the shock ans not just to the credit variable. If so, the country might experience a welfare decrease.

In general, the literature illustrates that most macroprudential policies are a efficient tool when it comes to reduce the volatility of the financial sector (mainly, through the financial accelerator). For example, Collard et al. (2013), analyzes the transmission mechanism of how macroprudential policies can affect risk behavior in a DSGE model that considers risky technology, so in the process of producing capital goods, firms can implicitly choose between risky technology or no-risk. The key assumption of the model, is that monetary policy can only affect the quantity of the credit but not the composition of it. Thus, through the implementation of macroprudential policies, capital requirement might be at such high-level, that firms are induced to choose only the riskiness production option. Last, Claessens, Kose, and Terrones (2009), Crowe et al. (2011), and International Monetary Fund - IMF (2012) describes how business cycles' duration period is amplified when there is a mix combination between credit and housing boom prices.

As a preliminary conclusion, there is an increasing consensus that countercyclical macroprudential policies are associated with less credit-cycle volatility and thus, it is a efficient tool to avoid extended recessions. For the case of Latam countries, evidence shows that these countries were not an exemption case over the financial crisis of 2007. Figure 1 illustrates credit growth in Latin America before and after the financial crisis[1]. It can be seen the notorious credit growth volatility before 2007, suggesting that by setting the proper macroprudential policy could dampen the cycle[2] and thus could lessen the

[1]Data in Figure 1 is seasonally adjusted.

[2]For this statement, I am assuming the definition of credit cycles from Crowe et al. (2011).

impact of the financial crisis over the region.

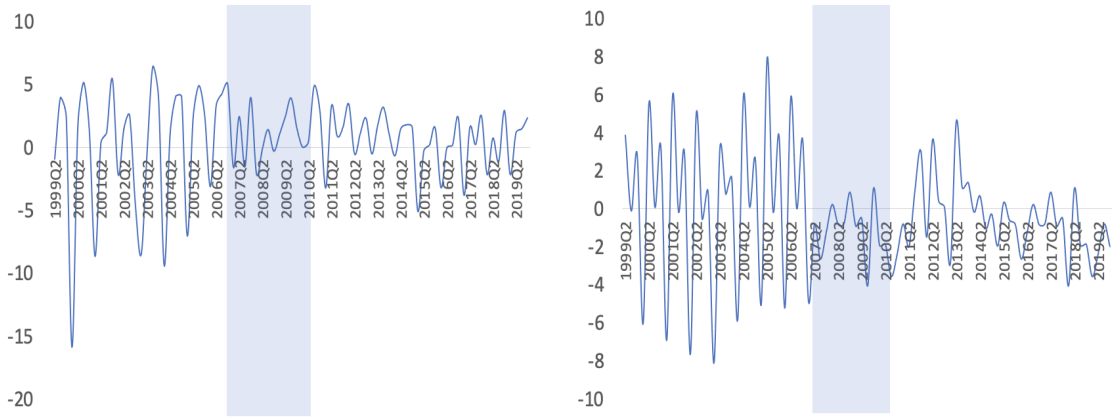

Figure 1: Credit Cycles in Latam. Core (left) - Peripheral (right)

2.1 The Feasibility of a Currency Union for Latin America

For the purpose of this study, I am assuming that it is feasible for Latam countries to implement a currency union. However, it is important to highlight that this situation might not be the case. Even tough there is a lack of literature that covers this topic, the few existing studies (rather than a conclusion), opens a case of debate for future studies to come. Next, I present the most important ones, that supports and not support the idea of the Latinzone.

Bringing the OCA criteria back, Dorrucci (2004) estimated that Latam countries are less integrated than country members of the European Union (EU) after and even before the implementation of the euro as single currency. Additionally, Aminian et al. (2009) goes further and concludes that also East Asian country members are more integrated than Latam country members. Hence, it is important to understand what are the main reasons behind Latam country member's low level of integration. Reyes et al. (2010) concludes that the lower degree of integration of Latam countries comes by the lack of economic development of the whole region. Additionally, Marquez et al. (2017) concludes that integration in Latam countries are heavily influenced by political and institutional factors. The mentioned researchers also explained that the integration process in Latin America were also affected by the terrorist attack on September 11th, 2001 as well as with the political affinity of the region during the implementation of the Revolucion Bolivariana. Finally, even with the mentioned low level of integration for Latam country members, Basnet & Sharma (2013) established that economic fluctuations for the main Latam countries (Chile, Brazil, Mexico, Argentina, Colombia, Peru and Venezuela), followed a similar pattern when it comes to: intensity, response and duration - both in the short and long run, suggesting that these similar behaviour could potentially benefit from the implementation of a union regime - rather fiscal or monetary.

Moreover, most research has focused mainly on a particular set of countries with common trade agreements, such as the Andean Community or MERCOSUR. The study of Bayoumi and Eichengreen (1993), finds that for the case of South American countries, there exists a low degree of correlation in supply shocks, while the correlation in demand shocks were lower than the ones for the case of Europe (seven times) as well as for Asia (three times). On the other hand, Eichengreen (1998) estimated that joining a currency union for Latin American country members of MERCOSUR (Argentina, Brazil, Paraguay and Uruguay), could decrease the exchange rates volatility of these countries. Additionally, the authors also concludes that a "feasible" monetary union requires first of all, the implementation of national regulations, similar as the ones considered for the Eurozone. In the same scope, Licandro (2000) analyzes if MERCOSUR country members have a similar degree of shocks comparing with the North American Free Trade Agreement (NAFTA) as well as the European Union. Licandro's results shows that MERCOSUR country members have a lower correlation of the supply shocks compared to NAFTA and the Eurozone. Last but not least, Larrain and Tavares (2003) presents some criteria for the implementation of a currency union for the case of Central and South American countries, under two different union regimes: A single currency and a dollarization currency. The study concludes that dollarization might be feasible for Central American countries. However, that is not the case for South American countries (neither the single currency option).

Hochreiter and Siklos (2002) considers the european Maastricht Treaty criteria for the case of Latin American countries in order to establishes the level of optimal convergence. The main findings suggest that for the case of Brazil (as country leader), as well as for most of Latam countries, there was a low level of convergence. Only Paraguay and Chile were the ones that obtained a positive level of convergence. The study also concludes that the implementation of a monetary union could be costly due to the low level of business cycle's synchronization. Hochreiter et al. (2002), presents an scenario for Latin American countries that considers different monetary union regimes. The authors concludes that there exists a high degree of heterogeneity for the Latin American zone, i.e. countries differ in economic policies, structure and size. Regarding trade, they conclude that there is a notorious increase in the amount of trade for most of Latin American countries, due mainly by trade regional agreements like the MERCOSUR. However, trade integration is still deficient. In the same regard, Numa (2011) establishes that both trade agreements CAN and MERCOSUR require a higher level of political and economic integration, in order to implement an OCA for Latam countries.

In the same vein, Kopits (2002) presents an scenario that compares some selected Central European countries that are not currently part of the Eurozone, with South American countries by using the Maastricht Treaty criteria. The study concludes that Europeans country candidates are better candidates for a currency union than Latin

American countries, due mainly to the degree of homogeneity among countries. Moreover, Edwards (2006) describes the economic performance of Latin American countries in a currency union. The authors concludes that country members do not experience a significant change in the current account as well as on capital flows. Hence, these countries are not perfect candidates for the implementation of a currency union.

Last but not least, Bresser-Pereira and Holland (2009) shows that a currency union for Latin America could enhance a positive integration process, mainly by the reduction of nominal exchange rate volatility, particularly for countries that are part of the MERCOSUR trade agreement. Important to emphasize that Basnet and Pradhan (2017) finds very similar results. The latter study concludes that countries that are part of MERCOSUR, share similar trends in their macroeconomic performance. Also, Hafner and Kampe (2018) finds evidence that Latin American countries have a prominent heterogeneity, mainly of economic structure, growth and income, and thus these countries are far away from being a suitable OCA. However, a very remarkable finding of the study is that countries that are part of the CAN exhibits better homogeneity for factor mobility and openness, compared to countries that belongs to the MERCOSUR.

After presenting the most relevant literature that studies the idea of having a currency union for Latam countries, it opens a caveat question of whether Latin American is prepare for the implementation of a monetary union. This concern is contemplated in Appendix 2.

3 The Model

The idea of having a currency union for Latam countries is presented as a two-region DSGE model $i \in \{c, p\}$, where c represents core Latin American countries (rich countries) and p peripheral countries (not as rich countries). These two regions have their own size n_c and n_p and thus both sectors sum to 1. The agents of the model are represented by: i) households that consume final goods and supply labor, ii) entrepreneurs that brings physical capital to produce goods, iii) intermediate and final firms that interact with each other to produce final goods as Bernanke (1999), iv) capital suppliers and last but not least v) a banking sector, which is a key component of the model as represents the channel for macroprudential policies, in the sense that entrepreneurs might requests loans from banks and thus incurred into default. Having discussed all the components of the model, in the next section I present the behaviour of each agent of the model.

3.1 Households

A representative household maximizes his intertemporal utility subject to a budget constraint. The utility function is given by:

$$U(C_{i,t}, H_{i,t}) = \frac{1}{1-\sigma_i^C}(C_{i,t} - h_i^C C_{i,t-1})^{1-\sigma_i^C} - \frac{\chi_i}{(1+\sigma_i^H)} H_{i,t}^{1+\sigma_i^H} \tag{1}$$

where $\sigma_i^H \geq 0$ is the curvature coefficient of labor, $\sigma_i^C \geq 0$ is the risk aversion coefficient and $h_i^C \in [0,1)$ are the corresponding external consumption habits. The budget constraint takes the form:

$$W_{i,t}H_{i,t} + (1 + R_{i,t-1}^D)D_{i,t}^d + \Pi_{i,t} = P_{i,t}^C C_{i,t} + D_{i,t+1}^d + T_{i,t} + P_{i,t}AC_{i,t}^D \tag{2}$$

where household income is composed by: i) labor income, where $W_{i,t}$ is the nominal wage, ii) interest payments for deposits where $D_{i,t}^d$ stands for deposits during period $t-1$ and $1 + R_{i,t-1}^D$ is the gross rate of interest between period t and $t-1$, and iii) earnings $\Pi_{i,t}$ from shareholdings of intermediate firms. Households spends this income on consumption, deposits and tax payments (for a nominal amount of $T_{i,t}$). Note also that the representative household has to pay an adjustment costs $AC_{i,t}^D(j)$ in order to keep having new deposit services and hold a constant quantity of money $\overline{M}_i$. Finally, in order to analyze the welfare gains of joining a currency union, I present the following expression of the welfare index:

$$W_{i,t} = \sum_{\tau=0}^{\infty} \beta^\tau exp(\varepsilon_{i,t+\tau}^U U(C_{i,t+\tau}, H_{i,t+\tau}) \tag{3}$$

where $C_{i,t}$ stands for consumption, $H_{i,t}$ represents labor effort, $\beta \in (0,1)$ is the discount factor and $\varepsilon i, t^U$ represents an exogenous time preference shock.

3.2 Firms

Assume there is a continuum of monopolistically firms, each producing differentiated goods by using $H_{i,t}$ hours of work, $K_{i,t}$ capital inputs and $P_{i,t}$ prices according to the Calvo approach. Output supplied by firms is given by:

$$Y_{i,t} = exp(\varepsilon_{i,t}^A) K_{i,t}^\alpha H_{i,t}^{1-\alpha} \tag{4}$$

where $\varepsilon_{i,t}^A$ represents productivity innovation and $\alpha \in [0,1]$ is the share of capital services. Following the Calvo approach, firms cannot re-optimize the selling price, in every period, with probability θ_i^P. Additionally, price can increase following the form $\xi_i^P \in [0,1]$ at the inflation rate of the last period, such as:

$$P_{i,t} = \pi_{i,t-1}^{\xi_i^P} P_{i,t-1} \tag{5}$$

where $\pi_{i,t} = P_{i,t}/P_{i,t-1}$. Under this scenario it is possible to derive the aggregate inflation rate, that is defined by the expression:

$$\pi_{i,t} = f(\mathbb{E}_t \pi_{i,t+1}, \pi_{i,t-1}, MC_{i,t}) \tag{6}$$

where $MC_{i,t}$ is defined as the marginal cost of production.

3.3 Entrepreneurs

There is a representative entrepreneur i that basically finances capital renting of intermediate firms. Hence, every entrepreneur and intermediate firm belong to the same business i. Thus, in period t, entrepreneur operates different projects with total value such as:

$$Q_{i,t} K_{i,t+1}(i) \tag{7}$$

where $Q_{i,t}$ is the price of capital and $K_{i,t+1}(i)$ is the amount of capital financed. These projects are financed by the entrepreneurs' net wealth and by loans from banks ($L_{i,t+1}^d(i)$). Hence, the entrepreneurs balance sheet reads as:

$$Q_{i,t} K_{i,t+1}(i) - N_{i,t+1}(i) = L_{i,t+1}^H(i) \tag{8}$$

where $L_{i,t+1}^H(i) = L_{i,t+1}^d(i) - h_i^L(L_{i,t}^d - L_i^d)$ denotes the external demand habits for loans. Note that here the entrepreneurs investment projects are risky and thus might incurred into default on its loans. To model the mentioned risk, assume that the aggregate return of every investment project is $1+R_{i,t}^k$. Hence the return of each project reads as $w(1+R_{i,t}^k)$, where w is a random value that follows a Pareto distribution. Consider now that the value for a profitable project is given by:

$$\overline{w}_{i,t} = \mathbb{E}(w | w \geq w_{i,t}^C) \tag{9}$$

where $w_{i,t}^C$ is the critical value of w that differentiates profitable over non-profitable projects. Hence, each entrepreneur have the following aggregate profit function with probability $\eta_{i,t+1}^E$[3]:

[3]With probability $1 - \eta_{i,t+1}^E$ the value for the profit function is zero.

$$\Pi^{E}_{i,t}(i) = \overline{w}_{i,t+1}(1 + R^{k}_{i,t+1})Q_{i,t}K_{i,t+1}(i) - (1 + R^{L}_{i,t})L^{H}_{i,t+1}(i) \tag{10}$$

where $\eta^{E}_{i,t+1}$ is the expected share of profitable projects. In order to introduce the financial accelerator into the model, assume that entrepreneurs are opmistic regarding their aggregate profitability, similar as De Grauwe (2010). Hence, the *ex ante* function of profitable projects is given by:

$$g(\overline{w}_{i,t+1}, \varepsilon^{Q}_{i,t} = \gamma_i(\overline{w}_{i,t+1})^{\frac{\chi_i}{\chi_i - 1}}(e^{\varepsilon^{Q}_{i,t}})^{\frac{1}{\chi_i - 1}} \tag{11}$$

where $\varepsilon^{Q}_{i,t}$ is an exogenous shock that follows an AR(1) process, χ_i is external finance's the elasticity, γ_i is a parameter. In that regard, entrepreneurs maximizes its expected profit according to a certain amount of capital $K_{i,t+1}(i)$, such that:

$$\max_{K_{i,t+1}(i)} \mathbb{E}_t\Big\{\eta^{E}_{i,t+1}\Big[g(\overline{w}_{i,t+1}, \varepsilon^{Q}_{i,t})(1 + R^{k}_{i,t+1})Q_{i,t}K_{i,t+1}(i) - (1 + R^{L}_{i,t})L^{H}_{i,t+1}(i)\Big]\Big\} \tag{12}$$

Thus, the expected spread required by entrepreneurs in order to undertake a decision to finance a firm investment is given by:

$$S_{i,t}(i) = \frac{\mathbb{E}_t\Big(1 + R^{k}_{i,t+1}\Big)}{1 + R^{L}_{i,t}} = \gamma_i^{\chi_i - 1}\left[\frac{\kappa}{\kappa - 1}\left(1 - \frac{N_{i,t+1}(i)}{Q_{i,t}K_{i,t+1}(i)}\right)\right]^{\chi_i} e^{\varepsilon^{Q}_{i,t}} \tag{13}$$

Thus, the size of the accelerator is determined by χ_i, so that an increase in net wealth induces a reduction of the external finance premium χ_i. In that scope, a shock that affects the entrepreneurs' net wealth $N_{i,t+1}(i)$, will also affect the return of capital, and it will have consequences on goods supply through the capital market channel. Finally, the entrepreneurs net wealth reads as:

$$N_{i,t+1}(i) = \Big(1 - \tau^{E}_{i}\Big)\frac{\Pi^{E}_{i,t}(i)}{e^{\varepsilon^{N}_{i,t}}} \tag{14}$$

where τ^{E}_{i} is the corresponding tax on profits and $\varepsilon^{N}_{i,t}$ is an exogenous shock i.e. an exogenous process of net wealth destruction.

3.4 Banks

Consider a representative bank that develops its services under a monopolistic competition regime. Banks provide deposits to households and credit services to firms. In that regard, banks collects deposits $D_{i,t}$ from households at a remunerated rate $R^D_{i,t}(b)$, then borrows funds $L^{RF}_{i,t}$ from the central bank at a refinancing rate $R^L_{i,t}(b)$, and supplies loans $L^S_{i,t}$ to entrepreneurs at a rate $R^L_{i,t}(b)$. Thus, considering entrepreneurs biased expectations, banks manage credit risks that considers entrepreneurs expected rate of default $1-\eta^E_{i,t+1}$. In order for banks to size back a loan in case of default, banks pay a proportional audition cost $\mu^B \in (0,1)$ (loss-given-default). Hence, banks have the following expected profit function:

$$\begin{aligned}\mathbb{E}_t\Pi^B_{i,t+1}(b) = &\Big[\mathbb{E}_t\eta^E_{i,t+1} + \Big(1-\mu^B\Big)\Big(1-\eta^E_{i,t+1}\Big)\Big]\Big(1+R^L_{i,t}(b)\Big)L^S_{i,t+1}(b) \\ &-\Big(1+R_t\Big)L^{RF}_{i,t+1}(b) - \Big(1+R^D_{i,t}\Big)D_{i,t+1}(b)\end{aligned} \tag{15}$$

Which has to be optimized according to the constraint:

$$L^S_{i,t+1}(b) = D_{i,t+1}(b) + L^{RF}_{i,t+1}(b) + BK_{i,t+1}(b) \tag{16}$$

Where $BK_{i,t+1}$ represents banks amount of equity. An important part of the model, is the following equation that shows how commercial loans are affected by macroprudential policies:

$$1 + MC^L_{i,t} = \frac{(1+R_t)}{\Big[1-\mu^B\Big(1-\mathbb{E}_t\eta^E_{i,t+1}\Big)\Big]} \tag{17}$$

In order to capture the pass-through of interest rates, banks sets the loan and deposit rates à la Calvo as Darracq-Paries et al. (2011). Thus, the aggregate deposit rate is given by, $R^D_{i,t} = f(\mathbb{E}_t R^D_{i,t+1}, R_t, \varepsilon^D_{i,t})$ where $\varepsilon^D_{i,t}$ represents a markup shock and R_t is the central bank rate. In the same vein, the aggregate loan rate is given by, $R^L_{i,t} = f(\mathbb{E}_t R^L_{i,t+1}, MC^L_{i,t})$. Hence, firms profitability and current and expected future central bank's rate determine todays credit rates.

3.5 Government

Government basically finance public spending by charging a compendium of proportional taxes on: i) banks capital τ^B_i, ii) entrepreneurs net wealth τ^E_i and iii) by collecting taxes $G(T_{i,t}(j))$ from households. Thus, the governments budget constraint is given by:

$$G(T_{i,t}(j)) + \tau^E_i G(N_{i,t}(e)) + \tau^B_i G(BK_{i,t}(b)) = P_{i,t}G_{i,t} = P_{i,t}\overline{G}\varepsilon^G_{i,t} \tag{18}$$

Where $G_{i,t}$ represents the countries public spending that follows an AR(1) shock process. Additionally, assume that public spending is affected exogenously by a productivity shock and that government demand for home good reads as:

$$G_{i,t}(i) = (P_{i,t}(i)/P_{i,t})^{-\varepsilon p} G_{i,t} \tag{19}$$

3.6 Capital Suppliers

Consider a representative capital producer that buys depreciated capital stock $(1-\delta)K_{i,t}$, investment goods $I_{i,t}$ and produces new capital goods $K_{i,t+1}$ at a price $Q_{i,t}$. Capital supplier buys home and foreign investment goods, $I_{i,t} = ((1-\alpha_i^I)^{\frac{1}{\mu}} I_{hi,t}^{\frac{\mu-1}{\mu}} + (\alpha_i^I)^{\frac{1}{\mu}} I_{fi,t}^{\frac{\mu-1}{\mu}})^{\frac{\mu}{\mu-1}}$ where $1-\alpha_i^I > 0.5$ is the home bias in its consumption basket.

3.7 Financial Frictions

Financial frictions appeared in the model, because it is necessary to finance the investment on new capital assets. The return of these investment projects that are particularly financed by entrepreneurs is heterogeneous and thus leads entrepreneurs to have a possibility of default when low return of capital. In that regard, entrepreneurs are at the center of the analysis, concerning the financial friction component of the model.

3.8 Monetary Policy

The union central bank is ruled by the following interest rate rule:

$$\left(\frac{1+R_t}{1+\overline{R}}\right) = \left(\frac{1+R_{t-1}}{1+\overline{R}}\right)^{\rho} \left(\left(\pi_t^C\right)^{\phi^{\pi}} \left(\frac{Y_t}{Y_{t-1}}\right)^{\phi^{\triangle y}}\right)^{1-\rho} e^{\varepsilon_t^R} \tag{20}$$

Where R_t represents the central bank interest rate and $\overline{R}$ its corresponding interest rate steady state, ρ is the interest rate smoothing coefficient, ϕ^{π} and $\phi^{\triangle y}$ are the level of reaction to inflation and the GDP growth target respectively, and ε_t^R is an exogenous AR(1) monetary policy shock for each country union members. Note also that inflation for the union is defined as: $\pi_t^C = (\pi_{c,t}^C)^n (\pi_{p,t}^C)^{1-n}$ and GDP growth as: $Y_t = (Y_{c,t})^n (Y_{p,t})^{1-n}$, where n represents the core country and $1-n$ peripheral Latin American countries. Finally, assume that the central bank is ruled by an optimal monetary policy, and thus Taylor rules parameters are chosen to maximize a second order approximation of the household utility function given the mentioned equilibrium conditions of the model.

3.9 Macroprudential Policy

The interaction of the macroprudential instrument $MP_{i,t}$ in the model appears as a reaction of credit growth $L^S_{i,t}/L^S_{i,t-1}$. Thus, macroprudential policies increases borrowers interest rate through the marginal cost of loan production $MC^L_{i,t}$. In that regard, these measures affects credit market conditions countercyclically to dampen credit cycles. The transmission channel appears in the understanding that the interest rate on loans is determined by the New Keynesian interest rate so that:

$$R^L_{i,t} = f(\mathbb{E}_t R^L_{i,t+1}, MC^L_{i,t}) \tag{21}$$

Where $MC^L_{i,t}$ is affected by the macroprudential instrument $MP_{i,t}$ with the corresponding policy stance ϕ_i such that:

$$1 + MC^L_{i,t} = \frac{(1 + R_t)(MP_{i,t})^{\phi_i}}{[1 - \mu^B(1 - \mathbb{E}_t \eta^E_{i,t+1})]} \tag{22}$$

Thus, the macroprudential instrument $MP_{i,t}$ is presented to directly affect the cost of loan production and its interest rate $R^L_{i,t}$ through a refinancing tax from the central bank. In that regard, macroprudential policy, as the main difference with monetary policy, does not affect the deposit rate and thus households consumption, on the other hand it allows to directly control financial imbalances through a Pigouvian taxation. Note that extra-earnings generated by the taxation are kept by banks as bank capital enhancing the resilience of the financial system. Assuming that macroprudential policies are based according to the growth of loans, thus there are two possible regimes for an independent country and for the union:

$$\begin{cases} MP_{i,t} = L^S_{i,t}/L^S_{i,t-1} & \rightarrow Regional \\ MP_t = (L^S_{c,t}/L^S_{c,t-1})^n (L^S_{p,t}/L^S_{p,t-1})^{1-n} & \rightarrow Union \end{cases} \tag{23}$$

Additionally, I am adding the possibility for the policy stance (intensity of the policy) ϕ_i to be either homogeneously or heterogeneously between the two presented macroprudential regimes, having four different regimes for macroprudential policies. Table 1 summarizes these scenarios: by combining independent ($MP_{i,t}$ with $i \in c, p$) or union-wide (MP_t) and by macroprudential policies with either an uniform ($\phi_c = \phi_p$) or regional ($\phi_c \neq \phi_p$) setting of the macroprudential intensity parameter.

Scenario	Targeting rule	Policy stance	Policy Channel
(1)	$\mathcal{MP}_t = \left(L^s_{c,t}/L^s_{c,t-1}\right)^n \left(L^s_{p,t}/L^s_{p,t-1}\right)^{1-n}$	$\phi_c = \phi_p = \phi$	$1 + MC^L_{i,t} = \frac{(1+R_t)(\mathcal{MP}_t)^{\phi}}{\left[1-\mu^B\left(1-\mathbb{E}_t\eta^E_{i,t+1}\right)\right]}$
(2)	$\mathcal{MP}_t = \left(L^s_{c,t}/L^s_{c,t-1}\right)^n \left(L^s_{p,t}/L^s_{p,t-1}\right)^{1-n}$	$\phi_c \neq \phi_p$	$1 + MC^L_{i,t} = \frac{(1+R_t)(\mathcal{MP}_t)^{\phi_i}}{\left[1-\mu^B\left(1-\mathbb{E}_t\eta^E_{i,t+1}\right)\right]}$
(3)	$\mathcal{MP}_{i,t} = \left(L^s_{i,t}/L^s_{i,t-1}\right)$ for $i \in \{h, f\}$	$\phi_c = \phi_p = \phi$	$1 + MC^L_{i,t} = \frac{(1+R_t)\left(\mathcal{MP}_{i,t}\right)^{\phi}}{\left[1-\mu^B\left(1-\mathbb{E}_t\eta^E_{i,t+1}\right)\right]}$
(4)	$\mathcal{MP}_{i,t} = \left(L^s_{i,t}/L^s_{i,t-1}\right)$ for $i \in \{h, f\}$	$\phi_c \neq \phi_p$	$1 + MC^L_{i,t} = \frac{(1+R_t)\left(\mathcal{MP}_{i,t}\right)^{\phi_i}}{\left[1-\mu^B\left(1-\mathbb{E}_t\eta^E_{i,t+1}\right)\right]}$

Table 1: Macroprudential Policy Regimes

Where Scenario 1 contemplates an uniform reaction of macroprudential policy to global lending in Latin American, while Scenario (4) represents a macroprudential independent policy at a regional level. Scenarios (2) and (3) are intermediate policies. Finally, the value of parameters ϕ_i optimizes households welfare index by employing perturbation methods.

3.10 Welfare gains approach

I calculate the welfare gains of joining a monetary union following the same approach by Lucas (1987). Given a set of allocations $(C^k_t, N^k_t)^{\infty}_{t=0}$ for $k = (I, MU)$, where I is the allocation that follows an independent monetary policy (non monetary union) and MU is the allocation under the monetary union, thus the welfare gain γ reads as:

$$E\left[\sum_{t=0}^{\infty}\beta^t u\big((1+\gamma)C^I_t, N^I_t\big)\right] = E\left[\sum_{t=0}^{\infty}\beta^t u\big(C^{MU}_t, N^{MU}_t\big)\right] \tag{24}$$

Thus, if the resulting parameter is positive, then there are net gains from entering a monetary union. On the other hand if $\gamma < 0$, then a country is better off following an independent monetary policy. In that regard, the aggregate welfare of households in country i is given by:

$$W_{i,t} = \sum_{\tau=0}^{\infty} B^{\tau} U_i(C_{i,t+\tau}, H_{i,t+\tau}), \quad i = (c, p) \tag{25}$$

where the utility function reads as,

$$U_i(C_{i,t}, H_{i,t}) = e^{\varepsilon^U_{i,t}}\left(\frac{(C_{i,t} - h^C_i C_{i,t-1})^{1-\sigma^C_i}}{1-\sigma^C_i} - \chi_i \frac{H^{1+\sigma^H_i}_{i,t}}{1+\sigma^H_i}\right) - \lambda^R(R_t - \overline{R})^2 \tag{26}$$

3.11 Aggregation and general equilibrium

The market conditions for the model to get a general equilibrium consists on: i) Aggregate all agents and varieties in the economy, ii) Impose market clearing conditions for all markets, and iii) Substitute the main demand functions. Regarding the shocks of the model, there are 7 structural shocks and one common Taylor rule shock for both core and peripheral countries. These shocks follow a first order autoregressive process such that $\varepsilon^S_{i,t} = \rho^S_i \varepsilon^S_{i,t-1} + \eta^S_{i,t}$ while the process for exogenous spending shocks is given by: $\varepsilon^G_{i,t} = \rho^G_i \varepsilon^G_{i,t-1} + \eta^G_{i,t} + \rho^{ag}\eta^A_{i,t}$. Additionally, $\rho^U_i, \rho^A_i, \rho^G_i, \rho^I_i, \rho^Q_i, \rho^N_i, \rho^D_i$ and ρ^R_i are considered autoregressive roots of the exogenous variables, $\eta^U_i, \eta^A_i, \eta^G_i, \eta^I_i, \eta^Q_i, \eta^N_i, \eta^D_i$ and η^R_i are mutually independent standard errors that are uncorrelated and normally distributed with zero mean and variances $\sigma^2_{i,U}, \sigma^2_{i,A}, \sigma^2_{i,G}, \sigma^2_{i,I}, \sigma^2_{i,Q}, \sigma^2_{i,N}, \sigma^2_{i,D}, \sigma^2_{i,R}$. The general equilibrium of the model is defined as a sequence of prices $(P_t)^{\infty}_{t=0}$ and quantities $(Q_t)^{\infty}_{t=0}$ such that for a given sequence of quantities among with the corresponding shocks, the sequence of prices guarantees equilibrium of the model on capital, labor, credit loans, intermediate and final goods markets. Regarding the goods market, the aggregate price index of domestic goods reads as:

$$P^{1-\varepsilon p}_{i,t} = \theta^P_i \left[P_{i,t-1} \left(\frac{P_{i,t-1}}{P_{i,t-2}} \right)^{\xi^P_i} \right]^{1-\varepsilon p} + \left(1 - \theta^P_i\right) \left(P^*_{i,t}\right)^{1-\varepsilon p} \tag{27}$$

Additionally, the final goods market equilibrium condition is defined by the following demand function from final goods producers:

$$G(Y_{i,t}(i)) = Y^d_{i,t} G(P_{i,t}(i)/P_{i,t})^{-\varepsilon p} \tag{28}$$

Where $G(Y_{i,t}(i)) = exp(\varepsilon^A_{i,t}) G(K_{i,t}(i)^{\alpha} H^d_{i,t}(i)^{1-\alpha})$ is the aggregation of intermediate goods suppliers with the corresponding resources constraint $Y^d_{i,t}$. Hence, by replacing the demand function of domestic and foreign goods, we have the following final goods equilibrium such that:

$$\begin{aligned} \frac{Y_{c,t}}{\triangle Y^P_{c,t}} = & \left(1 - \alpha^C_c\right) \left(\frac{P_{c,t}}{P^C_{c,t}} \right)^{-\mu} C_{c,t} + \left(1 - \alpha^I_c\right) \left(\frac{P_{c,t}}{P^I_{c,t}} \right)^{-\mu} \left(1 + AC^I_{c,t}\right) I_{c,t} \\ & + \frac{n-1}{n} \left(\alpha^C_p \left(\frac{P_{c,t}}{P^C_{p,t}} \right)^{-\mu} C_{p,t} + \alpha^I_p \left(\frac{P_{c,t}}{P^I_{p,t}} \right)^{-\mu} \left(1 + AC^I_{p,t}\right) I_{p,t} \right) \\ & + G_{c,t} + AC^D_{c,t} \end{aligned} \tag{29}$$

Where $\triangle Y^P_{i,t} = G(P_{i,t}(i)/P_{i,t})^{-\varepsilon_p}$ denotes price dispersion induced by price stickiness. Additionally, adjustment costs on deposits are given by:

$$AC_{i,t}^{D} = G(AC_{i,t}^{D}(i)^{\frac{\varepsilon p-1}{\varepsilon p}})^{\frac{\varepsilon p}{\varepsilon p-1}} \tag{30}$$

Regarding the loans markets equilibrium, it is defined by the following demand function from retail banks:

$$G(L_{i,t+1}^{S}(b)) = \triangle_{i,t}^{L} L_{i,t+1}^{d} \tag{31}$$

Where $L_{i,t+1}^{d}$ is the aggregate demand and the aggregate loan rate index behaves as:

$$(R_{i,t}^{L})^{1-\varepsilon_L} = \theta_i^{L}(R_{i,t-1}^{L})^{1-\varepsilon_L} + (1-\theta_i^{L})(R_{i,t}^{L})^{1-\varepsilon_L} \tag{32}$$

While the aggregate deposit rate index evolves according to:

$$(R_{i,t}^{D})^{\frac{1}{1-\mu_{i,t}^{D}}} = \theta_i^{D}(R_{i,t-1}^{D})^{\frac{1}{1-\mu_{i,t}^{D}}} + (1-\theta_i^{D})(R_{i,t}^{D})^{\frac{1}{1-\mu_{i,t}^{D}}} \tag{33}$$

Hence, the equilibrium on the deposit market is defined by the aggregate demand and supply of households deposit services.

4 Data

For the purpose of the study, I divided Latin American countries in two, core (home country) and peripheral countries (foreign country). Following Quint and Rabanal (2014), the selection of these groups were made based on the economic size of the countries[4] (see Table 2). Thus, I considered Chile, Brazil, Argentina and Uruguay as core countries and Peru, Colombia, Bolivia and Paraguay as peripheral countries.

Countries	GDP p/cap.	Selection
Chile	11,435	Core
Brazil	8,029	Core
Argentina	12,305	Core
Uruguay	12,684	Core
Peru	4,918	Peripheral
Colombia	5,123	Peripheral
Bolivia	2,553	Peripheral
Paraguay	4,643	Peripheral

Table 2: Latin American country selection ($us)

Regarding the database, I use quarterly data from 1999:Q1 to 2019:Q4, which makes

[4]GDP growth percapita is expressed as an average over the period 1999:Q1 - 2019:Q4.

a total of 83 observations for each variable. The dataset presents the following fifteen times-series variables: real GDP, real consumption, real investment, the Central Bank monetary-policy rate, the Harmonised Index of Consumer Prices (HICP), the deposit rate of households and firms, the amount of loan and lending rate. Data is divided by the population and detrended by taking log-differences. Figure 2, plots the transformed data for Latin American countries compared with the Euro data used in Poutineau and Vermandel (2017).

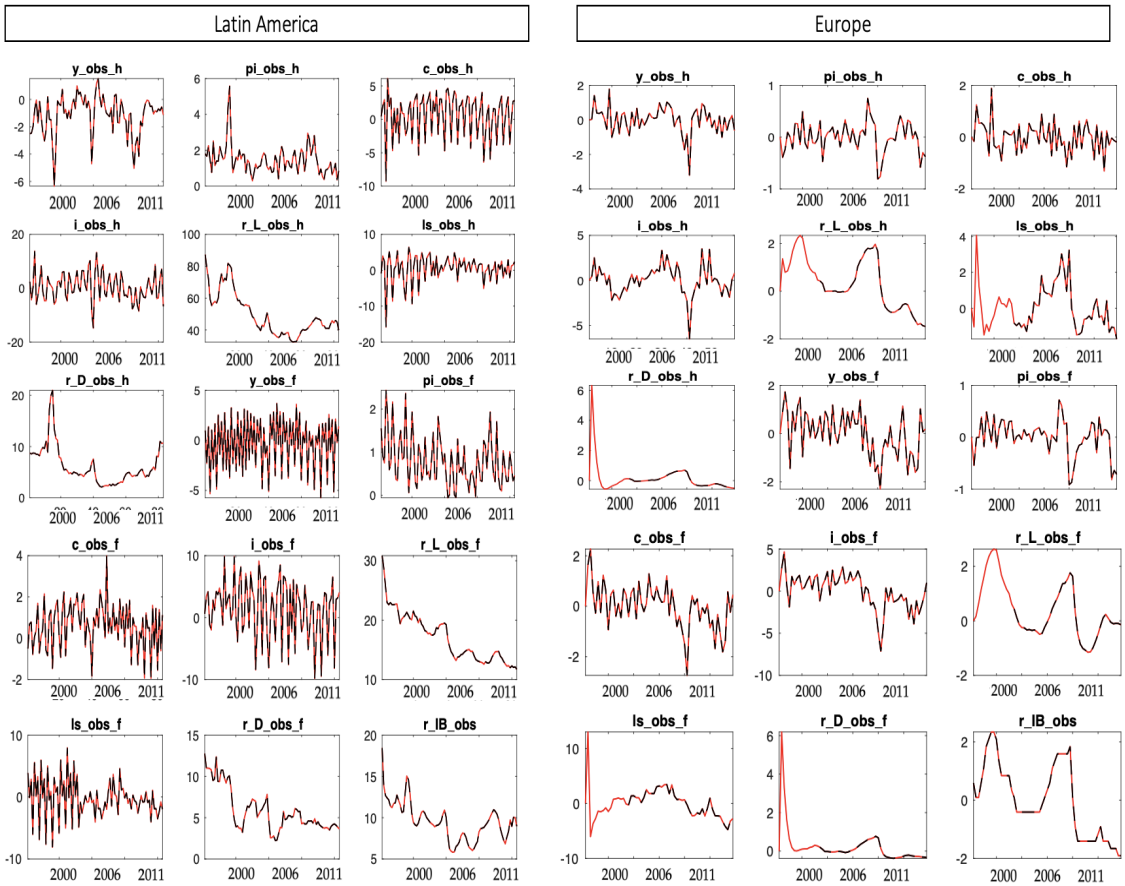

Figure 2: Data Collection

The previous figure shows evidence that generally, Latin American countries are more volatile than Euro countries, specially for the case of peripheral Latam countries. Table 3, presents a more detail analysis of these country comparison. Macroeconomic variables such as the loan supply, as well as the interest rates for deposits and loans shows that notorious difference. On average the ratio difference between Latam and Euro countries is 7.3.

Variable	Indicator	Core	Peripheral
Real GDP	Avg. Latam	18.3	8.9
	Avg. Euro	70.3	54.0
	Diff. (ratio)	3.8	6.1
Consumption	Avg. Latam	8.1	4.9
	Avg. Euro	38.1	31.7
	Diff. (ratio)	4.7	6.4
Investment	Avg. Latam	2.2	1.4
	Avg. Euro	13.5	11.7
	Diff. (ratio)	6.2	8.5
Inflation	Avg. Latam	1.5	0.8
	Avg. Euro	0.4	0.6
	Diff. (ratio)	3.4	1.3
Int. Rate Loans	Avg. Latam	50.0	17.3
	Avg. Euro	4.0	4.9
	Diff. (ratio)	12.5	3.5
Int. Rate Deposits	Avg. Latam	6.2	6.0
	Avg. Euro	0.8	0.7
	Diff. (ratio)	7.9	8.8
Int. Rate Central Bank	Avg. Latam	13.7	5.8
	Avg. Euro		2.4
	Diff. (ratio)	5.7	2.4
Loan Supply	Avg. Latam	24.1	8.7
	Avg. Euro	338.9	387.6
	Diff. (ratio)	14.1	44.7

Table 3: Per-capita data comparison among Latam and Euro countries (in $us and %)

Concerning the time-period of the study, following Padilla et. al (2020), it has to avoid larger fluctuations of the main macroeconomic variables, specially for the case of Latam countries (better known for large periods of price instability during the 80s and 90s - see Figure 3). In that regard, the chosen period of time, from 1999:Q1 to 2019:Q4, is considered as a period with a certain pattern of economic stability in the behaviour of prices (see Dorrucci (2004)). Figure 4 plots Latam inflation volatility over time.

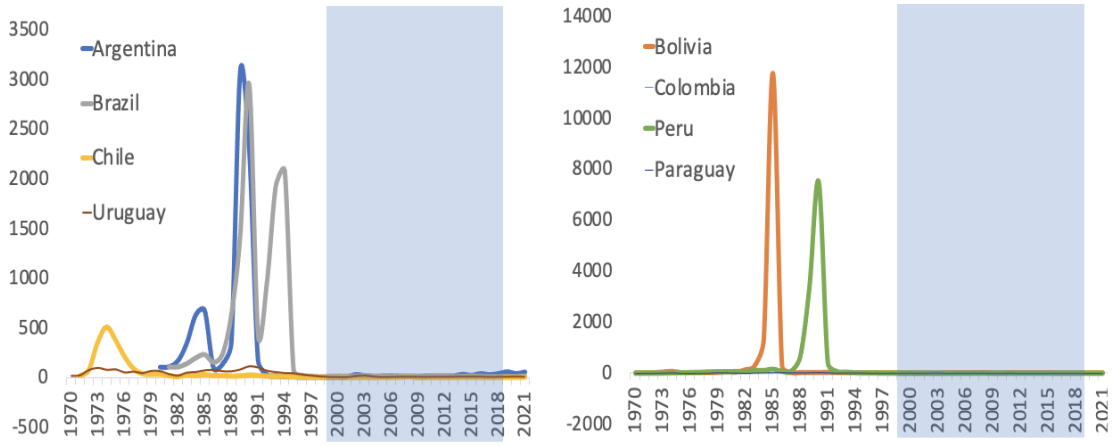

Figure 3: Inflation (%) - Core (left), Peripheral countries (right)

5 Calibration

Following the calibration that uses Quint and Rabanal (2014), Poutineau and Vermandel (2017) and the standard literature of real business cycles and new keynesian models, I fix a small number of parameters commonly used in the literature. These include the discount factor $\beta = 0.99$, $\delta = 0.025$ and the share of worked hours $H = 1/3$. The substitutability between final good varieties $\varepsilon_P = 10$ is determined following Smets and Wouters (2007), as well as the markup of 11%. Concerning financial parameters, I fix the net worth to capital ratio of entrepreneurs at $N/K = 0.3$ as in Gerali et al. (2010). Also, the annual share of defaulting entrepreneurs projects $1 - \eta^E$ is determined at 2.5% and the quarterly cost of monitoring μ_B as 0.12, following the same approach as Bernanke et al. (1999). Table 4 presents an extended list of parameters that were taken by the literature.

Parameter	Value	Definition	Estimation based on:
delta	0.025	Depreciation rate	Smets and Wouters (2007)
chi_D_i	0.070	Portfolio adjustment cost	Schmitt-Grohé & Uribe (2003)
mu	2.500	Substitutability final goods	Smets and Wouters (2007)
alpha_I_i	0.044	Investment goods	Eyquem & Poutineau (2010)
alpha_C_i	0.092	Final goods	Eyquem & Poutineau (2010)
eta_E	0.300	Leverage ratio N/K	Gerali et al. (2010)
eta_B	0.110	Leverage ratio N/K for banks	Gerali et al. (2010)
mu_b	0.120	Recovery cost	Bernanke et al. (1999)
epsilon_P	10	Markup	Smets and Wouters (2007)
eta_s	0.994	Quarterly failure rate	Smets and Wouters (2007)
Q	1.000	Asset price	Smets and Wouters (2007)
A	1.000	Productivity	Smets and Wouters (2007)
P	1.000	Price	Smets and Wouters (2007)
H	0.333	Share of hours worked by day	Smets and Wouters (2007)
sigmaC_i	1.500	Consumption utility	Smets and Wouters (2003)
sigmaL_i	2.000	Labor utility	Smets and Wouters (2003)
theta_P_i	0.750	Price rigidity	Smets and Wouters (2003)
xi_P_i	0.000	Price indexation	Darracq-Pariès et al. (2011)
theta_L_i	0.750	Credit rate rigidity	Smets and Wouters (2003)
theta_D_i	0.750	Deposit rate rigidity	Smets and Wouters (2003)
varkappa_i	0.050	External finance premium elasticity	Gilchrist et al. (2009)
alpha_C_i	0.200	Share of foreign goods in consumption basket	Lubik and Schorfheide (2006)
alpha_I_i	0.100	Share of foreign goods in investment basket	Lubik and Schorfheide (2006)
chi_D_i	0.100	Cost of adjustment of deposits	Bernanke et al. (1999)
chi_I_i	8.000	Cost of adjusting investment	Bernanke et al. (1999)
hc_i	0.700	Habits formation - consumption	Schmitt-Grohé & Uribe (2003)
h_L_i	0.000	Habits formation - loans	Schmitt-Grohé & Uribe (2003)
mu	2.000	Subs. btw. home foreign consumption goods	Bailliu et al. (2015)
phi_r	1.500	Monetary policy inflation reaction	Quint and Rabanal (2014)
phi_y	0.100	Monetary policy GDP growth reaction	Quint and Rabanal (2014)
rho_A_i	0.950	AR(1) home/foreign productivity	Kolasa (2009)
rho_N_i	0.600	AR(1) home/foreign net wealth	Kolasa (2009)

Table 4: Fixed parameters taken from the Literature

Moreover, there are other parameters that were exclusively chosen for Latam countries based on previous studies, and that are different than the parameters used for the euro model. For example, the parameter that represents the economic size for core countries n at 65%, is calculated by the average of GDP over the period 1999 - 2010. Table 5, presents a list of the parameters that are different for both the Latam and Euro models as well as the corresponding studies from were these parameters were taken.

Parameter	Latin America	Europe	Definition	Estimation for LAT based on:
alpha	0.360	0.130	Share of Capital in Ouput	Restuccia (2013)
beta	0.990	0.974	Discount Factor (Mean of the CB Rate)	Jacome (2016)
R_D	0.010	0.026	Bank Deposit Rate	Database
R	0.014	0.028	Central Bank Interest Rate	Jacome (2016)
gy	0.240	0.297	Public Spending in GDP	IDB (2018)
R_L	0.021	0.109	Bank Loan Rate	Database
n	0.650	0.790	Share of Core Countries	Database
phi_r	1.500	3.920	Monetary Policy Inflation Reaction	Database & Dermott(2008)
phi_y	0.100	0.770	Monetary Policy GDP Growth Reaction	Database & Dermott(2008)

Table 5: Parameters that changed in the model compared with Euro model

Also, to check the veracity of the chosen parameter values, I estimate some of these parameters with observational data. I found that the results with observational data are very close from the values taken by other studies. For example, by following the Taylor Rule approach for Latam countries, I found a value of 3.92 for the inflation rate gap and a value of 0.77 for the value of the output gap (see Table 6).

Inflation rate gap	
Current inflation rate	0.48%
Target inflation rate	4.40%
Inflation rate gap	3.92%

Output gap	
Current GDP	0.58%
Long Run GDP	3.40%
Output gap	0.77%

Real Interest Rate	
Nominal interest rate	12.07%
Real Interest Rate	11.59%

CB interest rate	
CB interest rate	9.73%

Table 6: Latam Taylor's Rule Parameters

Finally, to test the calibrated Latam model (how well the model fits the data), I present in Table 7, the second moments of the observable variables and their counterpart in

the model for the main macroeconomic variables (GDP growth as an indicator of the countries economic size and credit growth as an indicator for macroprudential policies). Results show that the model does reasonably well in explaining the standard deviation of the mentioned variables.

	GDP Growth	Credit Growth
Empirical - core	1.4394	3.6290
Theoretical - core	1.4345	3.6232
Empirical - periphery	2.6976	3.6124
Theoretical - periphery	2.6900	3.6061

Table 7: Empirical and Theoretical Standard Deviations

6 Results

In order to set the results for the Latam calibrated model that considers a currency union, these are compared with a benchmark scenario that follows the Taylor Rule as monetary policy. In that regard, the parameter values of monetary policy inflation reaction $\phi_\pi = 4.4\%$ as well as monetary policy GDP growth reaction $\phi_{\triangle Y} = 3.4\%$ were taken from Padilla (2020). Moreover, to contrast this results, I also calculate those parameter values empirically based on the Programa Fiscal Financiero (PFF) of each Latam country[5]. Hence, if we consider the average values of Latam countries from the empirically exercise, the results gets very close from the values of Padilla (2020), as it can be shown in Table 8.

	GDP growth	Inflation Target
Core		
Brazil	1.4%	3.8%
Chile	4.3%	3.0%
Argentina	3.3%	10.0%
Uruguay	2.5%	5.0%
Peripheral		
Colombia	2.6%	3.0%
Peru	3.9%	2.0%
Paraguay	4.7%	4.0%
Bolivia	4.7%	4.5%

Table 8: Policy Parameters according to the Programa Fiscal Financiero - 2018

[5]The PFF is an agreement between the Government and the Central Bank of each Latam country, with the aim of preserve the macroeconomic stability of the country by setting targets and/or limits for the main macroeconomic variables such as inflation and GDP growth, among others

Regarding the results of the study, these were taken mainly by comparing the benchmark scenario with the four presented scenarios that considers different regimes of monetary and fiscal union. First, I find a greater inflation response in the estimated model compared to the parameter value taken from the Taylor rule. Second, I find no output responses in the estimated model, while a response of 3.4% for the case of the Taylor rule. Both results are coherent with the ones of the euro model as well as with Schmitt-Grohé and Uribe (2007). Regarding the macroprudential policy parameters, I find that both core and peripheral Latam countries should have to be different. Moreover, the optimized parameter value estimated from the model suggest a higher value for peripheral countries in a global fiscal union $\phi_p = 0.28$ compared with the parameter value in a regional fiscal union $\phi_p = 0.24$. More interesting, for both regional and general fiscal union, it seems that core countries do not need any macroprudential measure that controls for credit imbalances (as $\phi_p = 0$). Hence, as a primer conclusion, having a fiscal union that reacts homogeneously among core and peripheral countries could incurred into a biased value towards peripheral countries and thus it might be policy inefficient. Note that the estimated parameters for peripheral Latam countries are almost double than the ones for the euro case, suggesting that macroprudential policies for Latam peripheral countries should be more pronounced given the notorious credit growth volatility (see Table 9).

	Latin America				Europe			
	Monetary Policy		Macroprudential Policy		Monetary Policy		Macroprudential Policy	
	phi_pi	phi_diffy	phi_c	phi_p	phi_pi	phi_diffy	phi_c	phi_p
Benchmark	4.4%	3.4%	-	-	2.37	0.16	-	-
Scenario 1	5.58	0	0.13		3	0	0.07	
Scenario 2	5.58	0	0	0.24	3	0	0	0.13
Scenario 3	5.58	0	0.17		3	0	0.09	
Scenario 4	5.58	0	0	0.28	3	0	0	0.15

Table 9: Policy Scenarios Parameter Values

Next, I present the main findings of the study based on the welfare gains comparison between the benchmark and the four different scenarios. First, in the same line of Poutineau and Vermandel (2017), I find that macroprudential tools are associated with welfare gains for the Latin American case. Thus, depending on the macroprudential tool regime, welfare gains might increase in a range between 0.0020% and 0.0089% with respect to the benchmark model that uses Taylor Rule. Moreover, in every single scenario, Latam countries have higher welfare gains by not forming a currency union, although all situations with a monetary union leads to positive welfare gains (see Table 10).

Additionally, macroprudential policies for core countries does not reflect any welfare

gains giving that the estimated policy parameter value is 0. Also, in all cases, it is a better-option to have a heterogeneous macroprudential policy rather than a homogeneous setting. Moreover, the difference between the two extreme regime scenarios (1 and 4) is increasingly high, suggesting that an scenario with a regional fiscal union rather than a wider union is the one associated with greater welfare gains. Note also, that for most of the cases, peripheral Latam countries are the big-winners. Moreover, core countries just barely gain from the implementation of macroprudential policies under different regimes. Scenario 4 for Latam peripheral countries represent the best welfare increase. More interesting, by having a currency union and a homogeneous macroprudential policy clearly shows that, core Latam countries are worse-off in this situation, as welfare decreases by -0.0016%. Hence, this evidence might induced that for core Latam countries there is no incentive to adopt a fiscal union (even at the regional level).

			Unconditional Consumption Gains (%)							
			Welfare Analysis Latin America					Welfare Analysis Europe		
	Macroprudential Policies		no Union	Welfare Gains - Currency Union for LATAM			Empirical Monetary Rule	Welfare Gains - Currency Union for EURO		
	Schemes	Policy Stance		Union	Core	Periph.		Union	Core	Periph.
Benchmark	-	-	0.0113	0.0099	0.0099	0.0084	0.0223	0.0196	0.0280	0.0092
Scenario 1	Global	$\phi_c = \phi_c = \phi$	0.0085 [-0.0028]	0.0119 [0.0020]	0.0083 [-0.0016]	0.0216 [0.0132]	0.0167 [-0.0056]	0.0235 [0.0040]	0.0274 [-0.0010]	0.0188 [0.0100]
Scenario 2	Global	$\phi_c \neq \phi_p$	0.01236 [0.0011]	0.0153 [0.0054]	0.0107 [0.0008]	0.0277 [0.0193]	0.0244 [0.0021]	0.0302 [0.0110]	0.0216 [-0.0060]	0.0407 [0.0320]
Scenario 3	Regional	$\phi_c = \phi_c = \phi$	0.0120 [0.0007]	0.0150 [0.0051]	0.0105 [0.0006]	0.0272 [0.0188]	0.0237 [0.0014]	0.0296 [0.0100]	0.0197 [-0.0083]	0.0418 [0.0325]
Scenario 4	Regional	$\phi_c \neq \phi_p$	0.0163 [0.0051]	0.0188 [0.0089]	0.0132 [0.0033]	0.0342 [0.0258]	0.0323 [0.0100]	0.0372 [0.0180]	0.0212 [-0.0070]	0.0570 [0.0480]

Table 10: Welfare Results

(values in parenthesis represents welfare increases compared to the benchmark scenario)

7 Conclusion

The study presents a welfare analysis for Latin American countries under different monetary and fiscal union regimes, in the understanding that for the case of the fiscal authority, it only reacts as a policy-control for credit growth disturbances. Results shows that even there is a positive welfare in a currency union for both core and peripheral countries, an scenario without a currency union brings a greater welfare increase of +0.0014%. Regarding, the fiscal component analysis, having a regional fiscal union rather than a global fiscal union incurred in a welfare increase of +0.0069%, in the understanding that countries also adopt a currency union. Moreover, it can also be seen that welfare gains distribution are different between Latam peripheral and core countries. In the best situation, core countries reports a welfare increase of 0.0033%, compared to the benchmark scenario. For the case of peripheral countries, the best situation reports a welfare gain of 0.0089%. Also, core countries might even be worse-off, in a currency and fiscal union with

homogeneous macroprudential policy reaction. In that regard, the most efficient macroprudential policy it is represented in a scenario that reacts at a regional level, rather than at a global.

In all different scenarios it can be shown than a currency union for euro countries report higher welfare gains than the Latinzone. This supports the idea that if Latam countries decide to implement a currency union, the gains coming from it will be potentially less than in the euro case. Also, there would be more adversities considering the high level of heterogeneity among Latam country members. Not surprisingly, the best scenario for the Latinzone goes for peripheral countries under a currency union and rather a fiscal authority that reacts at a regional level. On the other hand, the worst scenario goes for Latam countries than are not part of the currency union but shares a global fiscal union authority. For the case of the Eurozone the worst scenarios goes for core countries in a regional fiscal union.

Even though a complementary analysis is needed that should include several other dimensions, I preliminary contributed to the discussion in two dimensions. First, I used a calibrated version of a DSGE model in a heterogeneous union that evaluates the welfare gains of Latam countries that adopts a monetary union. Second, I evaluate the role of macroprudential measures as a countercyclical policy for credit growth that adds a new component into the analysis - a regional and a union fiscal authority that corrects credit disturbances.

It is worth to mention again, that I used the model of Poutineau and Vermandel (2017), calibrated for Latin America, thus in order to have a better analysis that responds to the high level of volatility and heterogeneity of Latam countries, it will be important to estimate a new model with the use of bayesian econometrics methods on one hand, but also to enhance some structural changes, perhaps. In that vein, considering the characteristics of Latam countries, one of the potential changes could be: i) To add a new component in the model that differentiates consumers that dispose a portion of future consumption in savings, and another type of not forward looking consumers that do not have any savings (i.e. non ricardian households), ii) Also, the model should illustrate the different levels of capital intensities among Latam country members, and iii) the model should contain different levels of banking integration (in the understanding that Latam countries have a different level of cross border lending compared to euro countries). Overall, results presented in this study are considered as a fair preliminary analysis of a currency union for Latam countries with macroprudential policies.

Last, with the intention of having a deeper analysis that analyze if it is feasible to implement a monetary union for Latin America, I present in Appendix 2, a multicountry model calibrated with observable data of Latin America. Results shows that Brazil and Uruguay are the only countries that experience negative gains if joining a monetary union. This can be seen as a problematic dilemma given the fact that Brazil accounts for almost

60% of the Latinzone's total GDP and also one of the greatest weights in the correlation of its ToT shocks with respect of the Latinzone (+0.630), so any decision from getting Brazil on board or without might notoriously affect the other's country member gains. Perhaps, Brazil might be willing to participate, by setting some trade agreements before joining the monetary union, such as the case of Germany with the Eurozone.

Last but not least, the game theory approach presented in Appendix 2, shows a preliminary idea of what to expect if Latam countries decides to put the idea of a currency union in the table. At first stage, Brazil might not be interested on being part of the proposal. The problem is that Brazilian's economic weight is so big with respect of the Latinzone, that by not having the country in the union, it might caused the rest of the countries into losses as well. Thus, no country might be interested on being part of the single-currency union if Brazil is not part of it. Fortunately, if the rest of the countries are willing to incurred into preliminary negotiations, this could mitigate the negative effect for Brazil, without affecting the rest of the countries welfare gains, hence the idea of the currency union might become a reality. It will be interesting to present a deeper analysis for this last point. I am leaving this analysis as an extension for future studies.

8 References

Alesina A, Barro RJ. (2002) *Currency unions.* Quarterly Journal of Economics 117:409-36.

Alesina A, Barro RJ, Tenreyro S. (2002). *Optimal currency areas.* In NBER Macroeconomics Annual, ed. M Gertler, K Rogoff 17:301-345. Cambridge(MA): MIT Press.

Alesina A, Grilli V. (1992). *The European Central Bank: reshaping monetary politics in Europe. In Establishing a Central Bank: Issues in Europe and Lessons from the U.S.* ed. M Canzoneri, V Grilli, P Masson, pp 49-78. Cambridge: Cambridge University Press.

Baele L, Ferrando A, Hordahl P, Krylova E, Monnet C. (2004). *Measuring financial integration in the euro area.* European Central Bank occasional paper series, no. 14, European Central Bank, Frankfurt am Main.

Baldwin RE. (2006). *In or out: does it make a difference? An evidence-based analysis of the trade effects of the euro.* London: Center for Economic Policy Research.

Barro R, Tenreyro S. (2007). *Economic effects of currency unions.* Economic Enquiry 45:1-197.

Bayoumi T, Eichengreen B. (1993). *Shocking aspects of European economic unification. In Adjustment and Growth in the European Monetary Union.* ed. F Torres, F Giavazzi, pp. 193-229. Cambridge: Cambridge University Press.

Bayoumi T, Eichengreen B. (1997). *Ever closer to heaven? An optimum-currency—area index for European countries.* European Economic Review 41:761—770.

Bayoumi T, Masson PR. (1995). *Fiscal flows in the United States and Canada: lessons for monetary union in Europe.* European Economic Review 39:253-274.

Bayoumi T, Prasad E. (1997). *Currency unions, economic fluctuations, and adjustment: some new empirical evidence.* IMF Staff Papers 44:36-58.

Blanchard O, Katz L. (1992). *Regional evolutions.* Brookings Papers on Economic Activity 23:1-75.

Bugamelli M, Schivardi F, Zizza R. (2008). *The euro and firm restructuring. In Europe*

and the Euro. ed. A Alesina, F Giavazzi, in press. Chicago(Il): University of Chicago Press.

Buiter WH, Sibert A. (2008). *New theories of optimal currency areas and their application to Poland's adoption of the euro: the asymmetric-shocks-on-its-head and the lender-of-last- resort theories of optimal currency areas.* $http://www.nbp.pl/konferencje/bise_2008/bin/buiterp.$

Bun MJG, Klaassen FJGM. (2002). *Has the euro increased trade?.* Tinbergen Institute Discussion Papers 108/2, Tinbergen Institute, Amsterdam.

Canzoneri MB, Diba BT. (1991). *Fiscal deficits, financial integration, and a central bank for Europe.* Journal of the Japanese and International Economy 5:381—403.

Carre M. Collard F. (2003). *Monetary union: a welfare-based approach.* European Economic Review 47:521—52.

Chari VV, Kehoe P. (2007). *On the need for fiscal constraints in a monetary union.* Journal of Monetary Economics 54:2399—408.

Chari VV, Kehoe P. (2008). *Time Inconsistency and Free-Riding in a Monetary Union.* Journal of Money, Credit and Banking 40:1329-56.

Ching S, Devereux MB. (2003). *Mundell revisited: a simple approach to the costs and benefits of a single currency area.* Review of International Economics 11:674-91.

Christoffel K, Kuester K, Linzert T. (2009). *The role of labor markets for euro area monetary policy.* European Economic Review in press.

Cooper RW, Kempf H. (2004). *Overturning Mundell: fiscal policy in a monetary union.* Review of Economic Studies 71:371—96.

Corsetti G, Pesenti P. (2001). *Welfare and macroeconomic interdependence.* Quarterly Journal of Economics 116:421-445.

D'Aguanno (2015). *Monetary Policy and Welfare in a Currency Union.* Warwick Economics Research Paper Series

Decressin J, Fatas A. (1995). *Regional labor market dynamics in Europe.* European Economic Review 39:1627-55.

De Grauwe P. (1994). *The Economics of Monetary Integration.* 2nd ed. Oxford: Oxford University Press .

De Sousa J, Lamotte O. (2007). *Does political disintegration lead to trade disintegration? Evidence from transition countries.* Economics of Transition 15:825-43.

Devereux MB, Engel C. (1998). *Fixed vs. floating exchange rates: how price setting affects the optimal choice of exchange-rate regime.* NBER Working Papers 6867, National Bureau of Economic Research, Inc. Cambridge(MA).

Dixit A, Lambertini L. (2001). *Monetary-fiscal policy interactions and commitment versus discretion in a monetary union.* European Economic Review 45:977—87.

Eichengreen B. (1990). *One money for Europe? Lessons from the US currency union.* Economic Policy 5:117-87.

Engel C. (2000). *Local-currency pricing and the choice of exchange-rate regime.* European Economic Review 44: 1449-72.

Faia E. 2007. (2007). *Financial differences and business cycle co-movements in a currency area.* Journal of Money, Credit and Banking 39:151-185.

Fidrmuc J, Fidrmuc J. (2003). *Disintegration and trade.* Review of International Economics 11:811-29.

Flam H, Nordstrom H. (2003). *Trade volume effects of the euro: aggregate and sector estimates.* IES Seminar Paper No. 746, Institute for International Economic Studies, Stockholm.

Flam H, Nordstrom H. (2006). *Euro effects on the intensive and extensive margins of trade.* IIES Seminar Paper No. 750, Institute for International Economic Studies, Stockholm

Fleming JM. (1971). *On exchange rate unification.* The Economic Journal 81:467-88

Frankel JA, Rose A. (1998). *The endogeneity of the optimum currency area criteria.* The Economic Journal 81:467-88

Frankel JA, Rose A. (2002). *An estimate of the effect of currency unions on trade and income.* Quarterly Journal of Economics 117:437-66

Frankel J, Wei S-j. (1993). *Trade blocs and currency blocs.* NBER Working Papers 4335, National Bureau of Economic Research, Inc. Cambridge(MA).

Gali, Monacelli (2008). *Optimal monetary and fiscal policy in a currency union.* Journal of International Economics 76. 116–132.

Giannone D, Reichlin L. (2006). *Trends and cycles in the euro area: how much heterogeneity and should we worry about it?.* European Central Bank Working Paper Series 595, European Central Bank, Frankfurt am Main.

Giavazzi F, Giovannini A. (1989). *Monetary policy interactions under managed exchange rates.* Economica, 56:199-213.

Gil-Pareja S, Llorca-Vivero R, Martinez-Serrano JA. (2008). *Trade effects of monetary agreements: evidence for OECD countries.* European Economic Review 52:733-55.

Glick R, Rose A. (2002). *Does a currency union affect trade?.* European Economic Review 46:1125-51.

Ishiyama Y. (1975). *The theory of optimum currency areas: a survey.* IMF Staff Papers 22:344-83.

Japelli T, Pagano M. (2008). *Financial market integration under EMU.* European Commission Economic Papers 312, European Commission, Brussels.

Kalemli-Ozcan S, Papaioannou E, Peydro J-L. (2009). *What lies beneath the euro's effect on financial integration? Currency risk, legal harmonization, or trade?* NBER Working Papers 15034, National Bureau of Economic Research, Inc. Cambridge(MA)

Kenen PB. (1969). *The theory of optimum currency areas: an eclectic view.* In Monetary Problems of the International Economy, ed. R Mundell, A Swoboda pp. 41-60. Chicago(Il): University of Chicago Press

Kenen PB. (2002). *Currency unions and trade: variations on themes by Rose and Persson.* Reserve Bank of New Zealand Discussion Paper Series DP2002/08, Wellington: Reserve Bank of New Zealand.

Lane P. (2006). *The Real Effects of European Monetary Union.* Journal of Economic Perspectives 20:47-66.

Meade, J, (1957). *The balance of payments problems of a free trade area.* Economic Journal 67:379-96.

Micco A, Stein E, Ordonez G. (2003). *The currency union effect on trade: early evidence from EMU.* Economic Policy 18:315-56.

McKinnon RI. (1963). *Optimum currency areas.* American Economic Review 53:717-25

Mundell RA. (1961). *A theory of optimum currency areas.* American Economic Review 51:657-65.

Mundell RA. (1973). *Uncommon arguments for common currencies.* In The Economics of Common Currencies, ed. HG Johnson, AK Swoboda pp 114-32. Cambridge(MA): Harvard University Press.

Neumeyer PA. (1998). *Currencies and the allocation of risk: the welfare effects of a monetary union.* American Economic Review 88:246-59.

Neumeyer PA. (1998). *Currencies and the allocation of risk: the welfare effects of a monetary union.* American Economic Review 88:246-59.

Nitsch V. (2002). *Honey I shrunk the currency union effect on trade.* World Economy 25:457- 474.

Obstfeld M, Peri G. (1998). *Regional non-adjustment and fiscal policy.* Economic Policy 13:205-59.

Obstfeld M, Rogoff K. (1996). *Foundations of International Macroeconomics.* Cambridge(MA): MIT Press.

Pakko MR, Wall HJ. (2001). *Reconsidering the trade-creating effects of a currency union.* Federal Reserve Board of St. Louis Review 83:37-45.

Papaioannou E, Portes R. (2008). *Costs and benefits of running an international currency.* European Commission Economic Papers 348, European Commission, Brussels.

Persson T. (2001). *Currency union and trade: how large is the treatment effect?.* Economic Policy, 16:433-62.

Rogoff K. (1985). *Can international monetary policy cooperation be counterproductive?.* Journal of International Economics 18:199-217.

Rose A. (2000). *One money one market: estimating the effects of common currencies on trade.* Economic Policy 15:9-48.

Rose A. (2001). *Currency union and trade: the effect is large.* Economic Policy 16:433—62.

Appendix 1.

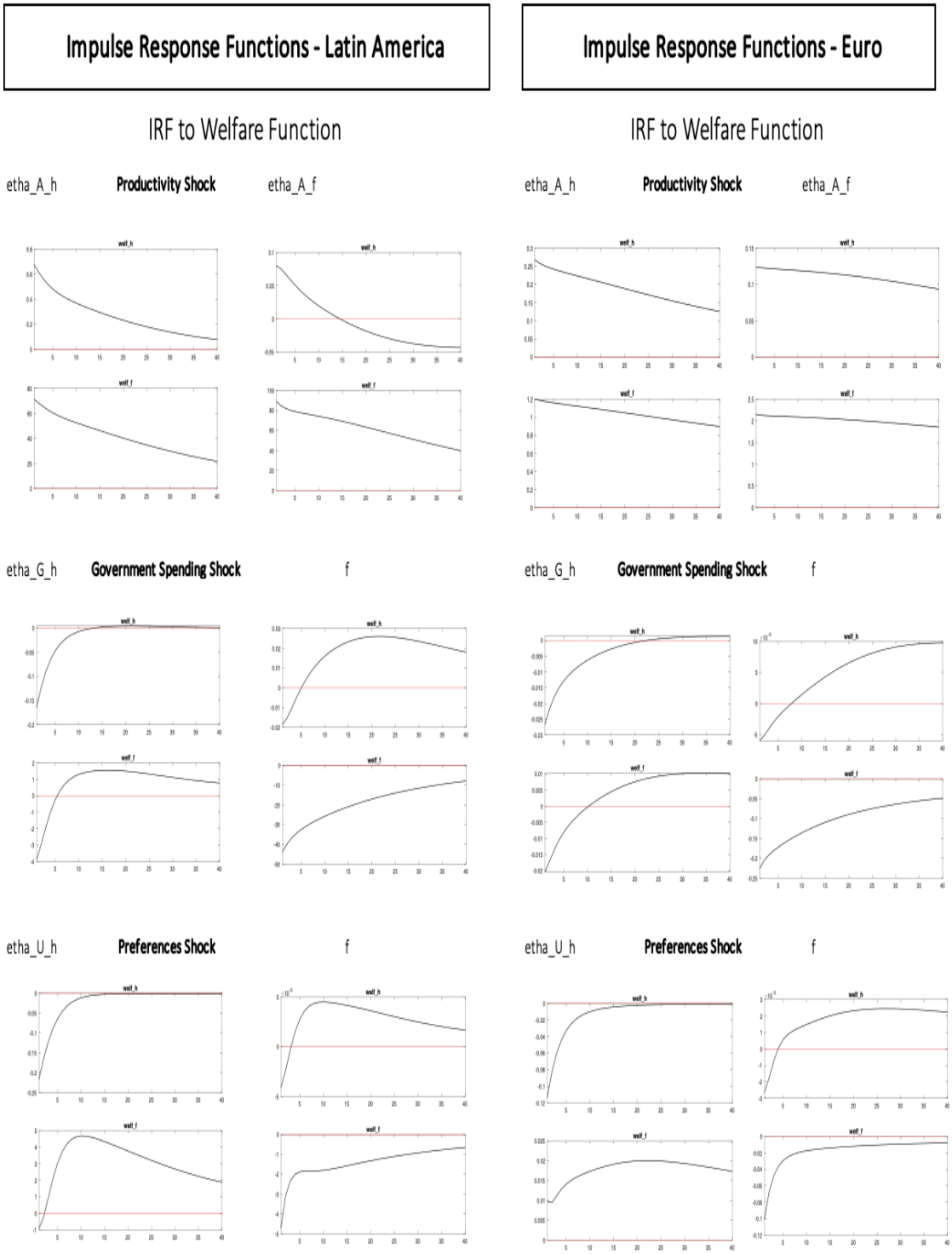

Figure 4: Impulse Response Functions to Welfare

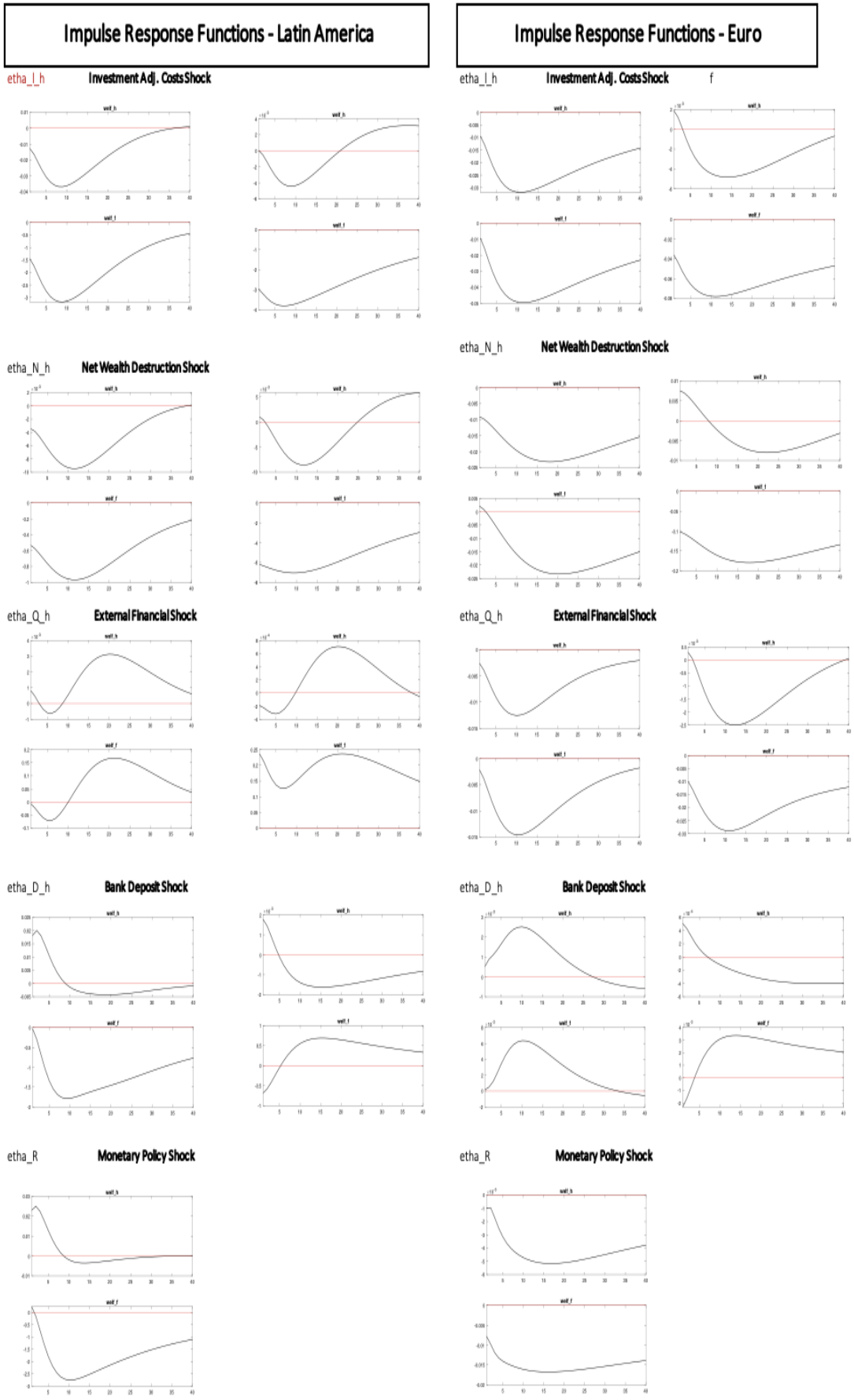

Figure 5: Impulse Response Functions to Welfare

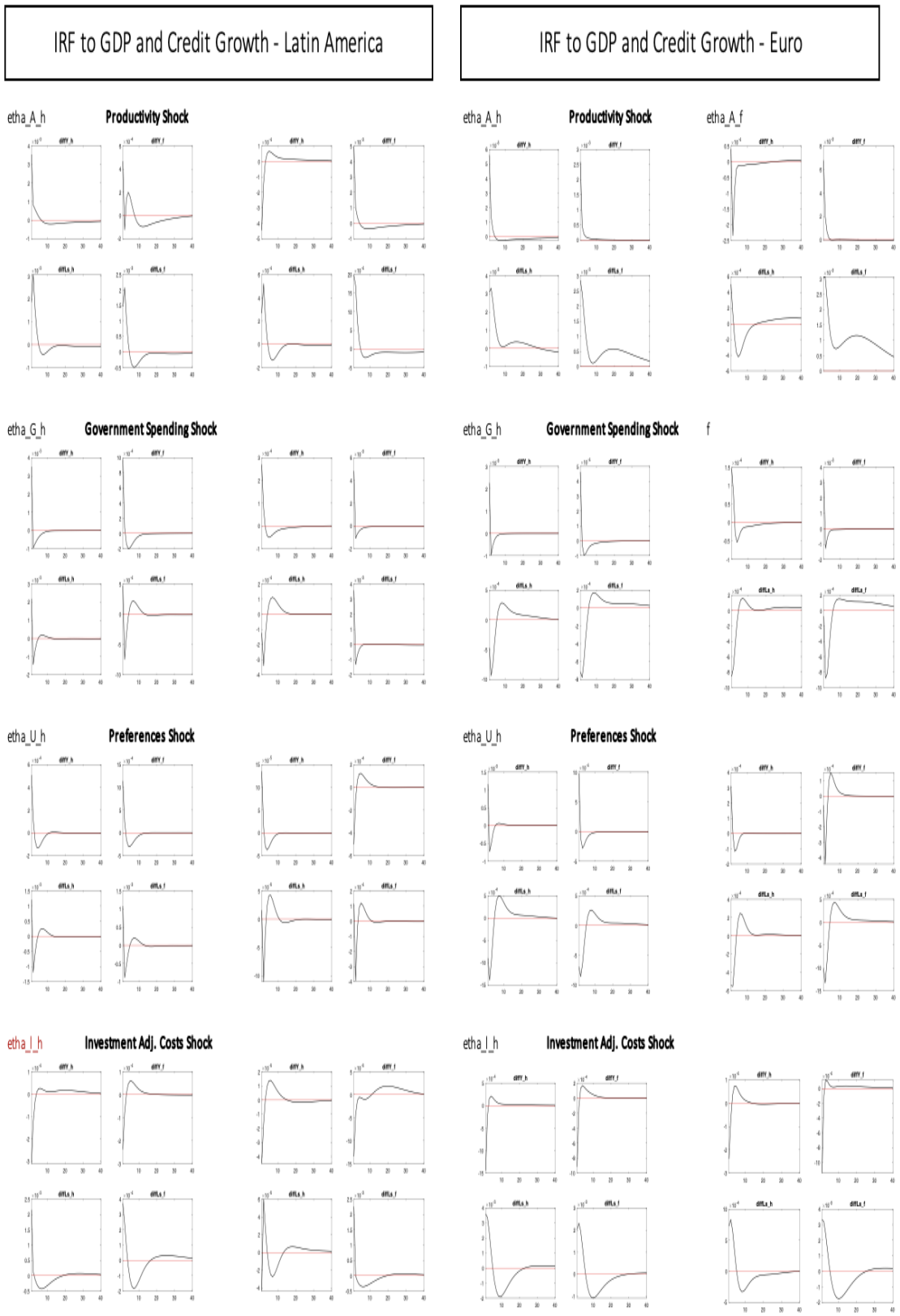

Figure 6: IRF to GDP and Credit Growth

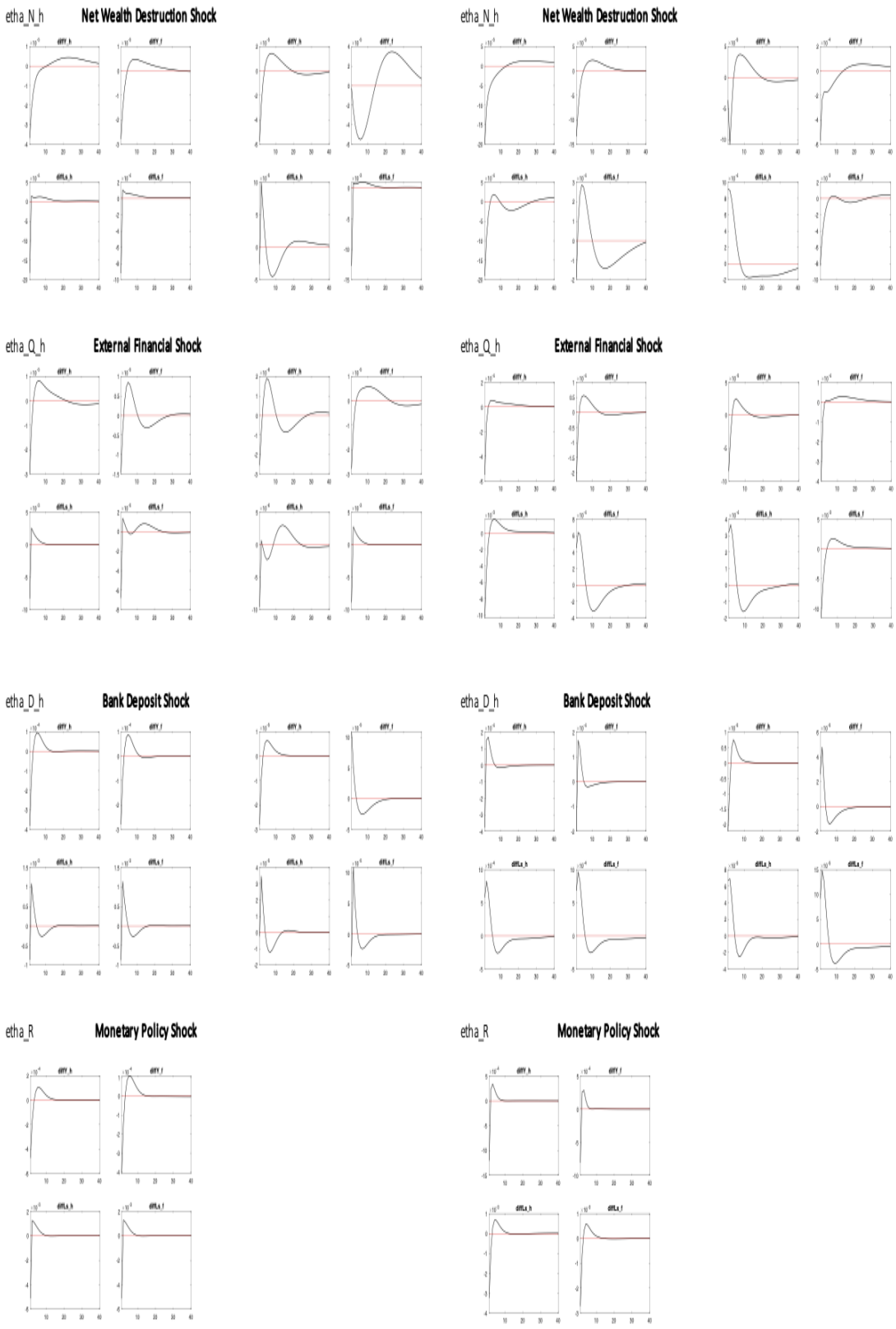

Figure 7: IRF to GDP and Credit Growth

Appendix 2 - Is it Feasible for Latam countries to implement a Monetary Union?

The purpose of this appendix is to provide a complementary analysis for the study, i.e. particularly give an empirical answer to the question provided in Subsection 2.1 (Is it feasible for Latam countries to implement a currency union?). In that vein, the idea of this analysis is to develop a simple theoretical model calibrated to the region's main economic and political features as well as with the traditional Optimum Currency Area - OCA arguments. The following section summarizes the main framework of the model, while the most relevant stylized facts regarding Latin America are presented in Section III. Section IV describes the characteristics of the calibrated model and thus, Section V presents the main results from the analysis. Section VI concludes with some recommended extension for future studies.

A.1. The Model:

The model relies on the mainstream literature of Beetsma (1998), Bovenerg (1999) and Martin (1995). Therefore it emphasizes in a scenario where credible institutional fixes are harder to implement regionally, for example country-tailor fiscal policies. On the other hand, the model allows addressing the interaction between monetary and fiscal policies as well as international policy coordination.

In that regard, next I present the model's framework. Consider a static economic area composed by n goods and n countries where these countries are considered small enough compared with the rest of the world. Moreover, countries differ only by: i) the size of their economy (expressed as the value of GDP), ii) the government's propensity to spend public resources on socially wasteful projects and last but not least, iii) shocks affecting output. Variables or parameters indexed by the subscript i are country-tailor, while other are considered identical across countries. Each variable is represented as deviations from an arbitrary steady state (with log-linear specifications). The model is presented in a simple 3-equation framework.

The first equation considers a supply function that considers unexpected inflation $(\pi - \pi_i^e)$, and thus determines output for each country y_i. Also, consider a tax τ on firms' total revenue that reduces output below its natural level (zero). Concerning inter-dependency, country policies might also affect neighboring countries, creating a policy-coordination externality, just through monetary policies. Assume that a monetary expansion in country i has a contractionary impact on the other Latam countries. This externality is captured by parameter $\theta_{i,k}$, representing the marginal effect of a monetary

policy in country k on output in country i[6]. Last, assume that output y_i is subject to a country specific shock ε_i.

$$y_i = c(\pi_i - \pi_i^e - \tau_i) - \sum_{k \neq i, k=1}^{n} \theta_{i,k} c(\pi_k - \pi_k^e) + \varepsilon_i, i = 1, ..., n \tag{1a}$$

Subsequently, consider the following one-period budget constraint:

$$g_i = \mu \pi_i + \tau_i \tag{2a}$$

Where g_i is the government spending (as a percentage of GDP), τ_i is the fiscal revenue to GDP ratio and μ is the inflation tax base parameter. Finally, the next equation represents the policymakers utility function as Barro and Gordon (1983):

$$U_i^G = \frac{1}{2}\Big\{-a(\pi_i - \tilde{\pi}(\varepsilon_i))^2 - b\tau_i^2 - \gamma(g_i - \tilde{g}_{G,i})^2\Big\} + y_i \tag{3a}$$

This equation implies that deviations of inflation, taxes and public expenditure from natural levels, denoted by a tilde, are costly. Moreover, it can be seen from the previous equation, the trade-off between output and inflation's variability. Hence, following Muscatelli (1998), consider $\tilde{\pi}(\varepsilon_i) = -\eta\varepsilon_i$ where $\eta > 0$[7]. Last, consider $\tilde{g}_{G,i}$ representing a fraction of governments public expenditure that is diverted to its own benefits where $\tilde{g}_{S,i}$ is the optimal level of public expenditure and thus $\tilde{g}_{G,i} > \tilde{g}_{S,i}$.

Next, consider now that each regime (non and monetary union) follows arbitrary steady states. For the case of a non monetary union (autonomous monetary policies), policymakers chooses tax rates τ_i and inflation rates π_i independently, by maximizing Equation 3a[8]. Thus, by assuming complete information, rational expectations and a scenario where policies regarding fiscal and monetary sectors are implemented, the optimal policy mix (denoted by the superscript "$*$") for inflation, fiscal revenue and public spending respectively, is expressed as follows:

$$\pi_i^* = \frac{\gamma\mu b}{\Lambda}\tilde{g}_{G,i} + \frac{\gamma(1+\mu)+b}{\Lambda}c - \frac{\eta a(b+\gamma)}{\Lambda}\varepsilon_i \tag{4a}$$

$$\tau_i^* = \frac{\gamma a}{\Lambda}\tilde{g}_{G,i} + \frac{\gamma u(1+\mu)+a}{\Lambda}c + \frac{\eta\gamma\mu a}{\Lambda}\varepsilon_i \tag{5a}$$

[6]This parameter illustrates the importance of bilateral trade linkages and thus its main determinants such as country relative sizes, geographic distance and the degree of economic integration among others.

[7]A negative output shock might induce policymakers to tolerate positive inflation

[8]This policy scenario implicitly assumes a flexible exchange rate regime

$$g_i^* = \frac{\gamma(a+\mu^2 b)}{\Lambda}\tilde{g}_{G,i} + \frac{b\mu - a}{\Lambda}c + \frac{\eta b\mu a}{\Lambda}\epsilon_i \tag{6a}$$

$$where \;\; \Lambda = a(b+\gamma) + \gamma u^2 b > 0 \tag{7a}$$

In the provided equations, the term c captures an incentive to extract revenue from the inflation tax and also it captures any degree of possible inflation bias that might affect output, see Alesina and Tabellini (1987). For the case of the monetary union regime, the union weighted cross-country optimal policy mix is given by the following equations:

$$\pi_{MU}^* = \frac{\gamma\mu b}{\Lambda}\tilde{g}_{G,A} + \frac{\gamma(1+\mu) + b - \theta_A(b+\gamma)}{\Lambda}c - \frac{\eta a(b+\gamma)}{\Lambda}\varepsilon_A \tag{8a}$$

$$\tau_{i,MU}^* = \left[\frac{a\gamma}{\Lambda} + \frac{\gamma^2\mu^2 b[1-\Psi_i]}{(b+\gamma)\Lambda}\right]\tilde{g}_{G,i} - \frac{a + \gamma\mu(1+\mu) - \theta_A\gamma\mu}{\Lambda}c - \frac{\eta\gamma\mu a}{\Lambda}\varepsilon_A \tag{9a}$$

$$g_{i,MU}^* = \left[\frac{a\gamma(b+\gamma) + \gamma\mu^2 b[b\Psi_i + \gamma]}{(b+\gamma)\Lambda}\right]\tilde{g}_{G,i} + \frac{b\mu(1-\theta_A) - a}{\Lambda}c + \frac{\eta b\mu a}{\Lambda}\varepsilon_A \tag{10a}$$

Where $\Psi = \tilde{g}_{G,A}/\tilde{g}_{G,i}$ is defined as a parameter that captures the difference between each country member spending target compared with the aggregate spending target considered by the common Central Bank. In that vein, any value different from 1 indicates that the union monetary policy failed to achieve the optimal trade-off between tax and monetary financing (from the perspective of each country member i). Also, parameter θ captures the union monetary discipline and parameter Ψ measures deviation from country spending objectives[9]. Note also that under the currency union regime, monetary policy is implemented by the common Central Bank based on the weighted average of each country members utility function[10], according to the following expression:

$$U^{MU} = \sum_{i=1}^{n} \omega_i U_i^G \tag{11a}$$

Where $\omega_i > 0$ and $\sum_{i=1}^{n} \omega_i = 1$.

[9] Countries with low spending targets ($\Psi > 1$) might suffer looses in the understanding that the union Central Bank will transfer them "above the target" revenues, offsetting potentially gains. On the other hand, if the value is too high, countries might benefit from the participation in the union

[10] The common Central Bank is subject to the same type of political pressures as the central bank of each country member. The difference is that in a currency union regime, joint decision process based on individual pressures are implemented according to the weight of the country

A.2. Stylized Facts for Latin American countries

This section review the main stylized facts of Latin America countries[11]. Recall that the presented model assumes that prospects of a monetary union configuration depends on the size differences among country members, and that government spending is financed through seigniorage and tax revenues. Also, the model implies that gains from implementing a currency union depends specifically on: the correlation of national shocks with other members; fiscal policy distortions among country members; and neighbor's national monetary policies through the strength of intraregional trade linkages.

A.2.1. Asymmetric Shocks

The terms of trade (ToT) are an important component of analysis for the implementation of a monetary union, specially for country members whose main activity are net exports. Table 1 illustrates: i) the openness degree of each country member, ii) Standard deviations changes in the ToT, and iii) the correlation between ToT of each country member.

		SD of ToT shocks		Correlation of ToT Shocks							
	Openness	Unscaled	Scaled	Brazil	Argentina	Chile	Uruguay	Bolivia	Colombia	Peru	Paraguay
Brazil	25.7	0.068	0.018		0.840	0.787	0.329	0.777	0.905	0.864	(0.092)
Argentina	32.4	0.013	0.004	0.840		0.897	0.514	0.573	0.786	0.899	0.103
Chile	65.3	0.147	0.096	0.787	0.897		0.282	0.578	0.800	0.974	(0.146)
Uruguay	50.3	0.089	0.045	0.329	0.514	0.282		(0.236)	(0.007)	0.211	0.651
Bolivia	65.1	0.017	0.011	0.777	0.573	0.578	(0.236)		0.906	0.719	(0.448)
Colombia	36.6	0.001	0.000	0.905	0.786	0.800	(0.007)	0.906		0.886	(0.311)
Peru	46.2	0.093	0.043	0.864	0.899	0.974	0.211	0.719	0.886		(0.188)
Paraguay	76.0	0.067	0.051	(0.092)	0.103	(0.146)	0.651	(0.448)	(0.311)	(0.188)	
Avg Latinzone	49.7	0.1	0.0	0.6	0.7	0.6	0.2	0.4	0.6	0.6	(0.1)
Avg Core	43.4	0.1	0.0	0.7	0.8	0.7	0.4	0.4	0.6	0.7	0.1
Avg Peripheral	56.0	0.0	0.0	0.6	0.6	0.6	0.2	0.4	0.5	0.5	(0.3)

Table 1a: Latam Openness, SD of ToT Shocks and Correlation of ToT shocks

It can be seen from Table 1a that Chile has the largest standard deviation of ToT changes. Moreover, the ToT shocks of core countries as Brazil, Argentina and Chile are correlated compared with most of country members. This can be considered as good first symptom for the implementation of a monetary union in Latin America[12].

A.2.2. Political Distortions

Equation 3a presents $\tilde{g}_{G,i}$, representing the extent to which public spending exceed the optimal target, as one of the main components of the policymaker's utility function. In that line, in the understanding that the mentioned variable is unobservable and thus

[11] Note that I am using the same Latam country selection as in the previous model.

[12] Cashin and Pattillo (2000) finds that shocks to the ToT of most African countries are not well correlated, due in large part to differences in commodity exports.

complex to measure, following Debrun et al. (2005), in this section I present some stylized facts of Latin American, supporting the idea that actual government spending might be higher than socially optimal and hence there are cross-country differences as well. Gupta et al. (1997) shows that for most developing countries, it exists some portion of government spending that is beneficial for society (specially public expenditure on educational and health). Table 2a compares corruption and institutional quality indices for Latam country members. Results show that Latam countries like Paraguay and Bolivia have the highest indices regarding corruption while Paraguay, Colombia and Brazil have the lowest index of institutional quality among the region.

	Corruption Index	ICRG Institutional Index
Brazil	0.57	0.42
Argentina	0.56	0.53
Chile	0.07	0.75
Uruguay	0.04	0.51
Bolivia	0.69	0.45
Colombia	0.57	0.40
Peru	0.55	0.48
Paraguay	0.81	0.29
Avg Latinzone	0.48	0.48
Avg Core	0.31	0.55
Avg Peripheral	0.66	0.41

Table 2a: Latin American Corruption and Institutional Quality Indices

A.2.3. Intraregional Trade Linkages

This section tries to address the externalities of the model, in the sense that an inflation surprise in a domestic country might affect neighboring countries' output through intraregional trade linkages. In general, trade across the region is relatively high[13]. For the case of peripheral countries, Paraguay and Bolivia accounts for 67% and 49% of their exports inside the Latinzone, while for core countries, Argentina and Uruguay have 32% and 23% of their total exports in Latam countries (see Table 3a)[14].

[13] Masson and Pattillo (2001) found that internal trade in African countries part of the ECOWAS account for less than 10%.

[14] Note that intraregional trade numbers might be a little bit higher mainly because of the presence of informal trade in Latin America, see Linares (2018)

	Brazil	Argentina	Chile	Uruguay	Bolivia	Colombia	Peru	Paraguay
Brazil		18.58	4.78	12.65	20.83	3.83	3.87	32.06
Argentina	6.55		1.07	4.83	16.97	0.67	0.40	24.71
Chile	2.81	5.07		1.36	1.51	2.71	2.56	7.03
Uruguay	1.29	2.00	0.16		0.12	0.16	0.09	1.66
Bolivia	0.64	1.08	1.51	0.63		0.34	1.44	0.66
Colombia	1.23	1.06	1.00	0.51	4.12		1.64	0.13
Peru	0.95	1.93	2.20	1.35	5.27	3.21		1.47
Paraguay	1.28	2.06	0.82	1.52	0.66	0.06	0.03	
Total share	14.75	31.78	11.54	22.85	49.48	10.98	10.03	67.72

Table 3a: Latam Exports as share of Total - in percent (1999 - 2019)

In addition to the analysis of possible sources of externality among the Latam monetary union, I present Table 4a that contains data for country $i's$ exports to country k, scaled by country $i's$ GDP. It can be seen sizable exports of Argentina, Uruguay, Bolivia and Paraguay to Brazil.

	Brazil	Argentina	Chile	Uruguay	Bolivia	Colombia	Peru	Paraguay
Brazil	0.0000	0.0268	0.0136	0.0334	0.0541	0.0061	0.0097	0.1184
Argentina	0.0096	0.0000	0.0031	0.0127	0.0441	0.0011	0.0010	0.0913
Chile	0.0041	0.0073	0.0000	0.0036	0.0039	0.0043	0.0064	0.0260
Uruguay	0.0019	0.0029	0.0005	0.0000	0.0003	0.0003	0.0002	0.0061
Bolivia	0.0009	0.0016	0.0043	0.0017	0.0000	0.0005	0.0036	0.0024
Colombia	0.0018	0.0015	0.0029	0.0013	0.0107	0.0000	0.0041	0.0005
Peru	0.0014	0.0028	0.0063	0.0036	0.0137	0.0051	0.0000	0.0054
Paraguay	0.0019	0.0030	0.0023	0.0040	0.0017	0.0001	0.0001	0.0000
Total Latinzone	0.0216	0.0459	0.0329	0.0603	0.1286	0.0175	0.0253	0.2502

Table 4a: Theta(i, k) - Inflation Surprises in Country i (top) to Country k (left)

In general terms, Brazil accounts for almost half (47%) of the average amount of total exports among the Latinzone.

A.2.4. Economic Size Differences

Another important assumption of the model is the fact that size differences among countries affect net gains coming by the implementation of a monetary union, in the understanding that the common Central Bank's policy decisions are proportional to the economic size of each country member. For the case of the Latinzone, it can be seen large differences in the economic sizes. Calls my attention the fact that Brazil represents more than 1/2 of the Latinzone's total GDP and also that Brazil and Argentina accounts for more than 3/4 (see Table 5a).

	GDP (mill. of $us)	GDP Share
Brazil	1,559,558	57%
Argentina	502,464	18%
Chile	195,701	7%
Uruguay	42,802	2%
Bolivia	25,664	1%
Colombia	231,358	8%
Peru	144,498	5%
Paraguay	28,961	1%
Avg. Latinzone	341,376	13%

Table 5a: Latinzone GDP share (1999 - 2019)

A.2.5. Fiscal Component

Table 6a illustrates fiscal behaviour of Latam country members on average during 1999 - 2019. A few points should be noted: Four of the eight members (Brazil, Uruguay, Bolivia and Colombia) have experienced more fiscal deficits than budget surplus. Recall Brazil represents more than half of Latinzone's total GDP, so it is important that the country should implement fiscal policies to overcome continuous fiscal deficits. On average, the government spending of Brazil accounts for more than 1/3 of the country's total GDP.

	Revenue/GDP	Spending/GDP	Deficit/GDP	Inflation	Share of GDP (%)
Brazil	28.83	33.56	(2.25)	6.29	57.11
Argentina	18.40	20.96	6.42	15.16	18.40
Chile	21.69	19.89	1.79	3.17	7.17
Uruguay	28.25	29.20	(0.95)	8.18	1.57
Bolivia	19.94	24.58	(1.04)	4.56	0.94
Colombia	22.57	26.55	(2.85)	5.28	8.47
Peru	19.23	18.57	0.66	2.75	5.29
Paraguay	15.84	13.80	1.45	6.25	1.06
Avg. Latinzone	21.84	23.39	0.40	6.46	12.50

Table 6a: Latinzone Main Fiscal Indicators (1999 - 2019)

A.3. Calibration

This section presents the calibration of the model based on the three main equations presented above: i) Supply function, ii) Government's budget constraint and iii) Government's utility function. Note that some of the parameters are specific to each country members while others are the same for all members. Next, I present the parameters according to each of the three equations of the model.

For Equation 1a (supply function), there is the parameter $\theta_{i,k}$ representing the externality parameter. This parameter is calibrated with data for country $i's$ exports to country k, scaled by the GDP of country i. Table 4a illustrates the data-values for this parameter on each country member. Another parameter deriving from Equation 1a, is θ_A which comes by the steady state equations under the monetary union's regime. In that line, θ_A is given by:

$$\theta_A = \sum_{i \varepsilon A} \sum_{j \varepsilon A} \omega_i \theta_{i,j} / \sum_{j \varepsilon A} \omega_i \tag{12a}$$

Where ω_i is the GDP share of country i with respect of the Latinzone. Thus, by equating $\omega_i's$ with the GDP weights presented in Table 6a, I obtain $\theta_A = 0.0104$. Last but not least, Equation 1a presents the shock ε_i, represented as terms of trade (ToT) disturbances. The standard deviation of the ToT shock is scaled by the country's openness (measured by the ratio of the sum of exports and imports to GDP), expressed as σ_ε, as it can be seen in Table 1a. Recall that one of the main costs of a monetary union is the correlation of shocks between country members. In that vein, Table 1a presents the correlation matrix of ToT shocks among members.

For Equation 2a (government's budget constraint), there is π_i represented as inflation and τ_i as government revenues as a ratio to GDP (see Table 6a). Last, there is the parameter μ, expressed as the hypothetical tax base that balance the governments budget [15]. Hence, public deficit divided by inflation (expressed as an weighted average of each country member), provides the region estimate $\mu = 2.18/6.46 = 0.34$. Next, as mentioned before, some portion of political decisions goes for the benefit of themselves, being these extra expenses above the socially optimal expenditure level $\tilde{g}_S$. This value expressed as $\tilde{g}_G$, is hard to measure in the understanding that it is unobservable. In that vein, following Mauro (1998) and Gupta, Davoodi and Tiongson (2000), I found this resource diversion value, by assuming that $\tilde{g}_G$ mainly depends on the quality of national institutions, i.e. poor institutions are associated by less expenditure on health and education, suggesting that poor institutional quality leads to stronger diversion effects on government spending $\tilde{g}_G$. Hence, following Debrun et al. (2005) to estimate the value, I consider a cross-section data for Latam country members and run an OLS regression that seeks to explain the effect of government expenditure on health and education. In accordance with the mentioned study, I found similar results, i.e. institutional quality has a significant positive impact on health and education expenditure. Thus, by assuming that ideal institutions prevent diversion, I use these estimates to calculate the efficient public expenditure levels if the countries achieved the maximum possible values in both the cor-

[15] The model requires μ to be the same value for all country members. Thus, I calculate it as the weighted average for each Latam country

ruption and institutional quality indices (these results are reported in the "no diversion" column of Table 7a). Hence, resource diversion is taken by the difference between the observed and the efficient levels described above.

Table 7a, contains resource diversion levels for the case of expenditure on health and education (estimated from the regression[16]). Hence, I use this estimates as a proxy for the political overspending distortions compared to the socially optimal public expenditure objective.

	Health		Education		Diversion as % of No	Government Spending	
	Actual	No Diversion	Actual	No Diversion	Diversion	Actual	Target
Brazil	0.25	0.40	0.26	0.46	59.49	19.29	25.03
Argentina	0.48	0.80	0.47	0.79	59.65	14.73	19.12
Chile	0.35	0.50	0.68	0.94	71.21	12.67	17.18
Uruguay	0.85	1.21	0.54	0.86	67.28	12.41	16.58
Bolivia	0.41	0.70	1.08	1.95	56.21	15.40	19.73
Colombia	0.1	0.16	0.41	0.75	56.26	15.02	19.24
Peru	0.11	0.19	0.22	0.40	55.54	11.65	14.88
Paraguay	0.64	1.46	1.24	3.07	41.50	9.80	11.83
Avg. Latinzone	0.40	0.68	0.61	1.15	58.39	13.87	17.95

Table 7a: Public Expenditure on Priority Sectors: Estimates on the Diversion Effect

Last but not least, for the case of Equation 3a (government's utility function), the model implies that the two regimes (non and monetary union) will have different incentives for inflation and government spending. Specifically, countries in a currency union should have lower public spending and higher taxes, for a given level of public spending target. Regarding the utility function parameters, following the calibration approach of Debrun et al. (2005) (explained below), the baseline model uses the following values: $c = 1, a = 0.335, b = 0.708, \gamma = 0.690$.

Recall that countries, depending of their regime (non or monetary union), may differ their spending and tax ratios, by making a comparison of equations (8a) - (10a) with equations (4a) - (6a), one of which is in a monetary union and the other is not, yields to:

$$\triangle\tau = \frac{\theta_A \gamma \mu c + a\gamma \triangle\tilde{g}}{a(b+\gamma) + b\mu^2\gamma} \tag{13a}$$

[16]Following Debrun et al. (2005), for the estimation of the health regression, I use a constant, the log of GDP per capita at PPP (as an average of 1999 - 2019), an index of institutional quality (as an average of ICRG indices for political stability, democratic accountability and corruption), life expectancy and infant mortality. For the case of the education regression, I include a constant, the log of GDP per capita at PPP (as an average of 1999 - 2019), the illiteracy rate, a variable that interacts the illiteracy rate and the institutional quality index (as an average of ICRG indices for political stability, democratic accountability, corruption, rule of law and bureaucratic quality).

$$\triangle g = \frac{-b\theta_A \mu c - (a\gamma + \gamma\mu^2 b)\triangle \tilde{g}}{a(b+\gamma) + b\mu^2\gamma} \tag{14a}$$

$$\triangle \pi = \frac{-\theta_A (b+\gamma)c + \gamma\mu b \triangle \tilde{g}}{a(b+\gamma) + b\mu^2\gamma} \tag{15a}$$

Where $\triangle\tau, \triangle g$ are the tax and spending ratios and $\triangle\tilde{g}$ represents the difference in spending propensities with respect of the spending target, respectively. Thus, assume a comparison between two countries, both in a monetary union and without, then θ_A cancels out. Thus, by comparing Equations 13a and 15a, yields to:

$$\frac{\triangle\tau}{\triangle\pi} = \frac{a}{\mu b} \tag{16a}$$

Thus, by comparing the average differences of tax revenues and inflation, between country members, yields to:

$$a = \mu\frac{0.049}{0.035}b = 0.473b \tag{17a}$$

Additionally, by doing the same approach by comparing Equations 13a and 14a, yields the following expression:

$$\gamma = -\frac{\triangle\tau}{\triangle g}b \tag{18a}$$

Hence, by substituting observable data in the previous equation gives:

$$\gamma = 0.97411b \tag{19a}$$

Last, by substituting Equation 13a into Equation 18a, assuming $\triangle\tilde{g} = 0$ and solving for parameter b with average data comparison among Latam countries, gives:

$$b = \frac{a(\triangle g - \triangle\tau) + \theta_A\mu c}{\triangle\tau\mu^2} = 0.708c \tag{20a}$$

Finally, by assuming that $c = 1$, I have a system of 3 equations with 3 parameters: a, b and γ.

A.4. Results

This section presents the main results from the baseline model calibrated for the Latinzone. Table 8a illustrates the gains of joining a monetary union for Latam country members individually, considering the baseline parameter values[17]. Some important features to point out is the fact that countries like Brazil and Uruguay are worst-off from implementing a monetary union. The rest of the countries are better-off from the union, being peripheral countries the members that gets the more benefit.

	ω	Gains MU	Correlation	Ψ
Brazil	0.571	-0.050	0.630	0.717
Argentina	0.184	0.001	0.659	0.939
Chile	0.072	0.120	0.596	1.045
Uruguay	0.016	-0.073	0.249	1.082
Bolivia	0.009	0.133	0.410	0.910
Colombia	0.085	0.081	0.566	0.933
Peru	0.053	0.191	0.624	1.206
Paraguay	0.011	0.246	-0.062	1.517

Table 8a: Latinzone - Gains from Monetary Union

Also, it can be seen that countries like Brazil accounts for the most profligate fiscal polices (with $\Psi < 1$), while Paraguay and Peru are the most fiscally conservative country members (with $\Psi > 1$). Thus, having Brazil or not in the Latinzone, will be a key determinant, given the fact that this country has not only one of the greatest weight in the correlation of its ToT shocks with respect of the Latinzone (0.630), but also the country's size represents more than 50% of the Latinzone, so any decision from the common Central Bank can be biased towards the country's domestic needs.

Finally, following one of Mundell's traditional pillar of OCA analysis - the need of having a certain degree of symmetry in the shocks among country members, results show that all members (besides Paraguay) have a positive correlation of its ToT shocks compared with the Latinzone (another good symptom for the idea of a monetary union in Latam countries).

A.4.1. A Final Game Theory Approach

In the understanding that a currency union for Latin America, implies the participation of all country member candidates, it is crucial to give special attention to Brazil, in the sense that is the country that represents more than 50% of the Latinzone's economic size as well as in the ToT shocks intensity. Unfortunately, it is one of the two countries that gets negative gains by joining a single-currency union. Thus, it is important to analyze

[17]For the baseline model, I use $a = 0.335, b = 0.708, c = 1, \eta = 1, \mu = 0.337$ and $\theta_A = 0.010$

the possible situations that could turned Brazilian's negative incentives to join a currency union into attractive ones.

To do that, I present a set of different game theory scenarios that analyze the mentioned situation. Even though game theory approach is not commonly used in macroeconomics, it can be seen more frequently studies nowadays, see Case (1979), Clemhout and Wan (1979) and Basar and Olsder (1982).

Table 9a illustrates the monetary union's current situation. The game theory scenario basically shows two players: Brazil and the rest of country candidates (Rest). Each player has two options: To choose for adopting a monetary union (MU) or to not choose it (NMU). All values are expressed in terms of welfare gains coming from the estimation of the model. For this first exercise, assume that both players: i) Play simultaneously, ii) Do not have previous information about each other, i.e. Brazil does not have the information than almost all the rest of the counties have positive gains by joining a currency union and viceversa.

		Rest	
		MU	NoMU
Brazil	MU	-0.050 ; 0.099	0.002 ; 0.045
	NoMU	0.002 ; -0.031	0.007 ; 0.045

Table 9a: Game Theory 1: No information
(Values expressed welfare gains from the model estimation)

Results shows that the best option for Brazil is by not incurring in a monetary union, while the best option for the rest of the countries is actually to adopt one. Therefore, not surprisingly, the outcome shows that Latin American countries might adopt a monetary union, but without Brazil. The problem comes in the sense that by not having Brazil in the union, the rest of the countries might incurred into losses. For that reason, it is important to present a new scenario that considers current actions based on previous information about own and other's welfare gains[18].

In that regard, I present Table 10a with the following assumptions. Exercise 2 considers the same rules of the game as previous exercise, but with the following additional assumptions: i) All players makes decisions based on information about itself as well as on the other player. Thus, it opens the possibility of a Nash equilibrium.

[18]Note that for this particular case, there is no Nash Equilibrium, because the country does not have any sort of previous information before making a decision based on a strategy.

Brazil | Info	Rest | Info: MU	Rest | Info: NoMU
MU	-0.050 ; 0.099	0.002 ; 0.045
NoMU	0.002 ; -0.031	0.007 ; 0.045

Table 10a: Game Theory 2: Information
(Values expressed welfare gains from the model estimation)

Decisions are now incurred based on the others best strategy, thus the best option for both players, Brazil and the rest of the countries, is not to adopt a monetary union. In fact, this strategy represents a Nash Equilibrium. This outcome opens a question of whether it will be feasible to get an scenario with both players choosing a strategy that involves adopting a monetary union.

In that vein. I present Table 11a, that considers a new situation. Following the experience of Germany in the process of adopting the Eurozone, suppose now that Brazil has an extra component, that enables the country to incurred in negotiations with the rest of the countries, before joining the union. In other words, Brazil can have the alternative to set some trade agreements that could entirely benefit the country.

Suppose now, that this power of negotiation for Brazil is expressed as x. Thus, by letting Brazil have an incentive to join a monetary union, consider the following equation:

$$-0.050 + x > 0 \tag{21a}$$

Equation 21a illustrates that, if the negotiation x could achieve a welfare gain greater than $+0.050$, then Brazil will be willing to cooperate and thus form a monetary union. Table 11a, shows that the Nash Equilibrium for both players goes to the strategy of forming a monetary union, when the mentioned criteria meets[19].

[19]Note that for this particular scenario, I am also assuming that each player follows a decision based on the other's best strategy, as previous exercise (see Game Theory 2)

		Rest|Info & Neg(-)	
		MU	NoMU
Brazil|Info & Neg(+)	MU	-0.050 + x ; 0.099 - x	0.002 + x ; -0.031 - x
	NoMU	0.002 + x ; -0.031 - x	0.007 + x ; 0.045 - x

Table 11a: Game Theory 3: Information and Negotiation
(Values expressed welfare gains from the model estimation)

Note that in Table 11a, I am assuming that the value of negotiation x, goes only for the benefit of Brazil. As it can be seen, the value of negotiation x is expressed as a positive value for the case of Brazil $(-0.050 + x)$, but as a negative value for the rest of the countries $(-0.050 + x)$. Nevertheless, the negative value for the rest of the countries might not be the case.

Important to highlight, that even by assuming that the value $x = 0.050$ completely affects the rest of the countries, they might still get a positive value in a currency union $(0.099 - 0.050 = +0.049)$. More surprisingly, this value is even greater than the welfare gains of the rest of the countries with no union $(+0.045)$. Hence, this gives some hope for the premise of a monetary union for Latin America.

A.5. Conclusions

I calibrated a model that captures the idea of joining a monetary union for Latam countries. The main characteristics of the model are that: i) it provides incentives for forming a currency union (depending on the extent of trade linkages among country members), and ii) includes a government distortion that causes an excessive public spending than the socially optimal level.

I used observable data to calibrate the model. Among the main results, is the fact that Brazil is a potential component of trade in the Latinzone, thus, it is crucial for the country to maintain stability, if countries decides to implement a feasible monetary union. Brazil and Uruguay have negative gains if joining a union. The rest of the countries are better off from the union, being peripheral countries the members that gets the more benefit (specially, Paraguay, Peru and Bolivia). Argentina is almost in the point where entering a monetary union gets neither positive nor negative gains. Even though a union might be in most of country members' interest, it is difficult to see that all Latam countries would be willing to adopt one despite previous agreements, similar as with the implementation of the Eurozone.

As an extension for future research, it is crucial to find more stylized facts from the literature that can capture the economic discrepancy among Latam country members, and thus include those in the model to see how results change. Moreover, giving the notorious spending disparities among country members, it would be important to implement a simulation that could predict if Latam countries have a certain degree of fiscal convergence.

Regarding the model, it would be also important to implement a sensitivity analysis that could analyze: i) what would happen with the results if missing some potential members such as Brazil perhaps, ii) what are the main components of the results (gains/losses from a monetary union), iii) Given that Brazil accounts for the majority of Latinzone's size, what would happen if there is change in the country's spending target, among many other possible scenarios.

Last but not least, based on the results taken from the game theory approach, it will be interesting to present a deeper analysis that shows how Brazil will get the extra welfare gain value of $x = 0.050$, with a precise combination of new trade agreements perhaps, and thus let the idea of a monetary union, become a reality. I am leaving this idea as a extension for potential future studies.