Commodity Speculation and Exchange Rate Swings in Latin America: a Stock Flow Consistent (SFC) Analysis

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Abstract

We are investigating the role of speculative agents during a commodity-boom period in a small-open, peripheral economy. Latin American countries (LAs) have a long history of speculative attacks, balance of payments crises, and currency devaluations. At the beginning of the 2000s, LAs experienced rising commodity prices and foreign investors shifted part of their portfolio composition towards their securities in search of short-term capital gains. Unlike past episodes, financialization has allowed international investors to have a wider range of financial instruments in which to invest. Apart from the traditional government bonds, new asset categories have appeared such as derivatives, exchange traded funds and structured notes. In order to replicate this macro-financial episode, this work will adopt a Stock Flow Consistent (SFC) framework. International real-financial connections are one of the main issues tackled by this methodology, as put forward in Godley (1999). The element of novelty of our contribution consists in depicting a speculative financial sector, which issues commodity-based assets (CBAs) to be sold to rentier households in the developed country. Comparative static exercises with different scenarios will be performed.

Keywords: International Finance Forecasting and Simulation: Models and Applications, Foreign Exchange, Macro-Based Behavioural Economics

JEL Codes: F37, F31, E7
1. Introduction

Latin American countries (LAs) have a long history of speculative attacks, balance of payments crises, and currency devaluations. Recently, once again, history repeated itself, even though it took some different connotations.

At the beginning of the 2000s, these countries experienced rising commodity prices and, as it has often happened in the past, foreign investors shifted part of their portfolio composition towards LAs securities in search of short-term capital gains. Unlike past episodes, financialization – which, as Epstein (2005) defines, is the increasing role of financial motives, financial markets, and financial actors in the economy – has allowed international investors to have a wider range of financial instruments in which to invest. Apart from the traditional government bonds, in the current financialized context new asset categories have appeared such as derivatives, exchange traded funds (ETFs) and structured notes.

In addition, the ultra-expansionary policies adopted by the major central banks in the aftermath of the 2008 financial crisis led investors in advanced economies to have at their disposal a great amount of liquidity which they used to seek higher returns in emerging countries. As a result, flows to Latin countries increased even more. However, starting from 2012, the international macroeconomic and financial context changed. The end of the commodities boom together with the start of a hawkish monetary policy in the United States modified the risk sentiment of international investors, shifting portfolio flows towards advanced economies again. From 2003 to 2010, Chile received on average roughly 7.5 US billion dollars in portfolio inflows per year, and the currency appreciated by 26% at the end of the period. However, from 2011 to 2016 the country experienced an average monthly outflow of almost 2 USD billions, while the currency lost 40% of its nominal value.

Thus, we have decided to build a two-country Stock Flow Consistent model (SFC) to investigate the role of speculative agents during a commodity-boom period in a small-open, peripheral economy. The analysis is inspired by the case for Chile during the period 2003-2016, and draws largely upon the Structuralist-post Keynesian literature.

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1 According to Moosa (2003), speculation is the deliberate assumption of risk to obtain profit. There are four main reasons why speculation occurs: i) according to Keynes (1939) and Hicks (1939), speculation substitutes the insurance market and transfers the risk from more to less risk-adverse traders; ii) the liquidity motive; iii) the divergence in expectations about future price of assets; iv) intermediaries have incentive to speculate in behalf of their clients, depending on how they are compensated.

2 There is no single definition of financialization within literature. Four main positions can be found: neoclassical, Marxist, Postkeynesian and regulation school. The four are different in the definition and evaluation of the process of financialization. This paper follows the post-Keynesian approach - Crotty (1990), Pollin (2007), Epstein (2005) - which has emphasized the growing weight of financial activities in the economy, showing that capital favours investment in finance rather than production. This phenomenon is behind the poor performance of the real sector experienced in the last decade and to describe it is used the term finance-led economy.
The element of novelty of our contribution consists in depicting a speculative financial sector, which issues commodity-based assets (CBAs) to be sold to rentier households in the developed country. As in Godley and Lavoie (2003; 2006a), Bonizzi (2015) and Valdecantos (2011;2015) we will assume that the advanced currency is used as international reserves by the local Central Bank.

This paper is divided as follows: in section 2, we will present some stylized facts on the exchange rate fluctuations in Chile and the role played by the increasing weight of financial liabilities in this economy. Section 3 will provide a review of the theories on exchange rate determination and a justification for the adoption of our framework. Section 4 will describe the transition flow matrix and detail the block structure of the model. In section 5 we will perform four scenarios simulation, while in section 6 we will highlight a number of limitations of the present work and some way forwards. Section 7 will sum up our findings.

2. Currency swings during the commodity boom period: 2003-2014

If we look at the evolution of the global financial sector during the last decades, we will find a more financialized world. There are two main consequences for currencies in developing countries in this context. On one hand, there are greater inflows and outflows of foreign capital into the domestic financial system, favoured by the elimination of entry/exit barriers in the capital account. These flows influence the demand for the domestic currency and, therefore, its value. On the other hand, there is a greater sensitivity of domestic financial markets to international financial conditions. Expectations about geopolitical and financial events can play an even more important role then the macroeconomic situation of the domestic country. This is exaggerated by speculative behaviors such as *self-fulfilling prophecy*.

Emerging, commodity-export economies are particularly sensitive to the macroeconomic and financial environment, especially when it comes to define the value of their currency. There is a relationship between the value of the currency and the price of the commodity the country exports. During a commodity boom period, the commodity-export economy experiences strong inflows, followed by sudden capital outflows as soon as the boom is over. Under the present environment, this process is exaggerated by the presence of financial derivatives, which are securities that have the power to create liquidity as quickly as they can drain it.

We are using the case of Chile to show some stylized facts about the interconnection between commodity prices, currency, and derivatives markets. Chile is a small-open economy that depends heavily on copper. Both ore and refined copper represent roughly 40 percent of its export. Starting from 2003 the price of basic products and raw materials experienced a boom period. The price of copper rose to from one to five dollars per pound. During this period, Chile received on average roughly 7.5 USD billions of dollars in portfolio inflows per year\(^3\).

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\(^3\) Data source Bank of International Settlement (BIS), 2019
From 2003 to 2014, the value of the currency closely followed the trend of financial commodity markets. In graph 1 we report the Chilean peso and the Thomson Reuters commodity index, a commodity future price index that replicates derivatives contract for 28 commodities. We use the commodity index as a gauge for market expectations. Notice, that we do not consider rational expectations in the neoclassical sense. Instead, we consider future price as what the market is pricing the future, without relying concepts on market efficiency and perfect information among players. In our view, these expectations are more to be interpreted as a bet, rather than a rational forecast about the future. Thus, expectations can be misleading, and correction in expectations impact the value of the currency.

The graph shows a close relationship between derivatives markets (futures prices) and the nominal value of the currency. As future prices increased from 2002 until 2007 – meaning bullish expectations for commodity markets – so did the Chilean peso. From 2009 to 2013 both futures prices stabilized after the Great Financial Recession and the nominal exchange fluctuate at around 470 pesos. From 2003 to 2013 the currency was around 30 percent more appreciated.

**Graph 1 – Chilean Peso and Thomson Reuters CRB commodity Index**

![Graph 1](image)

*Data source: Bloomberg (2019)*

As shown in figure 1, derivatives generate part of the inflows that determinate swings and fluctuation in the currency. The relation between currency, derivatives and flows may be better understood looking at graph 2 where we report the daily turnover of Over the Counter (OTC) currency derivatives (BIS, 2019). By definitions, over the counter contracts are non-standardized contracts traded outside official exchanges. They are customized agreements between two parties with no intermediaries involved. These contracts have been gaining importance since the increase in regulations for those derivatives traded in stock exchange.
From 1998 to 2003, the volume of FX operation carried out in Over the Counter (OTC) markets was stable around 2.5 USD billions per day. Starting the commodity boom, however, the volume increased from 2.5 to 12 USD billions per day. The growth took place in two different stages. Until 2009, volume growth was steady. However, starting in 2010, right after the adoption of extraordinary expansive monetary policies, data show a sudden acceleration. That is, from 2010 to 2013, the volume doubled from 6 to 12 billions, roughly a 100% increase in daily FX operations. After 2013, capital flows moved from developing countries to developed ones, causing the volume of OTC derivatives to decrease by 4 billions per day, reaching a daily average turnover of 8 USD billions in 2016. Sudden outflows represent changes in preferences by international investors and are powerful in changing the trajectory of the currency, as the Chilean experience showed.

**Graph 2 – Currency Derivatives Turnover**

![Graph 2 – Currency Derivatives Turnover](chart)

*Data source: Bank of International Settlement (BIS) 2019*

To give some context at the numbers we have just shown, we also report the monthly exports per type of product. The total volume of exports during the peak in the commodity boom, 2010-2014, reached the average volume of 7 billions per month, less than what was daily traded on the OTC derivative market during the same period. Thus, there is a strong mismatch between financial and trade volumes, implying that most of the FX operation carried out in the OTC market had the objective of speculating to obtain capital gains, rather than covering trade exposure to change in the exchange rate.
3. Literature review and theoretical justification for choosing a SFC approach

The conventional theory about the determinants of the exchange rate is characterized by three elements: a) the focus on the real exchange rate; b) the existence of an equilibrium value towards which the currency converges in the long term; c) the absence of an explicit role for financial speculative capital in the long term analysis, as they are generally considered transitory, short term elements. On the contrary, the heterodox theory focuses mainly on two aspects, namely: i) the determinants of the demand to hold currency; ii) the importance of capital, speculative flows.
Nominal exchange rate fluctuations are generally expressed through uncovered and covered interest parity, UIP and CIP respectively. These two rules, augmented with macroeconomic elements, are often the starting point in real exchange rate analysis.

UIP asserts that, if there is freedom of capital movements and government bonds are perceived as substitutes, then interest rate differentials between two countries are equal to the expected exchange rate depreciation. According to this theory, higher rate differentials imply an expected depreciation. However, there is ample empirical evidence that this prediction is not fulfilled (Moosa, 2004); on the contrary, it has been shown that in the long-term higher interest attract inflows and appreciate the currency (Harvey, 2009). CIP is rather preferred to UIP. According to CIP, there a close relationship between interest rates, spot rates and forward rates as assets are not homogeneous and investors hedge currency risk through derivative markets.

A first introduction of the concept of long run macroeconomic equilibrium was introduced by Cassel (1918) with the purchasing power parity (PPP), a theory based on the Ricardian law of the single price. According to this theory, in the absence of transaction costs and with perfectly competitive markets, the same good traded in two different countries would have the same price. If there were a difference in prices, there would be the possibility of arbitrage, which would re-establish the single price in the long term. Applied in terms of currency, PPP implies that there are no fluctuations in the real bilateral exchange rate between two countries, and that eventual misalignments of the PPP equilibrium are momentary and over time the equilibrium is re-established.

Dornbusch (1976) contributes to the exchange rate determinants literature developing a theoretical model that combines PPP and UIP. According to the author, financial elements, through UIP, do matter in the short term, while the long-term determinant is the PPP, which, according to Dornbusch, takes time to comply due to price rigidity. However, Dornbusch's theory has been criticized by Rogoff (2002).

The concept of equilibrium has developed further since the early 1990s. With the purpose of determining in level of undervaluation / overvaluation of the currency - the compound models, so defined by Cheun, Chinn and Pascual (2005) - were introduced in the literature. These models use macroeconomic fundamentals to determine the long-term trajectory of the real exchange rate, including terms of trade, per capita income, level of debt and current account. From the theoretical point of view, these models use the concept of exchange rate equilibrium as that level of exchange rate that balances the trade balance and the internal market (inflation). In the short term, there may be some degree of misalignment of the exchange rate of its equilibrium level due to imbalances in the macroeconomic fundamentals that determine the exchange rate. In the long run, however, equilibrium is restored through macroeconomic adjustment policies. According to this family of models, the effect of financial markets on the real exchange rate is
considered to affect the behavior of the currency only in the short run, while in the long run what really matters are the real fundamentals. Examples of these models are represented by Clark and MacDonald's (1999) Behavioral Equilibrium Exchange Rate (BEER) model, Stein's (1999) Natural Real Exchange rate (NATREX), or Williamson (1994) Fundamental Equilibrium Exchange Rates (FEER). For a detailed theoretical explanation of these models it is recommended to review MacDonald (2000).

An important criticism of the mainstream position on the determinants of the real exchange rate is found in the heterodox literature, which has turned its attention to the determinants of the demand for the exchange rate, particularly financial capital flows, expectations and speculation in the foreign exchange market.

Branson (1972) and Tobin and Macedo (1980) consider the exchange rates from the point of view of the asset portfolio optimization, the so-called portfolio approach. This approach considers that financial assets differ in their country-specific risk premiums, so exchange rate demand is then determined by the desire to diversify the portfolio according to risk preferences and expectations.

Within the post-Keynesian literature, Harvey (1991, 1996, 2009) is the author who mostly contributed to study the exchange rate and its financial determinants. The author's main hypothesis (Harvey, 2009) is based on the importance of aggregate expectations in the exchange rate trajectory. According to Harvey, currency demand is conditioned by a psychological component of market participants, who may have inappropriate expectations that lead to sudden corrections in the exchange rate trajectory. Harvey, however, does not differentiate between developed and developing countries. An extension of Harvey's work can be found in Kaltenbrunner (2015). In her work, the process of determining the exchange rate in developing countries is given by their different institutional characteristics, the size of financial markets and the currency integration into a hierarchical and structured international monetary system. Kaltenbrunner (2015) stresses the importance of international liquidity premiums on currency prices.

The study of the determinants of the exchange rate and its relationship with the financial sector has also been developed following the microeconomic approach to behavioural finance. The authors of this stream (Westerhoff, 2009; Schulmeister 1988, 2009; Menkhoff/Taylor, 2007; De Grauwe and Grimaldi, 2006), distinguish market participants between fundamentalist and chartist. Fundamental analysis studies the macroeconomic and political context of a country to determine the intrinsic, or "fundamental" value, of a currency. Fundamental value is established using purchasing power parity or, more commonly, with more elaborate structural macroeconomic models - for example, extensions of the Clark and MacDonald model (1999). Chartists, on the other hand, use technical analysis, which is a method of prediction based on the
belief that current prices represent all the necessary information about an asset. For this reason, this methodology focuses on studying how the price of currency can vary over time. The most basic concept of technical analysis is that markets have a "tendency to follow trends" (Westerhoff, 2009).

In what follows, we have decided to draw from the insights of both the Post-Keynesian literature and the portfolio balance approach, as synthetized by the family of models known as Stock Flow Consistent approach (Godley and Cripps, 1983; Godley and Lavoie, 2007). The intellectual roots of the latter lie in the national account – based macroeconomic models, built in Cambridge in the sixties by Richard Stone, whose work was successively taken up by Wynnie Godley one decade later. Essentially, their central contribution was to construct social accounting matrixes representing all the relationships among institutional agents in terms of flows and flows-od funds, in order to carry out scenario simulations or policy experiments. A logical implication of this framework is the integration between real and financial variables and sectors, as well as the avoidance of mis specifications and missing components in defining accounting identities.

Nikiforos and Zezza (2017) and Zezza and Zezza (2018) have identified four principle for a model being fully Stock-Flow consistent: (i) the flow consistency, i.e. that every flow must come from somewhere and goes somewhere else – for example, in open economy model, exports of one country are the imports of another one; (ii) the stock consistency, i.e. that every asset owned by an agent (sector) is the liability of another one in the system; (iii) The stock-flow consistency, i.e. that every flow implies the change in one or more stocks; (iv) the quadruple entry, i.e. that every transaction is recorded four times in the accounting matrix, for instance twice as a flow of expenditure and twice as a change of asset or increase of liabilities.

Besides the aspects of completeness and consistency in representing economic relationships, SFC models present another relevant innovation, namely in the set of equations that are meant to represent the behavior of agents. Differently from conventional theories, based on the rational expectations hypothesis in individual decisions, this literature adopts simple specifications that capture norms or rules, that not necessarily implies the full knowledge of the system. In other words, agents behave according to a weak or bounded form of rationality (Simon, 1955; Lavoie, 2014). According to Godley and Lavoie (2006, p. 16),

(agents) set themselves norms and targets, and act in line with these and the expectations that they may hold about the future. These norms, held by agents, produce a kind of autopilot. (...) In addition, except in the simplest models, agents will be assumed to know only the values taken by the various key variables of the previous period, and not those of the current period. This information about the past will allow them to make predictions about future values, but in a world of uncertainty.
This approach is particularly suitable to carry out our analysis, as it allows to departure from conventional theories of exchange rate determination, with respect to both the fulfillment of the UIP and the existence of a long-run equilibrium position for the value of the currency. Moreover, it permits to combine Tobin’s portfolio balance approach with the treatment of expectations and preferences over foreign denominated assets by Harvey (2009) and Westerhoff (2009). In fact, the central tenet of our framework is that abrupt changes in the portfolio composition of households towards (against) more complex financial products based on the price of commodities could lead to destabilizing dynamics in the exchange rate and in the current account of developing countries. As a result, the very notion of a stable attractor for the former is, in our opinion, at best questionable and should be replaced with a wider analysis of its determinants, especially the financial ones.

4. A brief description of the two economies and the transition flow matrix

The following parts will describe the SFC model. It is grounded on the Chapter 12 of Godley and Lavoie (2006) book, with the significant difference being the presence of a financial sector in both economies. These have been labelled as “US” and “LA”, and they will look like each other with some small, but significant, differences. Although the model contains over 106 equations, assumptions were made in critical area, such as trade, production and the behavior of the financial sector itself. For instance, households are all the same and they receive income from both wages and profits. Additionally, there is no room for capital accumulation. Finally, LA Central Bank let the exchange rate floating and holding constant reserves, while the US counterpart does not demand any foreign liabilities.

The second novelty is the presence of three additional assets, respectively time deposits and two new securities. We have branded the latter as “Commodity-Based Asset” (CBA) and “Derivatives” (DER), and we assumed that they are issued by the financial sectors of US and LA, respectively. With those terms we do not refer to any specific type of derivate contract. We define the acronym CBA referring to a generic type of derivative contract whose underline security is represented by a commodity, thus replicating how these contracts can generate profit as soon as there is an improvement in the commodity price market. Thirdly, we assumed that both the US and LA financial sectors carry out non-standard amount of functions; for instance, while they both provide deposits to their resident households and hold treasury bills issued by the local government, they additionally buy foreign bills and issues CBA (DER) securities to be sold to US (LA) savers. The CBA liability can be considered a securitized instrument similar to a derivative contract, whose price follows (or tends to replicate) some fundamentals of the emerging markets – most notably, commodity prices and returns on foreign T-bills. Thus, our US financial sector takes on an “originate and distribute” behavior, using LA bills as collateral for CBA contracts.
Finally, for the sake of simplicity, some of the traditional characteristics of the banking system are left out in both countries. The financial sector does not make loans, neither the CBs grants advances. In further works we will task ourselves with the proposal of reducing this heterogeneity.

On the flow side, as in Chapter 12 of Godley and Lavoie (2006a), households’ income comes from both real and financial sources (deposits and local bills for both US and LA citizens, plus Derivatives and CBAs). Moreover, all profits of the Financial Sector are redistributed to household in each country – just like CB’ profits are redistributed to Government. Thus, in both the economies households are “rentiers”. Finally, the LA Central Bank holds a fixed amount of reserves (US bills), letting the exchange rate to adjust freely. However, as the LA currency is not considered to have the same liquidity preference as the dollar, only the latter is used as the international reserve currency.

4.1 Arterial Flows

Section 1 describes the arterial flows of the model, that is, the fundamental capitals flows among countries originated by the interaction of real and financial sectors. We report from equation 1 to 16 the functioning of disposable income, wealth, capital gains, central bank’s profits, government budget constraint, and current and capital account.

Equation (1) and (2) describe the disposable income identity. This equation is enlarged with a new asset, the CBA. This asset originates capital gains, described in equations (5), which are calculated through variations in the price of the CBA. Shortly, it will be presented that the price of this asset is a function of commodity prices (exports) and interest rates. This specification differs from the derivative (DER) in equation (2), which relies only on the interest rate. Section 4 explains the difference in detail.

Equations (3) and (4) describe the accumulation of wealth by the household sector, which is calculated as the part of disposable income that is not consumed. Equations (7) and (8) concern the taxable income. They imply a fixed tax rate, \( \theta < 1 \), which is decided by the government, thus, we consider it as exogenous. Notice that the government in this case does not tax capital gains.

Central banks’ profits – equations (9) and (10) – are the sum of the capital gains earned by holding assets. The dollar is the reserve currency, thus, US Central Bank needs to hold only domestic bills, while the Latin central bank holds domestic and foreign bills as reserves. An important assumption here is that central bank profits are all paid back to the government.

The budget constraint reported in equation (11) and (12) describes the amount of bills that a country can issue. When government expenditures exceed the amount of taxes received plus the central bank’s profits paid back to the government – that is, when there is a primary budget deficit – the government issues more domestic bills.
Finally, equations (13) through (16) show the balance of payment identities. The current account balance (CAB) is the result of the trade balance and the interest on bills received from, and paid to, the foreign country. The capital account (KAB) tracks the variation in flows due to the bond market

Disposable income

(1) \[ YD^{US} = (Y^{US} + Fb^{US} + r^{US}_{(-1)} \cdot B^{US}_{d,(-1)} + r^{US}_{d,(-1)} \cdot D^{US}_{d,(-1)} + CBA_{d,(-1)} + CG^{US}) \cdot (1 - \theta^{US}) \]

(2) \[ YD^{LA} = (Y^{LA} + Fb^{LA} + r^{LA}_{(-1)} \cdot B^{LA}_{d,(-1)} + r^{LA}_{d,(-1)} \cdot D^{LA}_{d,(-1)} + DER_{d,(-1)} + CG^{LA}) \cdot (1 - \theta^{LA}) \]

Wealth

(3) \[ \Delta V^{US} = YD^{US} - C^{US} \]

(4) \[ \Delta V^{LA} = YD^{LA} - C^{LA} \]

Capital Gains

(5) \[ CG^{US} = (\Delta p_{cba}) \cdot CBA_{s,(-1)} \]

(6) \[ CG^{LA} = (\Delta p_{der}) \cdot DER_{s,(-1)} \]

Tax

(7) \[ T^{US} = (Y^{US} + Fb^{US} + r^{US}_{(-1)} \cdot B^{US}_{u,(-1)} + r^{US}_{d,(-1)} \cdot D^{US}_{d,(-1)} + CBA_{d,(-1)}) \cdot (\theta^{US}) \]

(8) \[ T^{LA} = (Y^{LA} + Fb^{LA} + r^{LA}_{(-1)} \cdot B^{LA}_{d,(-1)} + r^{LA}_{d,(-1)} \cdot D^{LA}_{d,(-1)} + DER_{d,(-1)}) \cdot (\theta^{LA}) \]

Central Bank profits

(9) \[ F_{cb}^{LA} = r^{LA}_{(-1)} \cdot B^{LA}_{u,(-1)} + r^{US}_{(-1)} \cdot B^{US}_{cba,(-1)} \cdot x^{US} \]

(10) \[ F_{cb}^{US} = r^{US}_{(-1)} \cdot B^{US}_{u,(-1)} \]

Government budget constraint

(11) \[ \Delta B^{US}_{s} = G^{US} - T^{US} + r^{US}_{(-1)} \cdot B^{US}_{s,(-1)} - Fcb^{US} \]

(12) \[ \Delta B^{LA}_{s} = G^{LA} - T^{LA} + r^{LA}_{(-1)} \cdot B^{LA}_{s,(-1)} - Fcb^{LA} \]

Current and Capital Account

(13) \[ CAB^{LA} = X^{LA} - IM^{LA} - r^{LA}_{(-1)} \cdot B^{LA}_{ubs,(-1)} + r^{US}_{(-1)} \cdot B^{US}_{bLA,(-1)} \cdot x^{US} + r^{US}_{(-1)} \cdot B^{US}_{cbLA,(-1)} \cdot x^{US} \]

(14) \[ KAB^{LA} = (\Delta B^{US}_{ubs,(-1)}) - (\Delta B^{US}_{cbLA,(-1)}) \cdot x^{US} - (\Delta B^{US}_{LA,(-1)}) \cdot x^{US} \]
\( \begin{align*}
CAB_{US} &= X_{US} - IM_{US} - r_{US}^{(-1)} B_{bLA}^{US} + r_{LA}^{(-1)} B_{bUS,s(-1)}^{LA} \times r_{LA}^{LA} + r_{US}^{LA} \times B_{cbUS,s}^{LA} - r_{US}^{LA} \times \_s \times r_{LA}^{LA} \\
KAB_{US} &= (\Delta B_{bLA,s}^{US}) - (\Delta B_{cbUS,s}^{LA}) \times r_{LA}^{LA} - (\Delta B_{US,s}^{LA}) \times r_{LA}^{LA}
\end{align*} \)

4.2 Trade

This section describes the trade between countries. Equations (17) through (28) formalize the relations among prices and quantities of goods and services exchanged between Latin America and the US.

Prices between countries are symmetric, that is, import prices for Latin America equal export prices for the US. Trade flows are measured in real term, as shown in equation (19) and (20) - variables in bold are natural logarithms, a transformation that allows to introduce elasticity among quantity demanded for exports (imports), domestic and foreign prices, and domestic income. According to equation (23) and (24), Latin exports are all absorbed by US imports, and vice versa.

As explained in Godley and Lavoie (2006), if the Marshall-Lerner condition were applied, the sum of price elasticity of export and imports would be greater than one. This would ensure that depreciation translates into a greater demand of goods, thus boosting growth. According to Carnevali (2018), this is translated into a specific condition for SFC models, that is, currency depreciation affects only import prices, while export prices are held constant. In other words, prices are assumed to be fixed in the currency of the exporter. This assures that a country experiences a deterioration in the terms of trade as soon as currency depreciation materializes.

Export and Import prices

\( \begin{align*}
\pi_{xUS} &= p_{m}^{LA} \times x_{LA}^{LA} \\
\pi_{mUS} &= p_{x}^{LA} \times x_{LA}^{LA}
\end{align*} \)

Export and Import real quantities

\( \begin{align*}
X_{LA} &= \epsilon_{LA}^{LA} - \eta_{LA}^{LA} \times (p_{m-1}^{US} - p_{y_{-1}}^{US}) + \epsilon_{LA}^{LA} \times y_{US} \\
M_{LA} &= \phi_{LA}^{LA} - \psi_{LA}^{LA} \times (p_{m-1}^{LA} - p_{y_{-1}}^{LA}) + \pi_{LA}^{LA} \times y_{US} \\
p_{x}^{LA} &= \chi_{0}^{LA} + \chi_{1}^{LA} \times p_{y}^{US} + (1 - \chi_{1}^{LA}) \times p_{y}^{LA} - \chi_{1}^{LA} \times x_{LA}^{LA} \\
p_{m}^{LA} &= \mu_{0}^{LA} + \mu_{1}^{LA} \times p_{y}^{US} + (1 - \mu_{1}^{LA}) \times p_{y}^{LA} - \mu_{1}^{LA} \times x_{LA}^{LA} \\
x_{US} &= m_{LA}
\end{align*} \)
4.3 Income and Expenditure

The block of income and expenditure follows closely the one defined in Godley and Lavoie (2007, Chapter 12). Again, real and nominal values are in lower and upper case, respectively, while the superscripts depict the nationality. Real disposable income is of the Haig-Simon type – i.e. gross of any inflation loss – while consumption depends both on lagged real wealth and real expected disposable income (33-34), which is assumed to be a simple average based on the past value of (31-32). Real sales are the sum of the domestic sales, which in turn are composed of household and government consumption (47-48), plus real exports. Prices are set with a mark-up over unit costs, according to equation (41-42), which includes the wage bill and imports demand – i.e., there are no trade in intermediary goods between the two economies. Therefore, the domestic output (both real and nominal) is defined as sales minus imports (49-52), with the GDP deflator being simply the ratio between nominal and real output (53-54). Finally, employment is the inverse of labor productivity (59-60), which in this model is set exogenously.

\[
\begin{align*}
\text{(29)} & \quad v^\text{LA} = \frac{v^\text{LA}}{p^\text{d} \text{LA}} \\
\text{(30)} & \quad v^\text{US} = \frac{v^\text{US}}{p^\text{d} \text{US}} \\
\text{(31)} & \quad yd^\text{LA} = \frac{yD^\text{LA}}{p^\text{d} \text{LA}} - \frac{\Delta p^\text{LA}}{p^\text{d} \text{LA}} \\
\text{(32)} & \quad yd^\text{US} = \frac{yD^\text{US}}{p^\text{d} \text{US}} - \frac{\Delta p^\text{US}}{p^\text{d} \text{US}} \\
\text{(33)} & \quad c^\text{LA} = \alpha^\text{LA} \cdot yd^\text{LA} + \alpha^\text{LA} \cdot v^\text{LA} (-1) \\
\text{(34)} & \quad c^\text{LA} = \alpha^\text{LA} \cdot yd^\text{LA} + \alpha^\text{LA} \cdot v^\text{LA} (-1) \\
\text{(35)} & \quad yd^e = \frac{yd^\text{LA} + yd^\text{LA} (-1)}{2} \\
\text{(36)} & \quad yd^e = \frac{yd^\text{US} + yd^\text{US} (-1)}{2} \\
\text{(37)} & \quad s^\text{LA} = c^\text{LA} + g^\text{LA} + x^\text{LA} \\
\text{(38)} & \quad s^\text{US} = c^\text{US} + g^\text{US} + x^\text{US} \\
\text{(39)} & \quad s^\text{LA} = s^\text{LA} \cdot p^\text{LA} \\
\text{(40)} & \quad s^\text{US} = s^\text{US} \cdot p^\text{US}
\end{align*}
\]
4.4 Financial Intermediaries

We are now getting to the innovative part of our model, namely the financial sector. In both countries, LA and US, it works in a similar way, except for the equations describing the behavior of the two structured assets, namely the CBA set (issued by the intermediaries in the US) and the Derivative (issued by the intermediaries in the LA). It is worth notice that the financial sector does not expressively consider commercial banks as their role in distributing financial instruments to households would be marginal. Indeed, it would be interesting to add commercial banks whether we were considering modelling the financing process of the production sector. However, this is out the scope of the present work, thus, in order to keep things simpler, we avoid including them.
Equations (61-68) state the budget constraint of the intermediaries, expressed in terms of their demand of US bills; as depicted in the vertical column of our transaction flow matrix (see appendix), liabilities of the financial sector are made of deposits and securitized assets (CBA and DER). The asset side of their balance sheets is made of domestic and foreign bills as well as Central Banks’ liabilities expressed in form of High-Powered Money (HPM). Financial intermediaries must hold a proportion of the HPM based on how many deposits they actually issue (62-69). Similarly, they must hold a certain quantity of foreign bills for each CBA or derivative they provide to households (63-70). The main difference between the two securities lies in the dynamic of their prices: whereas for the derivative in the Latin American economy is simply the inverse of its yield, the one of the CBA depends also on the natural logarithm of the price of exports of the foreign economy (66-73).

In equation 66, we assume that the export prices are a proxy for commodity prices. This is quite realistic for commodity-export country that relies solely on one commodity, such as Chile does with copper. However, it is worth remembering that small-open, peripheral economy do not have the market power to affect commodity prices, which means they are price takers. Hence, we will refer to the exogenous parameter, $\chi_0^{LA}$, of equation 21 when we perform shocks to evaluate case scenarios in the following section. The price formula states that as commodity prices increase, the CBA’s price rises. When commodity-export countries experience a boom, it is often associated with higher export prices. Thus, when export prices are high, financial securities in those countries are more expensive. This logic implies a positive relationship between CBA and exports price. In addition, the price of CBA follows closely the performance of the credit market. As risk increases - that is, the interest rate increases - the price of the CBA will drop.

The assumptions behind the definition of this asset are meant to capture the process of securitization carried out by transnational banks and investment funds on both commodities and liabilities of resource-dependent countries. In this sense, the intermediaries here represented are solely focused on “originate-to-distribute” kind of operations, rather than the standard “originate-to-hold” ones. Hence, it should come with no surprise if loans are out of the picture, as in Bonizzi (2015). In contrast with his work, we have allowed the financial sector in LA to issue their own structured liabilities, since Latin America have progressively seen their economy becoming more financialized, and started to follow the typical practices of the financial intermediaries in advanced countries (Abeles, Pérez Caldentey e Valdecantos, 2018). Furthermore, due to the increasing weight of these operations, they have become an essential feature of modern financial sectors - both in developed and developing countries. Thus, just as mortgages became the “raw materials” of which complex instruments are made of (Caverzasi et al, 2019), we argue that also commodities have been playing a similar role for LA currency
derivatives. In this sense, (63), (66) and (70) should be regarded as a (extremely) simplified representation of the aforementioned processes.

Intermediaries profits’ (67-74) are computed as the difference between their lagged interest payment inflows (namely on bills) and outflows (on Deposits and Derivatives), gross of any capital gains (losses) they benefit (bear) on foreign bills. These gains differ from those of the households, since they are calculated on the change of the nominal exchange rate rather than on the price of the structured security (65-72). Finally, interest rates on deposits moves in line with the returns on local bills (64-71).

US Financial sector

\[
B_{b,d}^{US} = D_{s}^{US} - B_{bUS,d}^{LA} - H_{b,d}^{US} + P_{eba} \times CBA_{s}
\]

\[
H_{b,d}^{US} = \rho_{0}^{US} \times D_{s}^{US}
\]

\[
B_{bUS,d}^{LA} = \rho_{1}^{US} \times CBA_{s}
\]

\[
\Delta r_{d}^{US} = \rho_{2}^{US} \times \Delta r_{US}
\]

\[
CG_{b}^{US} = (\Delta x r_{LA}) \times B_{bUS,s(-1)}^{LA}
\]

\[
P_{eba} = \frac{1}{r_{eba}} + p_{LA}^{\text{der}}
\]

\[
r_{b}^{US} = r_{(-1)}^{US} \times B_{bUS,d(-1)}^{LA} - r_{d}^{US} \times D_{s(-1)}^{US} + r_{(-1)}^{LA} \times B_{bUS,d(-1)}^{LA} \times x r_{LA} + CG_{b}^{US} - CBA_{s(-1)}
\]

LA Financial sector

\[
B_{b,d}^{LA} = D_{s}^{LA} - B_{bLA,d}^{US} - H_{b,d}^{LA} + P_{der} \times DER_{s}
\]

\[
H_{b,d}^{LA} = \rho_{0}^{LA} \times D_{s}^{LA}
\]

\[
B_{bLA,d}^{US} = \rho_{1}^{LA} \times DER_{s}
\]

\[
\Delta r_{d}^{LA} = \rho_{2}^{LA} \times \Delta r_{LA}
\]

\[
CG_{b}^{LA} = (\Delta x r_{US}) \times B_{bLA,s(-1)}^{US}
\]

\[
P_{der} = \frac{1}{r_{der}}
\]

\[
r_{b}^{LA} = r_{(-1)}^{LA} \times B_{b,d(-1)}^{LA} - r_{d}^{LA} \times D_{s(-1)}^{LA} + r_{US}^{(-1)} \times B_{bLA,d(-1)}^{US} \times x r_{US} + CG_{b}^{LA} - DER_{s(-1)}
\]

### 4.5 Assets Demand and Supply and Exchange Rate Closure

\footnote{For a more detailed description of the process of securitization see Caverzasi et al (2019), while for a more specific focus on how this process work in developing countries see Ocampo et al (2009) and Kaltenbrunner and Panceira (2017).}

\footnote{Still, as the exchange rate is effectively a price (Frenkel and Repetti, 2010), foreign bills are by all means subject to these gains (losses).}
This section describes how assets are supplied and demanded. Assets demand of households in the two countries follows the principles put forward by Brainard and Tobin (1969). They are expressed in the usual matrix form, wherein the vertical and horizontal constraints must be respected at once. The former implies that the sum of the autonomous and non-autonomous coefficients must add up to one and zero respectively, while the latter postulates that also the non-autonomous coefficients within the demand for each asset must yield zero\(^6\).

The model assumes, in line with Godley and Lavoie (2006), the supply of assets matches demand. Equations (83) to (94) show all the identities for the several asset classes used in the model. Moreover, changes in central banks stocks of domestic Treasury bills are equal to changes in the liabilities of each central bank, as shown in equation (95) and (96). Once again, the equation for the LA central bank is enlarged with foreign bills held as reserves.

Having defined all the equations for both countries, it is now possible to close the model using the exchange rate. Equations (99) to (103) define the exchange rate for Latin America as the ratio between supply and demand of domestic bills. Higher (lower) demand of bills appreciates (depreciates) the exchange rate. Notice that (102) implies an upward (downward) movement for appreciation (depreciation). The reader could argue that this closure makes the nominal exchange rate only dependent upon the supply and demand of foreign assets; however, this could be a misleading interpretation, since the model is a fully interdependent one. Consider for instance foreign bills’ demand: this would depend on how much “leverage” intermediaries could make in issuing their structured papers, which in turn would depend on households’ wealth, income, and so on. This is the essence of the financial view on exchange rate adopted by our work; it means, encompassing explicitly money and financial transactions among the determinants of the exchange rate. Furthermore, the choice of a flexible exchange rate regime shall not be considered as a simplification, but rather as a step towards realism, as most of the Latin American countries nowadays implement pragmatic managed floating strategies - i.e. influencing it with a wide array of policy instruments, but without pursuing any explicit commitment (Frenkel and Repetti, 2011). Finally, (104) is the redundant equation that is logically implied by the other equation, and therefore can be dropped.

\[ B_{LA,d}^{LA} = V^{LA} (\lambda_{10}^{LA} + \lambda_{11}^{LA} * r^{LA} + \lambda_{12}^{LA} * r_d^{LA} + \lambda_{13}^{LA} * r_{der}) \]
\[ D_{d}^{LA} = V^{LA} (\lambda_{20}^{LA} + \lambda_{21}^{LA} * r^{LA} + \lambda_{22}^{LA} * r_d^{LA} + \lambda_{23}^{LA} * r_{der}) \]
\[ P_{der} * DER_{s} = V^{LA} (\lambda_{30}^{LA} + \lambda_{31}^{LA} * r^{LA} + \lambda_{32}^{LA} * r_d^{LA} + \lambda_{33}^{LA} * r_{der}) \]

\[ B_{US,d}^{US} = V^{US} (\lambda_{10}^{US} + \lambda_{11}^{US} * r^{US} + \lambda_{12}^{US} * r_d^{US} + \lambda_{13}^{US} * r_{cba}) \]

\(^6\) Formally, for the vertical constraint to be realized it must be that \(\lambda_{10}^{i} + \lambda_{20}^{i} + \lambda_{30}^{i} = 1\) and \(\lambda_{1k}^{i} + \lambda_{2k}^{i} + \lambda_{3k}^{i} = 0\), while the horizontal constraint implies \(\lambda_{j1}^{i} + \lambda_{j2}^{i} + \lambda_{j3}^{i} = 0\).
\( D_{\text{US},d}^{US} = V^{US} \ast (\lambda_{20}^{US} + \lambda_{21}^{US} \ast r^{US} + \lambda_{22}^{US} \ast r_d^{US} + \lambda_{23}^{US} \ast r_{cba}) \)

\( P_{cba} \ast CBA_s = V^{US} \ast (\lambda_{30}^{US} + \lambda_{31}^{US} \ast r^{US} + \lambda_{32}^{US} \ast r_d^{US} + \lambda_{33}^{US} \ast r_{cba}) \)

**Demand for cash**

\( H_{\text{US},d}^{US} = V^{US} - B_{\text{US},d}^{US} - D_{\text{US},d} - P_{cba} \ast CBA_{s,d} \)

\( H_{\text{LA},d}^{LA} = V^{LA} - B_{\text{LA},d}^{LA} - D_{\text{LA},d} - P_{der} \ast DER_{s,d} \)

**Supply of stocks equals demand**

\( H_{s}^{US} = H_{d}^{US} \)

\( H_{s}^{LA} = H_{d}^{LA} \)

\( D_{s}^{US} = D_{d}^{US} \)

\( D_{s}^{LA} = D_{d}^{LA} \)

\( B_{\text{US},s}^{US} = B_{\text{US},d}^{US} \)

\( B_{\text{LA},s}^{LA} = B_{\text{LA},d}^{LA} \)

\( CBA_{s} = CBA_{d} \)

\( DER_{s} = DER_{d} \)

\( B_{b,s}^{US} = B_{b,d}^{US} \)

\( B_{b,s}^{LA} = B_{b,d}^{LA} \)

\( H_{b,s}^{US} = H_{b,d}^{US} \)

\( H_{b,s}^{LA} = H_{b,d}^{LA} \)

\( B_{cbUS,s}^{US} = B_{cbUS,d}^{US} \)

\( B_{cbLA,s}^{LA} = B_{cbLA,d}^{LA} \)

**Changes in central banks stocks of domestic Treasury bills are equal to changes in the liabilities of each central bank**

\( (\Delta B_{cbUS,d}^{US}) = (\Delta H_{s}^{US}) + (\Delta H_{b,s}^{US}) \)

\( (\Delta B_{cbLA,d}^{LA}) = (\Delta H_{s}^{LA}) + (\Delta H_{b,s}^{LA}) - (\Delta B_{cbLA,d}^{US}) \ast x_{r}^{US} \)

**Exchange rate closure**

\( x_{r}^{US} = \frac{1}{x_{r}^{LA}} \)

\( B_{bUS,s}^{LA} = B_{bUS,d}^{LA} \ast x_{r}^{US} \)

\( \Delta B_{cbLA,d}^{US} = \Delta B_{cbLA,s}^{US} \ast x_{r}^{US} \)

\( x_{r}^{LA} = \frac{B_{bLA,s}^{LA}}{B_{bLA,d}} \)

\( B_{bLA,s}^{US} = B_{bLA,s}^{US} - B_{bUS,s}^{US} - B_{cb,s}^{US} - B_{cbLA,s}^{US} - B_{b,s}^{US} \)

\( B_{bLA,s}^{US} = \frac{B_{bLA,d}^{US}}{x_{r}^{US}} \)
5. Scenarios analysis

This section explores different scenarios by introducing shocks in the model. Shocks are meant to replicate real macro-financial events that determine movements in the exchange rate. Four scenarios are reported: I) changes in LA propensity to export; II) changes in the desire to hold CBAs; III) oscillations in LA export prices; IV) joint effect of a shift in LA export prices and a change in portfolio composition towards CBAs. Scenarios I) and II) will be compared with the same experiments carried out in the OPENFLEX model by Godley and Lavoie (2006), in order to highlight the main differences with respect their model.

The first two shocks are an intent to replicate results presented in Godley and Lavoie’s Chapter 12. We use them to validate our model and control that the variables in the model are responding in a proper way. The third shocks replicate a pure macro shock, namely, a shock in the exogenous component of the export price (equation 21). This shock can be interpreted as increase in the exogenous demand for the commodity the peripheral economy export – for example, an increase in copper prices due to higher demand from China, such as in 2003-2014. Finally, we are interpreting the last shock as macro shock in the presence of a speculative financial sector. This means imposing a shock not only on export prices, but also in the exogenous component of the demand for CBA ($\lambda^{US}_{30}$), which we define as the US preferences to hold Latin CBA.

5.1 Changes in LA propensity to export

As expected, a brisk fall in LA exports causes the exchange rate in this country to depreciate against the dollar, as both the trade and current account suddenly deteriorates, driving down output and prompting the government in a deficit position. Consequently, the total outstanding stock of debt will have to rise, including those bills supplied to foreign financial intermediaries. As pointed out earlier, a fall in the LA exchange rate will cause export and import prices to rise and the terms of trade to deteriorate. However, thanks to a depreciated currency, exports will recover promptly, and the trade account will revert almost completely towards a balanced position, with the current account stabilizing in a small deficit position. Although the overall process resembles the same scenario depicted in Godley and Lavoie (2006), there are nonetheless two remarkable differences: first, the $xrla$ correction is brisker, and the new level achieved is slightly more depreciated, with the ensuing shift in both trade and current account being more immediate; second, the two balances end up in a completely different steady state with respect
the OPENFLEX model, which instead displays in the long run a trade surplus and a current account equilibrium, respectively.

These different outcomes are caused by the presence of new agents (LA and US financial sectors) and stocks (Derivatives, CBA). In particular, the higher devaluation of the LA currency is due to the presence of CBAs: in fact, as income in the US will rise and households will save more, their demand for assets will rise. The US financial sector will prop up its demand for LA liabilities, as it will require more of them in their portfolio to answer the demand for their securitized assets, matching the increased supply of US bills. This explains why the swing is more pronounced and the adjustment process faster; however, it also explains why both current and trade account end up being in a lower steady state. Increased interest payments on the larger stock of LA bills are behind the minus sign in LA current account, while the trade surplus does not materialize because the output recovery – and thus, import demands - is quicker in LA.

Figure 1: Effect of a decrease in the LA propensity to export on US and LA nominal exchange rate
Figure 2: Effect of a decrease in the LA propensity to export on US and LA current and trade account

5.2 Changes in the desire to hold CBAs

Similar explanations apply when considering the difference with respect the change in liquidity preferences between our model and OPENFLEX. A shift in portfolio composition towards CBAs leads to a sudden appreciation of $x_{rLa}$, which is immediately reflected into a current account deficit as well as in a lower output. This will cause LA tax revenues to fall and the government to run a budget deficit, issuing new government debt in form of LA bills, and gradually stabilizing the currency and the external balance. The additional step consists in the financial sector demanding foreign asset in order to accommodate the demand for their backed papers. The adjustment process is, overall, faster and the steady state variables more stable in comparison with the same scenario in Godley and Lavoie (2006). This stability comes to a cost of a less pronounced trade surplus, and to higher off the equilibrium values.
Figure 3: Effect of an increase in the desire to hold CBAs on US and LA nominal exchange rate.

Figure 4: Effect of an increase in the desire to hold CBAs on US and LA current and trade account.
5.3 Fluctuations in LA export prices

A country that depends heavily on commodity exports, such as Chile, shows a strong relationship between the value of its currency and the international price of commodities. Thus, an increase in commodities prices is simulated in the model by increasing 10 percent the autonomous growth component for export prices - the parameter $\chi_0^{LA}$ in equation (21) - for the period 2003-2013. Then we impose a 20 percent decrease on the parameter starting from 2014. The reason why the two price shocks are asymmetric relies on the price formula. We express export prices in logarithms, which is a measurement of change in growth rate. Imposing a smaller shock for the period 2003-2014 means the prices rose at lower rate than the fall after the end of the commodity boom.

The increase in exports prices immediately lifts export revenues, although the trade balance deteriorates shortly afterwards; this is due to the fact that the GDP deflator in LA reacts with a lag to the new level of prices, as expectations on disposable income are based on a simple average on past values, as in (35-36). Hence, in the third year after the shock, both current and the trade account return towards their long-run convergence path driven by the (appreciating) dynamic of the LA exchange rate. Again, trade balances start to return faster (although not completely) to the original steady state than current accounts due to increased interest payments on the external debt – heavily influenced by the presence of the securitized assets, as the LA financial sector will demand more US bills according to (70).

Then, this movement is interrupted by a 20 percent decrease in the parameter $\chi_0^{LA}$. The outcome of the shock is the mirror image of what happened in the first price hike, with the notable difference that this time the correction is more violent, given the dimension of the change. The new steady state, as a result, will be characterized for LA by both a current account and trade deficit - with the latter less pronounced than the former.
Figure 5: Effect of a increase in the LA export prices on US and LA nominal exchange rate

Figure 6: Effect of a increase in the LA export prices on US and LA current and trade account
5.4 Change in LA export prices and in portfolio composition towards CBAs

This is the most realistic experiment we are conducting on the model. The aim is to introduce two shocks in the attempt of reproducing the stylized facts for the commodity boom period experienced in Chile from 2003 to 2014.

Two shocks reproduce the following process. First, an increase in commodities prices that leads to higher demand for CBAs. This is replicated by increasing 10 percent the parameter $\chi_0^{LA}$ in equation (21) for the period 2003-2013. In turn, the increase in export prices shifts the price of CBAs. Growing asset prices in an emerging market makes international investors to increase their risk appetite, which translates into a shift in portfolio preferences. However, the shift in preference is not contemporaneous to the increase in exports prices, as expectations require time before adapting to the new macroeconomic environment. Thus, we assume that US investors rebalance their portfolios one year after the commodity price shock occurred. Investors reallocate portfolios by reducing their position in high-powered money in favor of CBAs. That is, from 2004 to 2014 there is a reduction in $\lambda_{20}^{US}$ in equation (79) counterbalanced by an increase in $\lambda_{30}^{US}$ in equation (80).

We introduce a second shock in 2015. We reduce export prices by 20 percent, followed one year later by a portfolio readjustment of the US investors. We assume that the readjustment doesn’t lead to the portfolio composition held prior to the 2003 increase in commodity price. In turn, we assume that international investors now have less appetite for riskier assets, which implies that $\lambda_{30}^{US'} > \lambda_{30}^{US''}$. Figure 7 and 8 show the result of the simulation on the exchange rate and balance of payment, respectively.

As export prices and preferences for CBAs rise, so does the LA exchange rate. This means that LA exchange rate appreciates vis-a-vis with the dollar. An appreciation of LA currency has consequences in the whole system, though. The appreciation makes exports more expansive, which in turn deteriorate both trade balance and current account, as shown by the fall in the two variables reported in figure 7. Now, we have a trade deficit with an appreciated currency which needs to be equilibrated somehow. This is possible only through a depreciation of the LA currency.

The second shock in prices occurs in 2015, when they fall by 20 percent. The effect on the trajectory of the LA exchange rate is the opposite compared to the prior shock. A negative shock in exports prices affects economic growth as well as CBAs prices. International investors change again their preferences and now they want to sell LA securities and hold high-powered money, driving the value of the exchange rate down (depreciating). The drop in LA exchange rate is
observed in 2015 in figure 7. With a more depreciated currency, LA can sell more exports and improve its current account.

The first thing to notice when introducing a financial shock in the model, the exchange rate experiences a higher level of volatility. While in the pure macro shock scenario the exchange rate appreciates until 1.08 then falls to 0.92, during the macro-financial shock the currency appreciates to 1.30 then falls to 0.90. Shifts in preferences contribute to create swings in the currency. This is an important element to consider from a policy making standpoint. Indeed, if exchange rate policies were to be used to promote development – as several schools of thought prescribe - currency stability would be undermined by speculative behaviors such as the initial euphoria fed by self-fulfilling prophecy and flight-to-quality outflows generated by the end of the euphoria.

In addition, it is worth comparing the long run behavior of the exchange rate during the two different scenarios. In scenario 3, the steady state level for the nominal exchange rates stabilizes at 0.92, while in scenario 4 reaches 0.92. That is, in the presence of financial markets the currency ends up to a more depreciated level, compared with a pure macro shock. More importantly, after the 2014 drop in export prices and preferences for the CBA it reaches the level 0.7. It takes more than 20 years to go back from the highly depreciated level to the steady state. In other words, financial shocks are not neutral in the long run, as some researchers would argue. On the contrary, they have the power to deviate the exchange rate from its long run steady state for a significant period. Real life data for Chile support this theoretical conclusion. This is, for example, the case for the Chilean peso. Prior to the 2003 copper increase, the currency traded at 660 pesos per dollar. When the boom reached its end, in 2015, the currency was exchanged at 707, a 7 percent less than before the beginning of the episode.

It is also important from the balance of payment perspective. Comparing figure 8 with 6, it shows a higher level of volatility in both current and trade account. Fluctuation in these variables requires a constant adjustment of macro prudential policy to restore a sustainable position in the balance of payments. This comes, however, with a price for development. As the Latin American experience shows, restoring sustainable positions requires drastic macroeconomic adjustment, which often comes at the expenses of the most vulnerable proportion of the population.
Figure 7: Joint effect of an increase (decrease) in export prices and in the desire to hold CBAs on US and LA nominal exchange rate.

Figure 8: Joint effect of an increase (decrease) in export prices and in the desire to hold CBAs on US and LA current and trade account.
6. Some limitations of the simulation

Even if the model replicates the real exchange swings for Chile for 2003-2014, we need to comment some limitations of our model that will be addressed in forthcoming works. A weakness of the model consists in the absence of an accumulation process – and henceforth, of capital goods.

As it is the case for Latin America, these kinds of stop-and-go swings happen to influence not only the short-term, but also the long-term dynamics (Botta, 2019). In particular, neither the technological dependence nor the catching up can be properly represented, although there is wide evidence that the instability of the nominal exchange rate could negatively affect both of them (Colacelli, 2010; Goya, 2014: 2018).

Furthermore, expectations play only a limited role and they follow quite simple rules; this is obviously not true when analyzing international financial operations involving institutions with multiple objectives and more importantly, deeply interconnected balance sheets (Harvey, 2007).

Finally, the model implies two non-explicit assumptions when describing the entire speculation process: (i) that speculation comes from operations carried out by the US financial sector; (ii) the speculative process refers to the LA currency, involved in the process through CBA trading. But (i) overlooks the growing importance of asset management activities as well as the growing complexity of banks and other financial institutions in Chile (Carreño and Cox, 2014).

As a result, carry trade operations increased to exploit the differential between the interest rates in the US and in Chilean economy. Such operations are completely different with respect to (ii), and they would require a more sophisticated portfolio specification for our financial sector, though this could be easily manageable within the present theoretical framework – besides implying a more active role for interest rates, that for the sake of simplicity have been assumed as fixed.

7. Conclusions

The aim of our work was to show how the presence of global financial intermediaries shapes exchange rates and balance of payments in open economies dependent on commodities such as the one of Chile. In order to capture the various channels through which these influences could manifest, we adopt a Stock-Flow Consistent framework, building a two-economy model closely resembling the OPENFLEX model presented in Chapter 12 of Godley and Lavoie (2006).

Our main innovation has been to include explicitly a simplified financial sector in both economies, engaged in speculative activities on the currency of our LA country. We introduced two securitized assets (Commodity-Based Assets in LA, Derivatives in the US), issued by the financial sector and backed by foreign bills, and we included them in the portfolio choice equation of households. Finally, we simulated four scenarios, two relatively straightforward – a
fall in autonomous demand for LA export and a shift in the preference for CBAs – and two more closely resembling the commodity boom (and bust) cycle that unfolded between 2003 and 2014 – a rise in export prices that abruptly comes to an end and the same shock coupled with a symmetric portfolio shift for CBAs.

The main takeaways for our paper are the following:

1) unfettered financial markets such as the ones depicted in our models lead our small world system to react more promptly when hit by shocks, both in terms of deviation from and convergence towards the long run steady state. Nevertheless, when compared with the OPENFLEX simulations, the external balances end up in a lower position, and remarkably the current account scores a deficit position, due to the increased interest payment on the foreign owned debt;

2) nominal exchange rates, when affected, follows a “J” dynamic: they first appreciate (depreciate) and then they slowly depreciate (appreciate), stabilizing at a new – and more devalued (overvalued) – level than the baseline;

3) in the short run, the effect of a shift in portfolio preferences on exchange rates is stronger than any change in parameters related to trade, although the reverse is true for the long-run. In other words, the value of the currency tends to respond initially more to variables related to the financial account than those related to the current account, while deviations in the latter settle permanently exchange rates at higher (lower) levels.
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