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BOLIVIANIZATION AND EFFECTIVENESS OF THE MONETARY POLICY

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ABSTRACT

This research paper examines whether the expansion of the degree of bolivianization of the financial system has implications in terms of a greater effectiveness of the monetary policy. In this regard, an estimation is made of the function associated to the liquidity of the financial system, as the operational objective of the Central Bank of Bolivia's monetary policy. The explanatory variables considered are the interactions between the instruments of the monetary policy, which are the Open Market Operations and the monetary regulation rate, with bolivianization of the financial system. The incorporation of these interaction variables approximates the variable effects of each instrument on liquidity control of the financial system for each specific value of the bolivianization in the period covered by the analysis. In addition, a Structural VAR is estimated which interrelates bolivianization and the variables making up the instruments, transmission mechanisms and the target variables of the monetary policy, with the aim of analyzing the implications of the effects of the bolivianization on the monetary policy transmission.

Classification JEL: C10, E52, E58

Keywords: Bolivianization, Monetary Policy

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I. INTRODUCTION

There is general consensus in economic literature regarding the benefits of dedollarization of an economy, particularly for monetary policy operations. Since the second five-year period of the 21st century, Bolivia has devoted itself to strengthening the national currency, which has been evident mainly in a decrease of the degree of dollarization of the financial system.

For the Bolivian case, one of the possible benefits resulting from bolivianization is the lower transaction costs by eliminating the losses associated to buying and selling foreign currency (e.g. dollars). Moreover, strengthening the national currency helps improve the debt payment capacity. Likewise, the bolivianization has contributed to an increase of the Net International Reserves (NIR), given that the reduction of financial transactions in foreign currency, mainly attributed to the fact that savings in foreign currency are replaced by savings in bolivianos, entailed more exchange transactions in which the monetary authority benefited from the foreign exchange accumulation. Concurrently and in line with the research objective of this paper, effectiveness of the monetary and exchange policy became stronger as the bolivianization deepened; this element has an impact on greater degrees of freedom for the monetary policy in the application of countercyclical policies.

Within this framework, the research objective of this paper is to analyze whether the monetary policy is more effective in a context of greater bolivianization. In this sense, using the Generalized Method of Moments an estimation is made of a function associated to liquidity of the financial system, which includes variables on the interaction between monetary policy instruments and bolivianization, with the aim of approximating the effects of those instruments in liquidity control for the different levels of bolivianization in the period covered by the analysis. Liquidity of the financial system is the operational objective of the monetary policy implemented by the Central Bank of Bolivia (BCB, in Spanish). In a complementary way to the previous approach and with the aim of providing evidence about the impact of the bolivianization on the BCB's monetary policy transmission flow through the financial system, is estimated using a Structural Autoregressive Vector model that shows the interrelations between the bolivianization and the variables making up the instruments, transmission mechanisms and target variables of the monetary policy.

This paper is divided into six sections. The first one is the introduction. The second section provides an overview of references in economic literature about the relationship and the implications of dedollarization in the monetary policy. The third one presents an analysis of the stylized facts concerning the variables that allow to operationalize the BCB's monetary policy and its relationship with the bolivianization into practice. The fourth section focuses on the methodological framework and the data used to obtain the results. Finally, the fifth and sixth sections present the results and conclusions.

II. LITERATURE REVIEW

High levels of dollarization may entail a series of complications that affect behavior of the monetary and exchange policy. Agénor and Montiel (2008) summarize these complications in

four spheres. First, dollarization implies a loss of income from seigniorage because of the lower demand for a monetary base of domestic currency; this reduction in the inflation tax base may lead to higher inflation, which may in turn have an impact in terms of a greater reduction of the balances in national currency (i.e. a greater dollarization)¹. Second, the dollarization complicates the choice of the assets which policymakers should consider in the monetary aggregates as indicators of the monetary conditions and as target variables, given that the aggregates that include money and deposits in foreign currency, as a medium of exchange, tend to distort the link between domestic money and inflation. Third, in essence the dollarization is indexed to bank deposits and to the exchange rate, i.e. the value (in national currency) of the deposits in foreign currency increases proportionately to the depreciation of the exchange rate; moreover, to the extent that loans are granted in foreign currency and deposits are held in national currency, the resulting currency mismatch may weaken the banks' balance sheets if the exchange rate depreciates and the lending rates are not adjusted to absorb the loss of capital for loans in foreign currency. This weakness may force the central bank to intervene with liquidity contributions, which would in turn enhance inflationary pressures. Fourth, the dollarization affects the choice of the exchange rate regime, given that in the short term it may imply high obligations in foreign currency which will be covered by the financial system's foreign exchange reserves; in this setting, an increase of the deposits in foreign currency may enhance vulnerability of the financial system and the exchange rate to an abrupt change in market confidence and capital flows. At the same time, the dollarization may imply a high degree of exchange rate volatility as the result of a persistent and unpredictable increase in foreign currency use for transactions².

With regard to dollarization of the financial system, Levy-Yeyati (2004) finds evidence that economies with highly dollarized financial systems tend to have domestic prices that are highly sensitive to the creation of money and high rates of inflation. In addition, their results suggest that dollarization of the financial system may result in a greater propensity of the banking sector to suffer systemic crises and a slower and more volatile output growth, without any visible gains in terms of financial system depth.

Among other papers addressing the implications of dollarization in the monetary sector, we can site the work of Fabris et al. (2004), which points to the following main problems derived from a high level of dollarization: i) the loss of foreign exchange reserves; ii) the supply of money is regulated exogenously (i.e. it is determined by the situation of the country's balance of payment); iii) effectiveness of the monetary policy instruments and the exchange rate is reduced; iv) problems to implement an independent monetary policy, particularly if the countries are in different stages of the economic cycle (e.g. if an economy faces a recession it will lower its monetary regulation rate, but if it has high levels of dollarization and the United States economy increases its monetary regulation rate because it is going through a boom phase, opposite policies are generated); v) if there is a systemic crisis in the financial system,

¹ Evidence on this topic can be found in Edwards and Magendzo (2006).

² Evidence on this topic can be found in Nicoló et al. (2005).

the central bank cannot act as a lender of last resort; vi) diminishment of the seigniorage possibilities; and vii) limited response in case of external shocks since the exchange rate cannot be used as an adjustment instrument.

In his analysis of the factors determining inflation in dollarized economies, for the case of Vietnam Goujon (2006) finds that in the 1990s inflation in this country was explained by exchange rate variations and excess money. Within this framework, he says that for a highly dollarized economy the concept of money should include the deposits in foreign currency in the banking system; moreover, for controlling the monetary expansion it is necessary to control the exchange rate, not only to control imported inflation but also because of the impact of exchange rate movements on non-tradable goods denominated in foreign currency. Therefore, in dollarized countries it may be that mistaken conclusions are drawn as regards effectiveness and complementarity of the monetary and exchange policies because by omitting the indexation to a foreign currency of some non-tradable goods, the exchange rate pass-through effect is underestimated and by not including holdings in dollars in the monetary aggregate the impact thereof is slanted.

Alvarez-Plata and García-Herrero (2007) analyze two particularly relevant topics for the monetary policy: i) whether there is a greater exchange rate pass-through effect in (partially) dollarized economies; and ii) the way in which dollarization affects the design and implementation of the monetary policy. In the first instance they compare a group of countries and they find that, on average, the rate of inflation is lower in the economies with the lowest levels of dollarization. In the second instance, they use Impulse-Response Functions to show that the exchange rate pass-through effect increases as generalized dollarization increases; they argue that since the non-tradable goods are valued in foreign currency, variations in the exchange rate may affect domestic inflation for a broader set of goods compared to economies with low levels of dollarization. Finally, they point out that the weak transmission of the monetary policy in dollarized economies may be attributed to the fact that in general, the monetary authority cannot influence the foreign currency component in the money, i.e. the money supply is somehow defined by the behavior of the agents holding assets denominated in foreign and domestic currency.

Kokenyne et al. (2010) point to the following drawbacks of the dollarization that affect the actions of the monetary authority: i) dollarization limits effectiveness of the monetary policy³; ii) dollarized economies lose part of or their entire seigniorage; in addition, the use of foreign currency implicitly entails that the country pays a certain type of seigniorage to the issuers of that currency; iii) dollarization reduces efficiency of the payments, since the foreign currency banknotes are not always adequate for the needs of local business (e.g. small transactions) and the monetary authorities of dollarized economies cannot control the quality of the banknotes in circulation; iv) partial dollarization increases the risk or vulnerability of the financial system in view of the possible misalignments that may occur in the banks' balance sheets; on the other

³ Evidence on this topic can be found in Ize, Levy-Yeyati (2005).

hand, the risk associated to credits is greater when the exchange rate is depreciated; v) the dollarization leads to a higher probability of suffering liquidity crises since the monetary authority, as the lender of last resort, can only provide funds in national currency but not in foreign currency in an unlimited way when facing a (foreign currency) liquidity crisis in the financial system.

Acosta-Ormaechea and Coble (2011) analyze the transmission channel of the monetary policy guided by the monetary regulation interest rate for the following countries: Chile, New Zealand, Peru and Uruguay. Using estimates based on VAR models for each country they show that for Chile and New Zealand the channel of the monetary regulation interest rate is relevant for the purpose of controlling the generalized price level; on the other hand, for Peru and Uruguay, the exchange rate channel plays a much more substantial role in controlling inflationary pressure. The limited impact of the monetary policy rate in the control of inflation for Peru and Uruguay, combined with the fact that both countries would have a more significant and persistent pass-through, seems to be associated to the high dollarization of their economies.

With regard to the dollarization and its policy implications in Bolivia, on the basis of empirical evidence Arce (1997) shows that the dollarization process in Bolivia was extremely persistent and restricted the possibility of using economic policy instruments to overcome this problem. Moreover, he points out that in the long term, the real exchange rate is more important than the determination of interest rates to explain the public's preferences for national or foreign currency.

Another study addressing the monetary policy and its link to dollarization in Bolivia, is Requena et al. (2001), in which the authors specify the following constraints in the monetary and exchange policy that result from a high degree of dollarization: i) vulnerability of the financial system; ii) transmission of the depreciation of the exchange rate to inflation; iii) the need for a greater coverage of the international reserves; iv) the offsetting of changes in Net Domestic Credit (NDC) and; v) a limited exchange rate flexibility.

Another paper that links dollarization and the effects thereof on the monetary policy for the Bolivian case is Morales (2003), which suggests that dollarization changes the nature of the central bank in fundamental ways. To the extent that banks hold obligations and deposits in foreign currency and allocate them directly to their consumers without intervention from the central bank, for making the change to national currency, the monetary authority loses full control over the monetary base. Furthermore, the central bank loses control of the monetary aggregates which are normally under its control in less dollarized economies. In addition, the transmission mechanisms of the monetary policy implemented by the monetary authority through the financial sector are amply hindered; the interest rate channel is hardly available, the credit channel has some scope but is attributed more to the needs for (or the lack of) public sector financing than to the effect of the central bank policy and, conversely, the exchange rate could be the only direct channel. A secondary effect of the partial dollarization is that the demand for domestic money is unpredictable and the signs in the variables explaining it might

not be the ones suggested by economic theory; if the demand for national money is highly unstable, the demand for bank reserves —kept in the central bank— is even more unstable and far from being controlled by the monetary authority.

Finally, Aguilar (2013) analyzes bolivianization of the financial system and its relationship with effectiveness of the monetary policy. In this sense, the proxy for the latter is an estimation of the exchange rate pass-through, evidencing that there is a greater effectiveness due to deepening of the bolivianization (dedollarization) in the financial system. He therefore concludes that in a setting with moderate dollarization there are greater degrees of freedom for an anticyclical monetary policy. Additionally, he finds evidence suggesting that the bolivianization of deposits causes the bolivianization of credits, and based on a SVAR estimation, he concludes that the prudential regulation policies explain the greatest proportion of the variation of the dedollarization of deposits.

III. STYLIZED FACTS

This section will first address the bolivianization (dedollarization) process of the financial system in Bolivia, emphasizing the determinants thereof and the evolution in recent years. Next, an analysis will be made of the relationship between the evolution of the degree of bolivianization of the financial system and the performance of a set of variables concerning application of the monetary policy, among which the instruments, the transmission mechanisms and the objectives of this policy.

a. Bolivianization

Giovannini and Turtelboom (1994) define “dollarization” as a situation in which a foreign currency (dollar) acts as a unit of account, a store of value and a medium of exchange. Calvo and Végh (1996) are more specific with respect to the function of a foreign currency, suggesting that the term “dollarization” (or asset substitution) be used to refer to the use of foreign currency as a store of value, and the term “currency substitution” as a reference to a level at which, beyond dollarization, the foreign currency is also used as a medium of exchange and a unit of account⁴. A common measure of the degree of dollarization is the proportion of deposits in foreign currency relative to total deposits in the financial system of an economy.

According to Agénor and Montiel (2008), dollarization tends to be associated to periods of economic instability and high levels of inflation⁵. Therefore, dollarization can be seen as an endogenous response of (national) agents to avoid inflationary taxes and capital losses in assets denominated in national currency. Within this framework, the dollarization in Bolivia was the result of periods of economic instability linked to constant depreciations of the national currency, impacting high levels of inflation.

⁴ In practice, both terms are used interchangeably.

⁵ Nicoló et al. (2005) use an extensive sample of countries for years 1990-2001 and find that the macroeconomic policy setting and the institutional structure are key determinants of variations in the dollarization of deposits among different countries.

Concretely, the last phase with high levels of dollarization in Bolivia stemmed from the crisis provoked by the hyperinflation in 1984-1985⁶, which was controlled at the end of 1985 by implementing the so-called New Economic Policy. One of the measures of this initiative was to authorize the entire banking system to operate with foreign currency. Moreover, it put in place a single and flexible exchange rate regime based on an auction system in which the central bank could intervene (i.e. dirty floating).

Nonetheless, even though inflation was controlled, the dollarization persisted over time; until the first half of the decade of the 2000s the degree of dollarization of the financial system was over 90%, both in deposits and credits (see Graph 1). The literature notes that de-dollarization after price stabilization would tend to be slow if it does not entail significant benefits upon once again going back to the national currency as the means of payment. Following the hyperinflation and its sequels, there was a general perception among the Bolivian agents in the sense that the forces that exercised a continuous pressure towards depreciation of the national currency at the same time exercised pressure for a price increase; hence, depreciation and inflation were synonyms. This implied that the agents increased the proportion of assets in foreign currency, deepening the dollarization. Moreover, in addition to the expectations of inflation associated to behavior of the exchange rate, growth of the dollarization was also influenced by the volatility of these variables⁷.

Within this framework, it was clear that the high dollarization of the Bolivian economy also brought a series of negative consequences: i) the boliviano did not fully perform its function of money as a unit of account, a store of value and a means of payment, because it was replaced by the United States Dollar to a large extent; ii) limited effectiveness of the economic policy (monetary, exchange and fiscal); iii) there were monetary transaction costs for the agents who decided to substitute currencies; iv) the function of the BCB as the lender of last resort was limited because of the significant volume of deposits and credits in US Dollars in the financial entities; v) dollarization of the financial system entailed significant fragility; vi) although the exchange risk in the financial system was transferred to the borrowers, who were granted loans in dollars, this risk transfer was not a real measure of protection since there was merely a transfer of the exchange risk from the financial sector to the real sector, i.e. an exchange shock would still have an impact in the financial system on the side of the credit portfolio, because the source of repayment was in national currency and the credit obligations in dollars; vii) the credit portfolio in foreign currency did not match the currency of the borrowers' economic operations⁸.

Consequently, a dedollarization (bolivianization) of the Bolivian economy had clear advantages. In the literature on this topic, authors such as Alvarez-Plata and García-Herrero

⁶ Analyses of Bolivia's hyperinflation can be found in Sachs (1987), Morales (1987), Morales (1988a) and Morales (1988b).

⁷ McNelis and Rojas-Suárez (1996) underscore that the degree of dollarization does not only depend on the inflation and exchange rate expectations, but also on the risk (volatility) of these variables. In periods with a high inflation the risk component tends to be dominated by the level of inflation, while in periods with a low inflation (post-stabilization periods) the risk factors (volatility) acquire greater relevance.

⁸ 10 años de la Economía Boliviana – February 2016.

(2007) point out that an agenda for dedollarization of an economy should be underpinned by three pillars: i) make sure that the regulation incentivizes, or at least does not penalize, the intermediation in national currency; ii) use of the national currency, or at least the indexation, in instruments should be promoted; iii) the institutional framework of the central bank and its monetary policy strategy should focus on reducing the uncertainty concerning the value of the national currency; this implies that the primary objective of the central bank is price stability and ensuring its institutional independence.

Furthermore, Kokenyne et al. (2010) point out that: i) in general, the dedollarization requires a combination of macroeconomic policies and microeconomic measures to improve attractiveness of the national currency over foreign currency; ii) the adequate sequence of microeconomic policies and measures makes the dedollarization easier, i.e. considering that building monetary credibility may take a long time, certain policies and measures to promote the dedollarization should be implemented in the transition process; iii) some fundamental ingredients for a permanent dedollarization are the credibility of the macroeconomic stability and the exchange rate variability, a public debt management that reduces the use of external financing and a prudential structure that internalizes the dollarization of bank balance sheets.

Thus, as from the second half of the 2000s, a process for reversion of the dollarization begins, particularly in the financial system. For this end, the Ministry of Economy and Public Finance (MEFP), the BCB and the Financial System Supervisor (ASFI, in Spanish) together took the following measures: i) appreciation of the exchange rate; ii) differentiated reserve requirements by currency; iii) an increase of the exchange spread; iv) bolivianization of the Open Market Operations (OMOs); v) differentiation in the setting of credit portfolio provisions by currency; vi) modifications in application of the Tax on Financial Transactions (ITF), taxing only the operations in foreign currency and in national currency with value maintenance (MVDOL, in Spanish); and vii) creation of the special tax on foreign currency sales (IVME, in Spanish)⁹.

In addition, the significant progress in the bolivianization process was underpinned to a large extent by the macroeconomic stability (understood in the sense of sustained economic growth and price stability) and the exchange policy, whereby mainly the latter allowed for anchoring the agents' expectations.

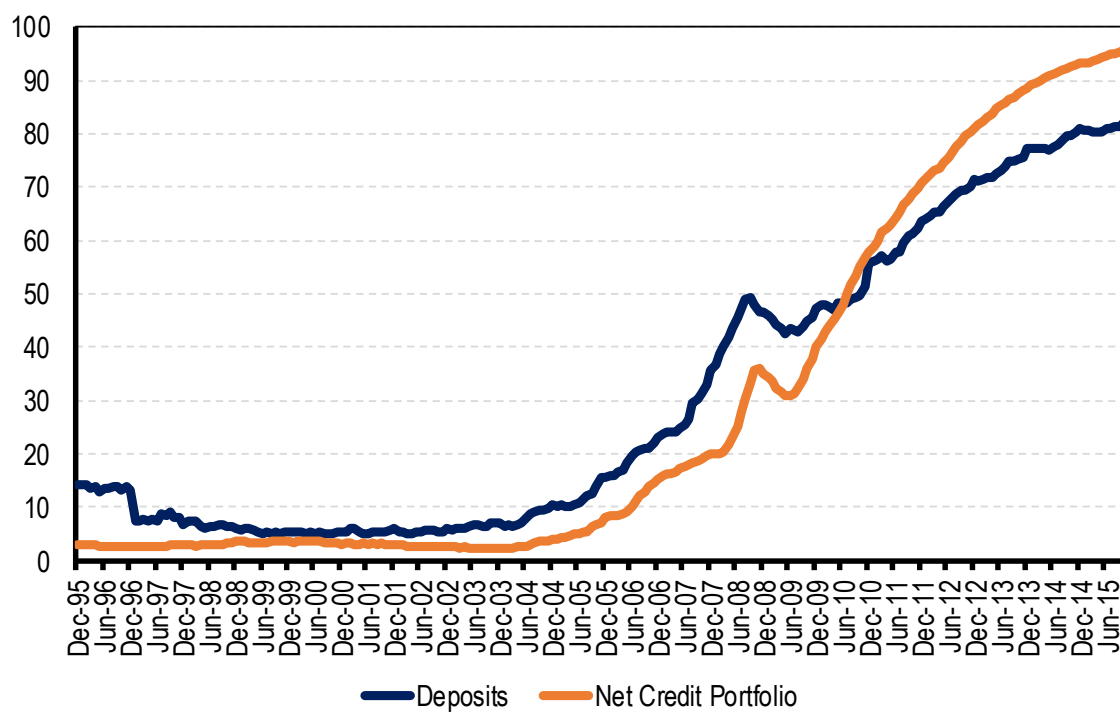
In this manner, as from the second half of the first decade of the 2000s, the bolivianization of deposits and the credit portfolio of the financial system grew exponentially. For example, the bolivianization of deposits increased from 5.3% at the beginning of 2000 to more than 80% at the end of 2015. Similarly, bolivianization of the credit portfolio rose from 3.5% at the beginning of 2000 to 96% at the end of 2015 (see Graph 1).

Another measure of the degree of dedollarization is the ratio between deposits in foreign currency in the financial system and the monetary aggregate M³.

⁹10 años de la Economía Boliviana – February 2016.

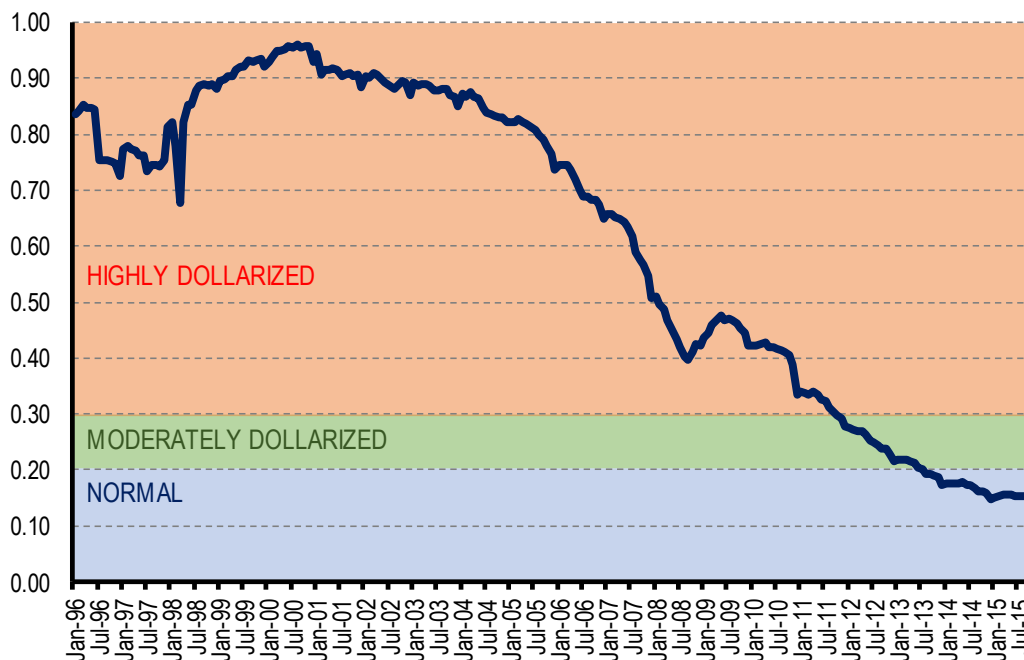
According to Baliño et al. (1999), if this ratio in an economy is between 20% and 30%, it is considered to be moderately dollarized and if this ratio is higher than 30%, the economy is deemed to be highly dollarized. For the case of Bolivia, there is a break point in the degree of dollarization as from the second half of the 2000s. As from that point onwards, the dollarization went down continuously. Within this framework, as from 2011 the Bolivian economy could be categorized as moderately dollarized and as from 2013 as a normal economy.

**Graph 1: Bolivianization of deposits and credits in the financial system
(Percentages)**



Source: Financial System Supervisor.

Graph 2: Degree of dollarization - Ratio of deposits in foreign currency to monetary aggregate M³ (Percentages)



Source: Financial System Supervisor and Central Bank of Bolivia.

b. Instruments, transmission mechanisms and target variables of the monetary policy and the relationship thereof with the degree of bolivianization

According to the Bolivian Constitution and Law No. 1670, the Central Bank of Bolivia is responsible for preserving stability of the purchasing power of the national currency through a low and stable inflation, aimed at contributing to economic and social development of the country. Within this framework, the monetary authority is obliged to continuously ensure a balance between price stability and strengthening of the economic activity, which is reflected in a medium-term inflation target that allows for a maneuvering space needed to keep in mind this dual commitment¹⁰.

First of all, the monetary policy lines are set within the framework of the Fiscal-Financial Program which has been signed every year since 2006¹¹ by the BCB and the Ministry of Economy and Public Finance (MEFP). This program defines the central objectives and macroeconomic goals for every year, which helps improve coordination, transparency and interactions of the monetary, fiscal and exchange policies¹².

¹⁰ Central Bank of Bolivia - Monetary Policy Report, January 2013.

¹¹ Until March 2006, the country signed an economic program with the International Monetary Fund (IMF) within the framework of the Stand-by Agreements, specifying the main economic targets and the conditions for making adjustments.

¹² Blanchard et al. (2013) point out that the monetary policy should not only set an inflation target, but that the said target additionally should be consistent with the fiscal policy and the external conditions.

In the second place and in line with the fiscal-financial program, the monetary policy implemented by the central bank is based on a strategy of intermediate targets concerning quantity and it sets limits on the expansion of its Net Domestic Credit (NDC). Aside from including net credit to the Non-Financial Public Sector (NDC-NFPS), the NDC takes into account net credit to the financial system. Therefore, setting targets for this variable is a guide for regulating liquidity in circumstances of a strong growth of the economic activity, revenues and private savings¹³. Moreover, the desirable reference behavior for the International Reserves is determined, which allows for anchoring the NDC and thus ensure the necessary flexibility for expanding monetary issuance.

In the third place and having a closer look at more operational details, the actions of monetary policy are carried out through an operational target, the modification of which allows for adjusting the intermediate targets to achieve the final objectives. The BCB's operational target is liquidity of the financial system, defined as the excess bank reserves (excess of legal reserves), which is a variable of quantity that can be reasonably controlled in the short term. In this regard, the BCB forecasts the variations of the excess of reserves and based on those forecasts it decides whether the ex-ante changes of liquidity of the financial system should be offset in order to reach the intermediate target and, from there, the final objectives (e.g. inflation).

In this context, in order to regulate liquidity of the economy, the BCB intervenes in the monetary market by using monetary policy instruments¹⁴, among which the Open Market Operations (OMOs), which are placements or redemptions of public securities. These operations are the main instrument for monetary regulation through which it is possible to contract or expand liquidity of the financial system. By placing public securities, the issuer withdraws excess liquidity from the economy (contractive monetary policy) while the redemption is used to inject liquidity (expansionary monetary policy)¹⁵.

Furthermore, the monetary policy seeks to modify the monetary and credit conditions in the economy. To this end, the monetary authority defines monetary regulation interest rates with the aim of impacting behavior of the rates of the financial markets. This transmission channel is known as the "interest rate channel". The transmission effect of the interest rate involves two stages: i) the monetary regulation rates have an impact on the interbank rate, which is the one used for short-term loan operations among the financial entities; and ii) the variations in the interbank rate impact the financial intermediation rates (i.e. lending and deposit rates).

Although an expansionary monetary policy boosted by a decrease of the monetary regulation rates, with lower lending rates, may expand the credit portfolio level and hence the available resources for investment and consumption, it would be further expected that the banks broaden

¹³ Central Bank of Bolivia - Monetary Policy Report, July 2013.

¹⁴ Considering that the central banks, which pursue the aim of price stability, cannot directly control inflation, Orellana et al. (2000) note that the central banks try to achieve this objective indirectly, using instruments to influence the interest rates, the quantity of money and credit in the economy.

¹⁵ Central Bank of Bolivia - Monetary Policy Report, July 2010.

their credit portfolio placements by reducing the loan costs or by reducing credit rationing as the result of an expansionary monetary policy boosted by a lower level of placements of securities to increase liquidity of the financial system beyond the level required for precautionary purposes (credit channel).

Having briefly elaborated on the characteristics and procedures of monetary policy in Bolivia, we should point out how the bolivianization –in theory- may have improved the conditions for developing the monetary policy. In the literature review in the second section of this document, more details can be found about the problems derived from dollarization and, therefore, about the benefits of strengthening use of the national currency. However, the broad consensus is that the benefits of expansion of the degree of bolivianization, fundamentally in the financial system, can be summarized as follows: i) improvement of the transmission mechanisms of the monetary policy and, hence, the BCB's capacity to contribute to softening the damaging effects of the economic cycles and to control inflation, ii) an increase of the international reserves, iii) an increase of the revenues from seigniorage since the central bank recovers its money issue capacity¹⁶, and iv) a greater payment ability of the families and enterprises regarding the obligations taken out with the financial system¹⁷.

Consequently, the remainder of this section will focus on a descriptive analysis of the evolution of bolivianization of the financial system, with the performance of the monetary policy instruments, which are OMOs and the monetary regulation rates, and the transmission mechanisms concerned, such as the interest rate channel and the credit channel.

Graph 3 shows the parallel evolution of the OMOs and liquidity of the financial system. The graph clearly shows that the orientation of the monetary policy, instrumented through the OMOs, has been countercyclical. For example, between 2008 and 2009 when the Bolivian economy went through a slowdown due to the international economic crisis, it is noted that liquidity of the financial system expanded in a scenario in which the BCB reduced its OMOs, i.e. it followed an expansionary strategy, increasing the redemptions of public securities. Likewise, in a relatively similar scenario as from mid-2014 an expansionary monetary policy was applied that allowed for injecting significant amounts of liquidity into the economy through the financial system. One element worth underscoring is that the countercyclical stance of the monetary policy, considering evolution of the OMOs, was weak in the years when the level of dollarization was still very high. The procyclical behavior of the monetary policy is not in line with the suggestions made by economic theory (the relationship between OMOs and liquidity should be negative). As mentioned by Morales (2003), in some cases one of the secondary effects of the partial dollarization is the incorrect signs in the monetary variables as suggested in economic theory.

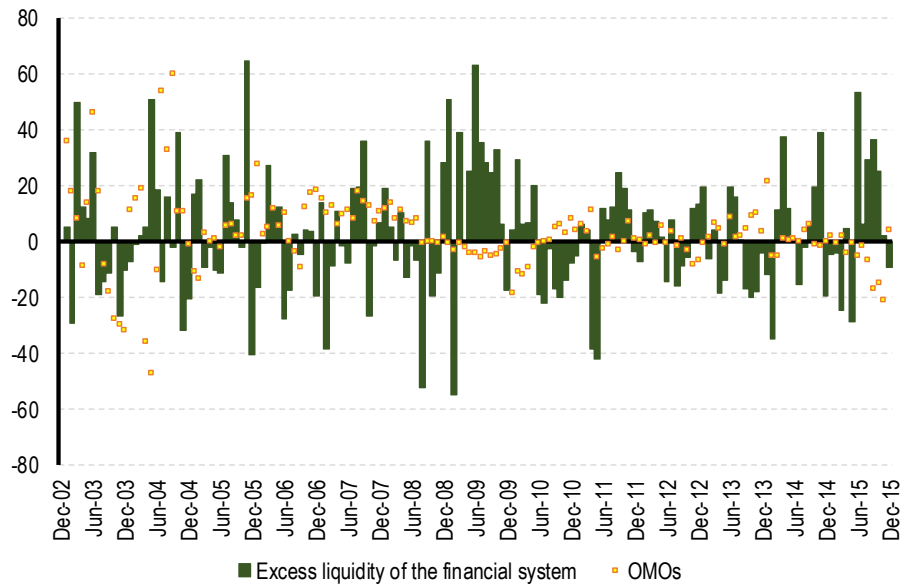
Continuing with the analysis of the OMOs and how they relate to liquidity of the financial system, the correlation between the growth rates of these variables is -15% for years 2003-

¹⁶ Seigniorage is defined as the difference between the value of money and the cost for producing it.

¹⁷ Central Bank of Bolivia - Monetary Policy Report, October 2014.

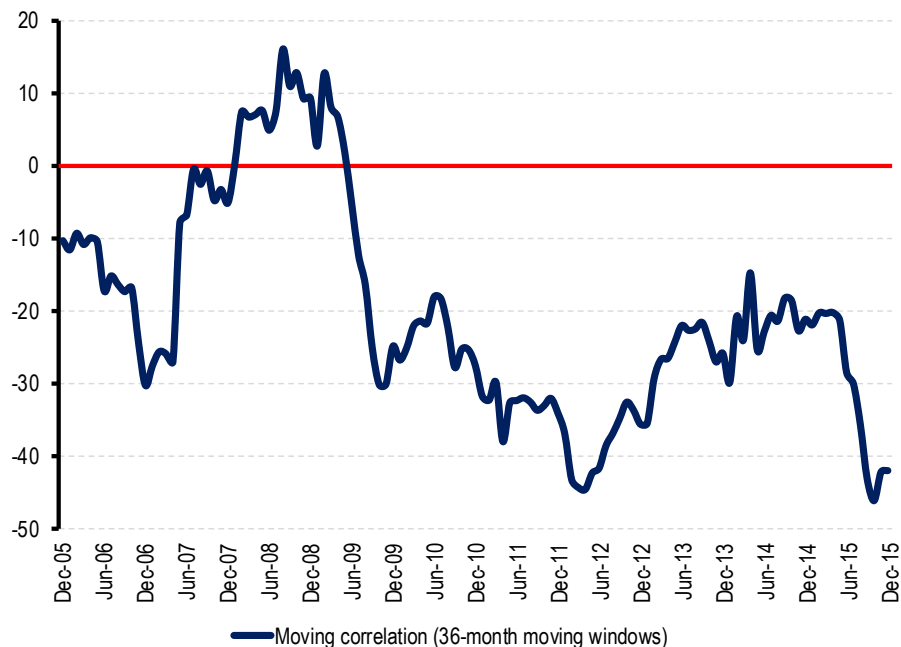
2015. Nonetheless, Graph 4 shows that the linear relationship between these variables has become stronger over time, to the point of evolving from -10% at the end of 2005 to -45% in 2015. Among others, the higher levels of bolivianization (see Graph 4) may be one factor explaining this increase in the correlation between these variables.

Graph 3: Variations of OMOs and excess liquidity of the financial system (Percentages)



Note: The variables were deseasonalized using the Census-X13 method.
Source: Central Bank of Bolivia.

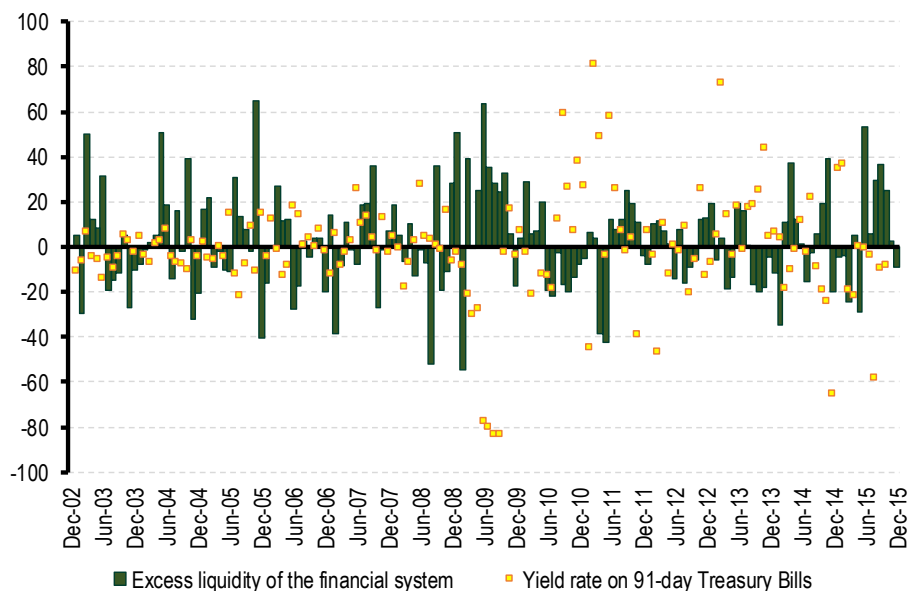
Graph 4: Moving correlation between variations of OMOs and excess liquidity of the financial system (Percentages)



Note: The variables were deseasonalized using the Census-X13 method.
Source: Central Bank of Bolivia.

Similarly, when considering the monetary regulation rate, in this case approximated by the yield rate on 91-day Treasury Bills, it is observed that it has a negative relationship with excess liquidity of the financial system, i.e. when the monetary authority increases (decreases) that rate, excess liquidity decreases (increases). Moreover, the correlation between these variables is negative (-25%, for years 2003-2015). With regard to the moving correlation between these variables, just like in the case of the OMOs, in one-time segment when the degree of dollarization was substantial, the relationship between these variables is positive, contrarily to what economic theory suggests.

Graph 5: Variations of the yield rate on 91-day Treasury Bills and of excess liquidity of the financial system (Percentages)



Note 1: The variables were deseasonalized using the Census-X13 method.
 Note 2: In April 2010, the variation is 2.161%, but this has been excluded from the graph for esthetical reasons; the yield rate for April 2010 was 0.0826% and for March 2010 0.0037%.
 Source: Central Bank of Bolivia.

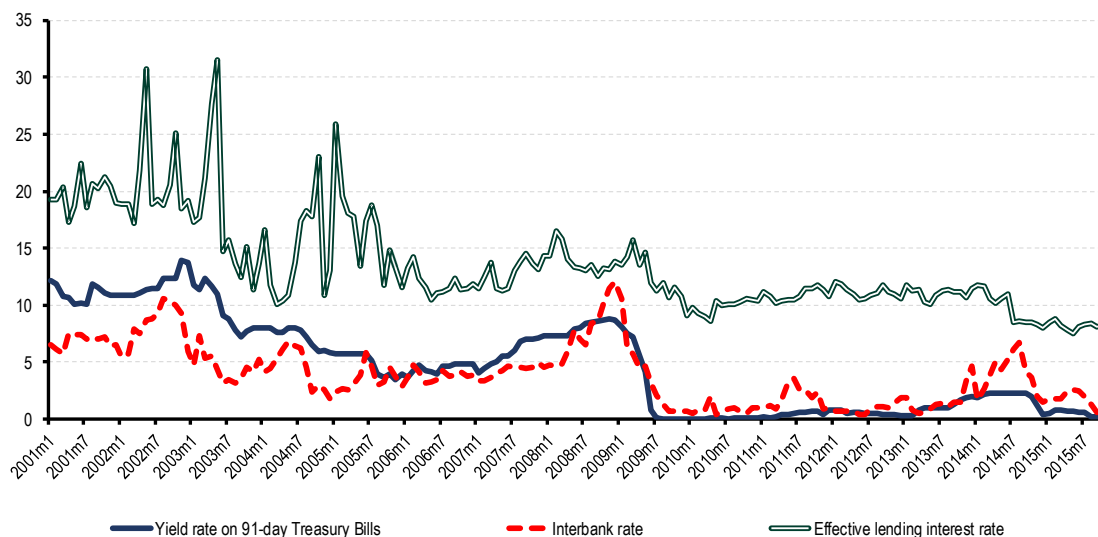
Graph 6: Moving correlation between variations of the yield rate on 91-day Treasury Bills and of excess liquidity of the financial system (Percentages)



Note: The variables were deseasonalized using the Census-X13 method.
 Source: Central Bank of Bolivia.

Furthermore, it is relevant to make an evaluation of the relationship between the behavior of the interest rates of the financial system, i.e. the interbank rate and the effective lending interest rate, in relation to evolution of the yield rate on 91-day Treasury Bills. The following graph shows that the performance of these three variables is very similar, suggesting the possible existence of a rate transmission channel. Moreover, one aspect worth underlining is that the volatility, particularly in the interbank rate, has gone down over the last ten years, which has an impact on the signals emitted by variations in these variables, being more transparent and enabling the transmission mechanisms of the monetary policy.

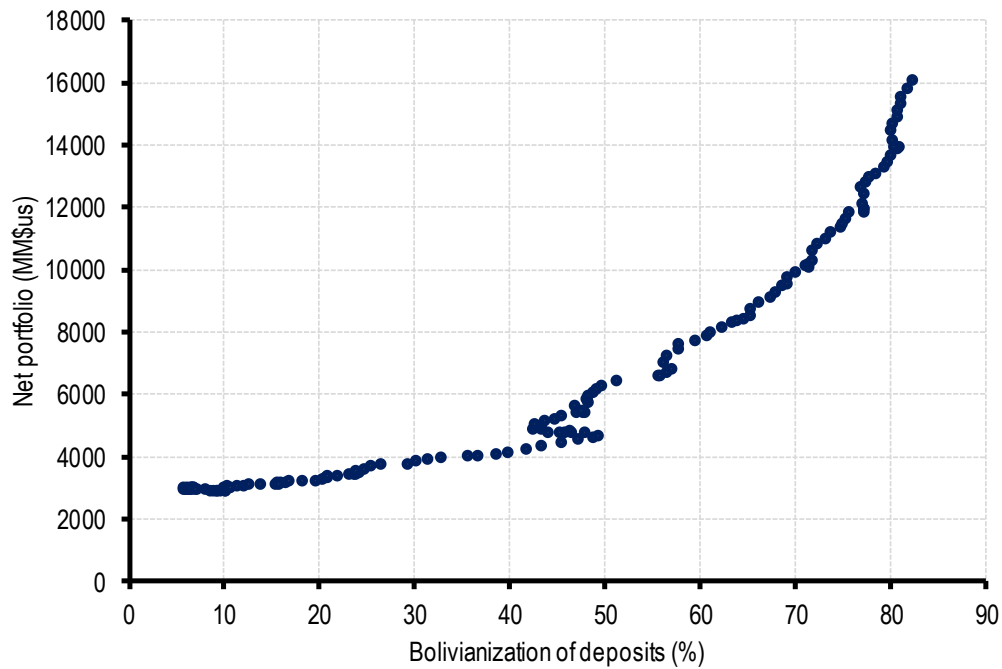
Graph 7: Yield rate on 91-day Treasury Bills, interbank rate and effective lending interest rate in national currency (Percentages)



Source: Central Bank of Bolivia and Financial System Supervisor.

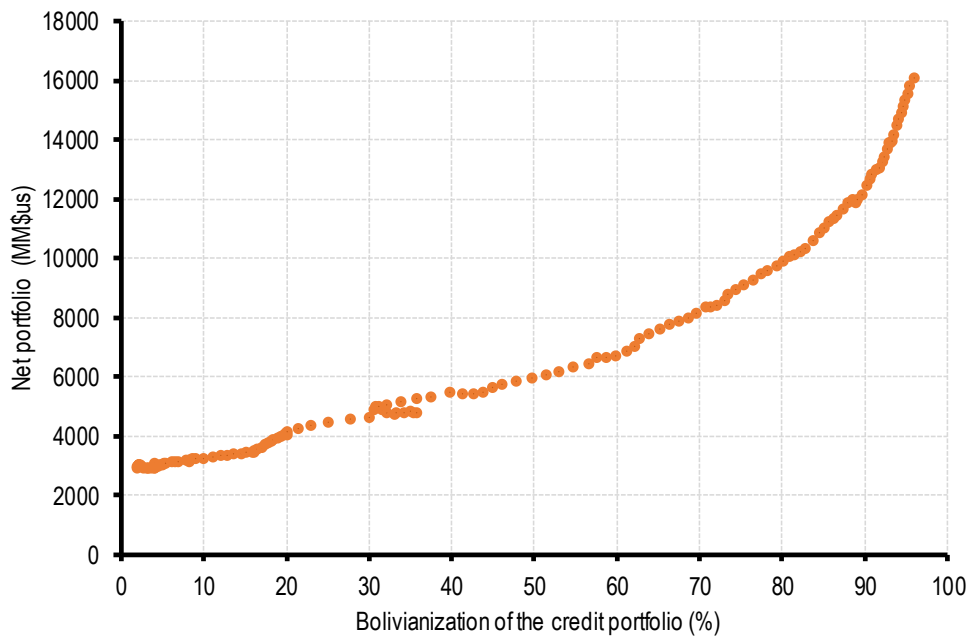
Finally, the credit portfolio levels of the financial system have grown at a high pace in the last ten years, in line with the expansion of the degree of bolivianization of the financial system. Graphs 8 and 9 show that the deeper bolivianization of the financial system, the higher the amounts of the credit portfolio. Therefore, one of the factors that may have underpinned the sustained and significant expansions of the credit portfolio is the bolivianization, because the payment of debts in national currency is less risky both for the lender and for the borrower.

Graph 8: Graph on dispersion between bolivianization of the deposits and the financial system credit (Percentages)



Source: Central Bank of Bolivia and Financial System Supervisor.

Graph 9: Graph on dispersion between bolivianization of the credit and the financial system credit (Percentages)



Source: Central Bank of Bolivia and Financial System Supervisor.

IV. METHODOLOGY

The empirical analysis regarding the objectives of this paper involves the use of two estimation techniques: i) Generalized Method of Moments (GMM), and ii) Structural Vector Autoregression (SVAR) Model.

a. Generalized Method of Moments¹⁸

Before developing the process underlying the estimation technique of Generalized Method of Moments (GMM), we should explain the specification that is the object of the estimation and the scope thereof in terms of interpretation.

This document intends to analyze whether effectiveness of the monetary policy increases as the bolivianization spreads. For this purpose and considering that the operational objective of the monetary policy conducted by the BCB is to control liquidity of the financial system¹⁹, a function associated to this variable will be estimated. The determinants of liquidity of the financial system covered in this study are²⁰:

$$Liquidity = f \left(\begin{array}{c} \textit{Bolivianization of the financial system,} \\ \textit{Open Market Operations,} \\ \textit{Yield rate on 91 – day Treasury Bills,} \\ \textit{Reserve Requirement,} \\ \textit{Deposits,} \\ \textit{Credits,} \\ \textit{Output Gap} \end{array} \right)$$

The OMOs and the yield rate on 91-day Treasury Bills, as a proxy of the monetary regulation rate, are the monetary policy instruments; in theory, increases (decreases) in these variables should decrease (increase) liquidity of the financial system. Although economic theory has not made any thorough studies of dedollarization (bolivianization) of the financial system as a determinant of liquidity, the inclusion of this variable is very relevant to achieve the objective of this study; a priori this variable is not subject to an expected sign. For the other variables, economic theory suggests that the required reserve and credits have a negative impact on liquidity of the financial system, while both deposits and the gap have a positive impact.

On the basis of this specification, two additional explanatory variables are included to approximate the change in the effect of the monetary policy instruments (i.e. OMOs and monetary regulation rate), with different values in accordance with the degree of

¹⁸ For a more in-depth explanation of the Generalized Method of Moments and its properties, see Hansen (1982).

¹⁹ The BCB defines liquidity as the immediately available resources of Financial Intermediation Entities. It is measured as the difference between the constituted legal reserve and the required legal reserve.

²⁰ The specification of the function of liquidity of the financial system is based on the work of Cernadas (2013), in which the determinants of excess liquidity for the financial system of Bolivia are estimated. Other researchers who addressed the determinants of liquidity are Mishkin (2001), Agénor et al. (2004), and Saxegaard (2006).

bolivianization of the financial system. These variables are the interactions between the variables of instrument and bolivianization²¹. Hence, the complete specification of the liquidity function will be:

$$Liquidity_t = \alpha + \beta_1 OMO_t + \beta_2 TB91_t + \beta_3 Bol_t + \beta_4 (OMO_t * Bol_t) + \beta_5 (TB91_t * Bol_t) + \sum_{i=1}^4 \delta_i \chi_{i,t}$$

Where OMO is the Open Market Operations, TB91 the yield rate on 91-day Treasury Bills, Bol the bolivianization and X a vector that includes the remaining explanatory variables detailed in the previous paragraph. Factoring OMOs and TB91, It is possible to obtain the effects of the instruments for each level of bolivianization.

$$Liquidity_t = \alpha + (\beta_1 + \beta_4 * Bol_t) OMO_t + (\beta_2 + \beta_5 * Bol_t) TB91_t + \beta_3 * Bol_t + \sum_{i=1}^4 \delta_i \chi_{i,t}$$

This way, it is sufficient to merely assign a value to the bolivianization to obtain the effect of one of the monetary policy instruments on the control of liquidity of the financial system, when bolivianization takes the determined value. In this study, we work with bolivianization of the deposits, which causes²² bolivianization of the portfolio of credits and therefore determines the degree of bolivianization of the financial system. The results associated to this methodological approach will present the differentiated effect of the different monetary policy instruments on liquidity of the financial system, for different levels of bolivianization of the deposits.

For this first methodological approach, the period covered by the analysis is from 2003m6 until 2015m10; the selection of this period was related to the availability of data. Moreover, all variables, except for bolivianization of the deposits, are in differences of logarithms. The bolivianization variable was kept in levels because if it had been transformed to differences of logarithms it would no longer be possible to obtain the variable effects of the monetary policy instruments on liquidity with varying degrees of bolivianization²³. Moreover, temporary control variables were included, e.g. the trend and a lag of the dependent variable, aimed at avoiding problems of non-stationarity, especially concerning the variable in levels of bolivianization.

Within this framework, the following data were used for estimating the regression with interactions:

²¹ In the literature related to analyses of the monetary policy, various studies use the technique of models with terms of interaction. For example, Angeloni and Kashyap (2003), Köhler et al. (2005), Zicchino and Nier (2008), Altunbas et al. (2010), Lambert and Ueda (2014), and Ananchotikul and Seneviratne (2015).

²² See Annex 1 for the results of the causality test of Granger between the variables of bolivianization of the deposits and the portfolio of the financial system. Moreover, for the case of Bolivia, Aguilar (2013) also finds evidence in the sense that bolivianization of the deposits gives rise to bolivianization of the portfolio.

²³ See Annex 2 for the unit root tests.

| Variable | Detail |
|--|---|
| Liquidity of the financial system | Ratio between the excess of legal reserves and required legal reserves |
| Bolivianization | Bolivianization of deposits |
| Open Market Operations ^{1/} | Balance of net placements |
| Monetary regulation rate ^{2/} | Yield rate on 91-day Treasury Bills |
| Legal reserve requirement | Required legal reserve |
| Deposits | Deposits of the financial system |
| Credits | Net portfolio of the financial system |
| Output gap | The difference between the logarithm of the General Index of Economic Activity (IGAE, in Spanish) and its trend level (obtained with the HP filter) |

1/ the interaction of this variable is the multiplication thereof by the bolivianization variable

2/ the interaction of this variable is the multiplication thereof by the bolivianization variable

With regard to the estimation technique, in view of the possibility of a simultaneity bias because the behavior of some explanatory variables may be closely related to the dependent variable, it is necessary to use instrumental variables; nonetheless, in view of the presence of heteroskedasticity, the estimation techniques with conventional instrumental variables (e.g. Two-Stage Least Squares) do not provide consistent standard errors, which means that the inference, specifically the tests for overidentification restrictions, is not valid.

Therefore, in order to achieve the purpose of the study described in the previous paragraphs, the Generalized Method of Moments (GMM) estimation technique is used. This estimation technique was used since it has the virtue of dealing with the problem of endogeneity and with the presence of heteroskedasticity. Below is a brief explanation of characteristics of the efficient GMM estimators.

If Y_t is a random variable with $E[Y_t] = \mu$ and $\sigma^2 = f(\mu)$, this implies that we would have two moments and a single parameter to be estimated. This way, the problem is focused on choosing an estimator of μ , knowing that:

$$E \left[\sum_{t=1}^T y_t \frac{1}{T} \right] = \mu$$

$$E \left[\sum_{t=1}^T \left(y_t - \sum_{t=1}^T y_t \frac{1}{T} \right)^2 \frac{1}{T-1} \right] = \sigma^2 = f(\mu)$$

Alternatively, the following functions can be defined:

$$\left(\sum_{t=1}^T y_t \frac{1}{T} \right) - \mu = m_1(y, \mu)$$

$$\left(\sum_{t=1}^T (y_t - \mu)^2 \frac{1}{T-1} \right) - \sigma^2 = m_2(s^2, \mu)$$

Within this framework, the idea is to choose μ as near as possible to both options. Knowing that $E(m_1) = E(m_2) = 0$, the GMM estimator will be the one that minimizes a criterion function such that $M = m'Am$, where $m' = (m_1, m_2)$ and A is a symmetric, positive and nonsingular matrix. Matrix A is in fact a matrix of weights that reflects the importance (weight) given to each one of the possibilities of estimating μ , which in the case of this explanation is of order (2x2).

b. Vector Autoregression Model

This second methodological approach initially focuses on evaluating the interrelations between bolivianization and the variables making up the instruments, transmission mechanisms and target variables of the monetary policy, from the perspective of the credit²⁴ and interest rate²⁵ channels. Consequently, within this methodological framework the effect of the bolivianization on all variables defined in the system can be approximated, thereby extending the analysis of the effects of bolivianization on the complete flow of transmission of the monetary policy.

Within this framework, a Structural Vector Autoregression (SVAR) model is used, not only to analyze the interrelations among the variables of the system but also as a model that is very helpful to deal with the problem of simultaneity between the groups of variables. Moreover, it is helpful to understand how these relations are transmitted over time.

In order to understand this estimation technique, we start from the reduced VAR form.

$$x_t = \Gamma(L)x_{t-1} + u_t$$

Where x_t is a vector (n x 1) of endogenous variables, $\Gamma(L)$ is a matrix (n x n) that corresponds to a polynomial of first order lags, u_t is a vector (n x 1) of reduced form innovations that are i.i.d. The relationship between the reduced form innovations u_t and the structural shocks v_t which are of our interest, is represented as follows:

$$Au_t = Bv_t$$

Where matrices (n x n) A and B describe the instant relationship between the variables and the linear relationship between the reduced form residues and the structural shocks, respectively. The assumption is that the structural shocks are not correlated with each other (i.e. the variance-covariance matrix of the structural shocks Σ_v is diagonal). Without restrictions in the parameters of A and B , the structural model is not identified. In this research, the identification

²⁴ In this paper, the extension of the credit channel comprises the analysis of the direct or indirect effects of application of the monetary policy on credit of the financial system.

²⁵ In this paper, the extension of the interest rate will be limited to an evaluation of whether behavior of the monetary regulation rate determines evolution of the interbank rate and the lending interest rate.

conditions follow the Cholesky approach. This identification strategy is assumed since it allows for making a relatively agnostic analysis, i.e. the results are less subject to specific impositions on the identification assumption and the analysis focuses on the co-movements of the variables of interest over time.

In the Cholesky decomposition, the contemporary effects matrix is triangular with ones on the diagonal, and relates to the reduced form of the residuals with the structural shocks. The underlying idea in this method is to structure the contemporary effects matrix from the most exogenous variable to the most endogenous one²⁶. Thus, the system is exactly identified since the structural model reached through this transformation is a recursive model.

The vector of endogenous variables, $x_t = [Bol_t, OMO_t, TB91_t, Liq_t, ibank_t, ilend_t, port_t, cpi_t, y_t]$ is composed of nine variables: the bolivianization of deposits, Bol_t , Open Market Operations, OMO_t , the yield rate on 91-day Treasury Bills, $TB91_t$, the ratio between the excess reserve and the required reserve, Liq_t , the interbank rate, $ibank_t$, the effective lending interest rate, $ilend_t$, the portfolio of the financial system, $port_t$, the Consumer Price Index, cpi_t , and the output, approximated by the General Index of Economic Activity (IGAE), y_t .

The variables in the system are declared in logarithms and to avoid non-stationarity in the mean of the variables, the trend is included as an exogenous variable. For the VAR estimation process, six lags are included. The period of the analysis is 2003m6-2015m10²⁷. The identification conditions are defined as follows²⁸:

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -\alpha_{Bol}^{OMO} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -\alpha_{Bol}^{TB91} & -\alpha_{OMO}^{TB91} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -\alpha_{Bol}^{Liq} & -\alpha_{OMO}^{Liq} & -\alpha_{TB91}^{Liq} & 1 & 0 & 0 & 0 & 0 & 0 \\ -\alpha_{Bol}^{ibank} & -\alpha_{OMO}^{ibank} & -\alpha_{TB91}^{ibank} & -\alpha_{Liq}^{ibank} & 1 & 0 & 0 & 0 & 0 \\ -\alpha_{Bol}^{ilend} & -\alpha_{OMO}^{ilend} & -\alpha_{TB91}^{ilend} & -\alpha_{Liq}^{ilend} & -\alpha_{ibank}^{ilend} & 1 & 0 & 0 & 0 \\ -\alpha_{Bol}^{port} & -\alpha_{OMO}^{port} & -\alpha_{TB91}^{port} & -\alpha_{Liq}^{port} & -\alpha_{ibank}^{port} & -\alpha_{ilend}^{port} & 1 & 0 & 0 \\ -\alpha_{Bol}^{cpi} & -\alpha_{OMO}^{cpi} & -\alpha_{TB91}^{cpi} & -\alpha_{Liq}^{cpi} & -\alpha_{ibank}^{cpi} & -\alpha_{ilend}^{cpi} & -\alpha_{port}^{cpi} & 1 & 0 \\ -\alpha_{Bol}^y & -\alpha_{OMO}^y & -\alpha_{TB91}^y & -\alpha_{Liq}^y & -\alpha_{ibank}^y & -\alpha_{ilend}^y & -\alpha_{port}^y & -\alpha_{cpi}^y & 1 \end{pmatrix}$$

²⁶The results are robust to changes in the order of the endogenous variables.

²⁷ See Annex 3 for the tests associated to the underlying VAR estimation.

²⁸ In matrix A, the parameters are declared with a changed sign.

$$B = \begin{pmatrix} \beta^{Bol} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \beta^{OMO} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta^{TB91} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta^{Liq} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta^{ibank} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta^{ilend} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta^{port} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta^{cpi} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta^y \end{pmatrix}$$

V. RESULTS

a. Effectiveness of the monetary policy to control liquidity of the financial system in a context of greater bolivianization

The table below displays the results of the estimation of the function of liquidity of the financial system.

Table 1: Results of the GMM estimation of the function of liquidity of the financial system²⁹

| VARIABLES | Liquidity of the financial system GMM |
|-----------------------|---------------------------------------|
| OMOs | -0.298*** (-2.697) |
| OMOs-Bolivianization | -0.426*** (-2.876) |
| TB91 | -0.137** (-2.252) |
| TB91- Bolivianization | -0.595*** (-2.577) |
| Bolivianization | 0.259*** -2.761 |
| Deposits | 3.774*** (3.266) |
| Portfolio | -15.594** (-2.079) |

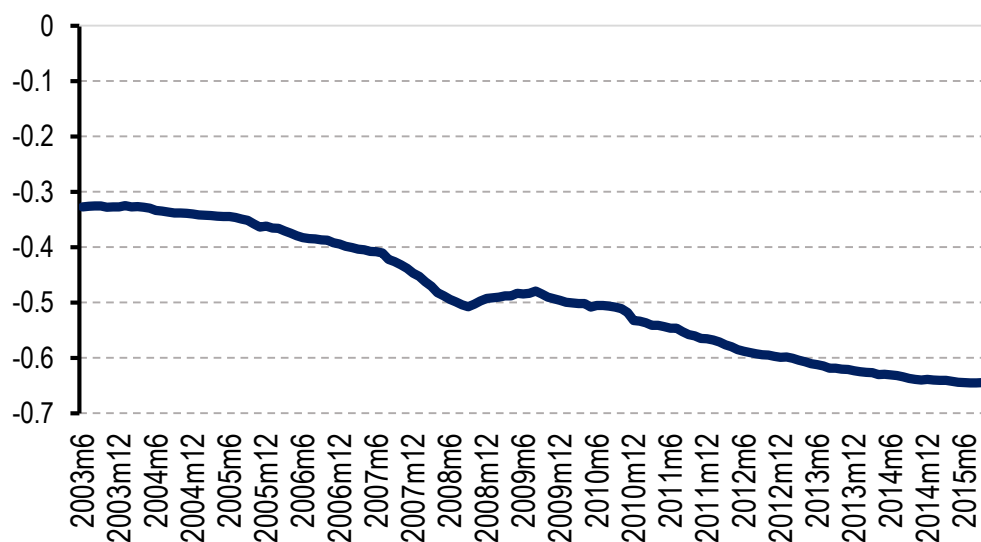
²⁹ The results are not sensitive to the use of bolivianization of the portfolio as a proxy of bolivianization of the financial system. The variables that were instrumented are Deposits, Portfolio and Required Legal Reserve; the instruments are lags of these variables. Moreover, to avoid problems of colinearity between the variables interacting in the specification, the terms of interaction were orthogonalized.

| | |
|--|-----------------------|
| Legal reserve requirement | -1.125*** (-3.735) |
| Output gap | 5.739** (2.261) |
| Liquidity of the financial system (-1) | 0.012 (0.158) |
| Trend | -0.003*** (-2.821) |
| Constant | 2.126*** (2.911) |
| Observations | 143 |
| Hansen test of exogeneity | 0.141 |
| Test for weak instruments | 9.837 |
| Portmanteau test for white noise | 0.240 |
| Robust t-statistics in parentheses | |
| *** p<0.01, ** p<0.05, * p<0.1 | |

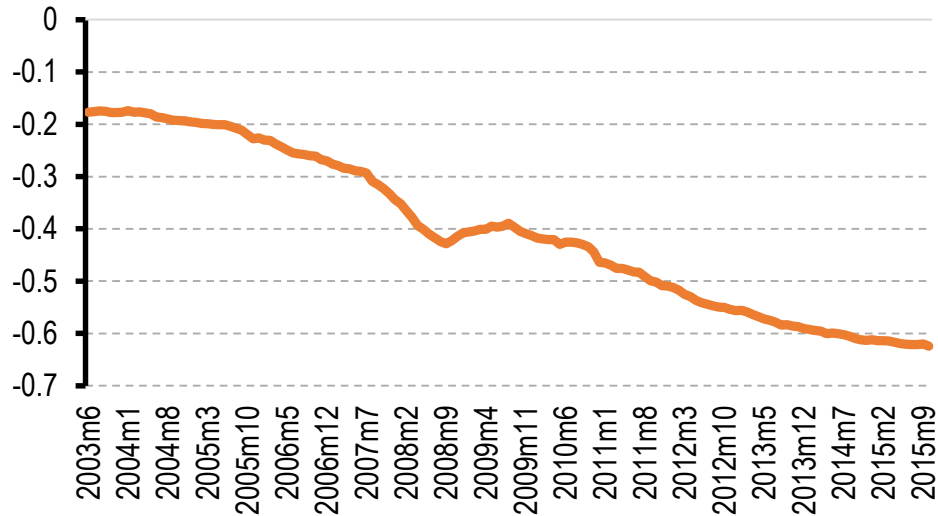
First of all, it should be noted that all variables considered in the specification are statistically significant and follow the signs expected within the framework of economic theory. Moreover, the goodness-of-fit tests are met.

With the (estimated) coefficients of the monetary policy instruments ($\hat{\beta}_1$ and $\hat{\beta}_2$) and of the interaction variables ($\hat{\beta}_4$ and $\hat{\beta}_5$), it is possible to calculate the variable effects of the instruments on liquidity for each value of the bolivianization ($[\hat{\beta}_1 + \hat{\beta}_4 * Bol]$ and $[\hat{\beta}_2 + \hat{\beta}_5 * Bol]$), in the period covered by the analysis.

Graph 10: OMO-Liquidity variable effect according to the degree of bolivianization of the deposits



Graph 11: TB91-Liquidity variable effect according to the degree of bolivianization of the deposits



As shown in graphs 10 and 11, the effect (effectiveness) of the OMOs and the yield rate on 91-day Treasury Bills on the control of liquidity of the financial system increases as the degree of bolivianization expands in deposits in the financial system. For example, considering the level of bolivianization of June 2003 of 6.8%, the calculation of the partial effects of the OMOs on Liquidity is -0.32; in a similar manner, the partial effect associated to TB91 for the said degree of bolivianization is -0.18. Nonetheless, by October 2015, when the level of bolivianization of the deposits had reached 81.9%, the partial effect of the OMOs on Liquidity was -0.65% and that of TB91 -0.62. Finally, when bolivianization of the deposits is zero, the interpretation of the results leads to the understanding that the partial effect of the OMOs is 0.30 (i.e. $\hat{\beta}_1$) and, for the case of TB91, 0.14 (i.e. $\hat{\beta}_2$).

Therefore, this evidence seems to suggest that effectiveness of the BCB's monetary policy on accomplishment of its operational objective (i.e. regulate liquidity of the financial system), instrumented on the basis of the OMOs and the definition of the yield rate on 91-day Treasury Bills, has more than doubled in the case of the first variable and more than tripled in the second case.

This improved effectiveness of the monetary policy is consistent since the degree of influence in the intervention of the monetary authority, through its monetary policy instruments, is more effective because the money supply is more endogenous to these measures as bolivianization increases. Before, when the economy was highly dollarized, despite BCB intervention it was difficult to influence determination of the money supply which rather responded to the situation of the balance of payments and behavior of the agents with asset holdings denominated in foreign and domestic currency. In addition, by including foreign currency-denominated money and deposits in the monetary aggregates, distortions arose in the link between money and inflation.

Another factor that helped improve effectiveness of the monetary policy is that now, liquidity of the financial system is virtually bolivianized; hence, most public securities are in national currency, which has an impact in that the monetary authority is not constrained and worried concerning the use of its reserves to intervene with securities in foreign currency (i.e. it has a greater degree of freedom to intervene with OMOs), as was the case when the economy was highly dollarized. On the contrary, as bolivianization deepened in the Bolivian economy, the BCB's reserves increased, which is a reference of aggregate stability and a buffer for maintaining stability of the financial system. This aspect is fundamental for optimal transmission of the monetary policy since liquidity of the financial system is more stable and controllable.

Another aspect that contributes to effectiveness of the monetary policy is that the signals emitted by the variables of the intermediate (e.g. liquidity of the financial system) and final targets, in a context with high levels of bolivianization, are clearer. In a setting of dollarization, they display volatility and a performance other than that suggested by economic theory; therefore, the intervention by the monetary authority is more complex.

On the other hand, it should be noted that with the measures to deepen the bolivianization, particularly the exchange policy, it has been possible to anchor the economic agents' expectations. Hence, the currency substitution stopped being so volatile. In this context, the monetary authority regains control of the money base and the monetary aggregates, on which it now has a greater influence with the OMOs and the definition of monetary regulation rates.

Finally, effectiveness in the control of liquidity of the financial system can be attributed also to the fact that, with the greater bolivianization, the demand for domestic money has become more predictable and the behavior of the explanatory variables follows the path suggested by economic theory. If the demand for national money is highly unstable, the demand for bank reserves kept at the central bank is even more unstable and is almost beyond the monetary authority's control.

b. Bolivianization and its relationship with the instruments, transmission mechanisms and target variables of the monetary policy, from the perspective of the credit and interest rate channels

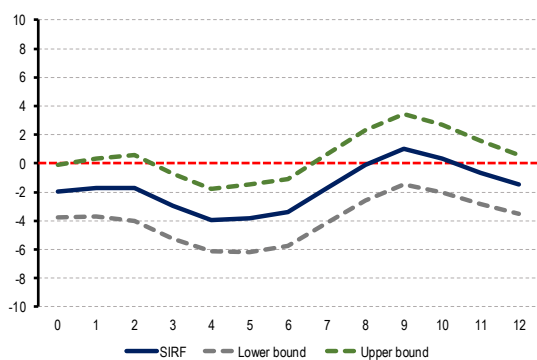
Prior to presenting the results approximating the relationship between the bolivianization of deposits and the different variables interfering in the credit and interest rate channels of the monetary policy, using Impulse Response Functions (IRF), we will present the interactions between the instruments, transmission mechanisms and target variables making up the system of monetary variables in these channels.

The first objective of this initial analysis is to show additional evidence to corroborate validity of the use of OMOs and the yield rate on 91-day Treasury Bills in the control of liquidity of the financial system. Secondly, within the framework of this methodology this analysis will allow greater understanding of how the credit and interest rate channels work in Bolivia's financial system.

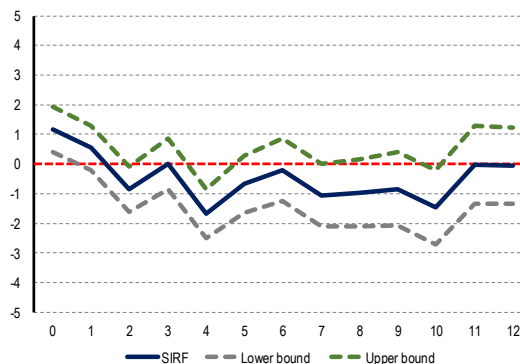
Accordingly, the following graphs present the IRFs derived from the Structural VAR estimation explained in section IV. We only present the IRFs that incorporate statistically significant effects among the variables of the system, with the purpose of the conclusions from these results being more robust³⁰.

Graph 12: Effects of OMOs in the system

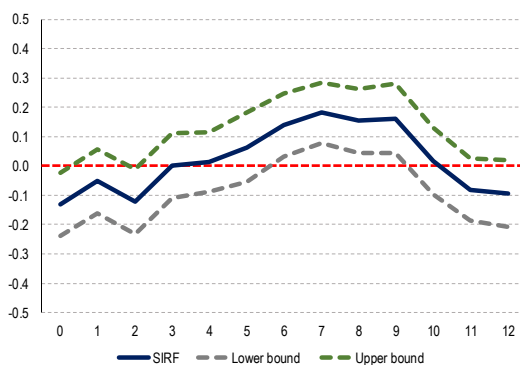
a) Impulse: OMOs, Response: Liquidity



b) Impulse: OMOs, Response: Effective lending interest rate in national currency



c) Impulse: OMOs, Response: IGAE

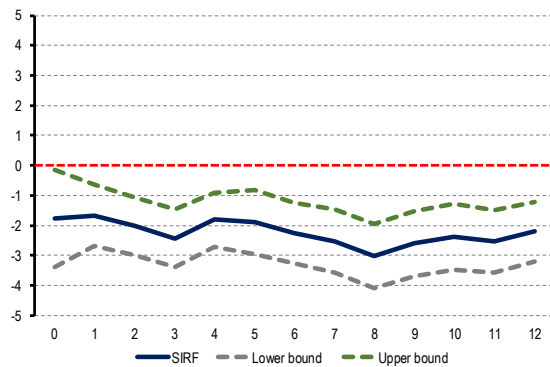


As was the case in the previous methodological approach, the results show that a greater level of placements of public securities (OMOs) would reduce liquidity of the financial system. Moreover, shocks increasing OMOs would tend to give rise to an upward adjustment of the effective lending interest rate and to contract economic activity. Still, in both cases these effects would be reversed after a few months.

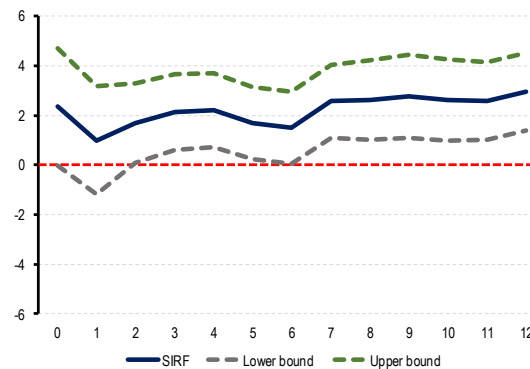
³⁰ The behavior observed in the Impulse Response Functions does not vary significantly when estimating the SVAR with other lags. The robustness analysis was conducted by estimating the SVAR with 5 and 7 lags.

Graph 13: Effects of the yield rate on 91-day Treasury Bills in the system

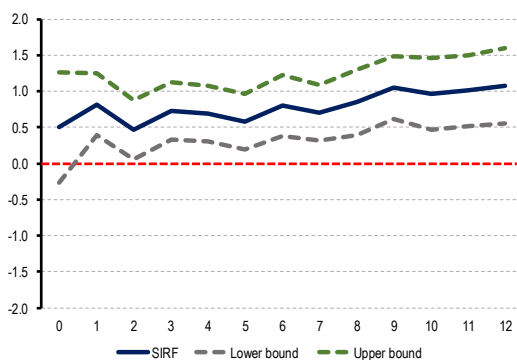
a) Impulse: TB91, Response: Liquidity



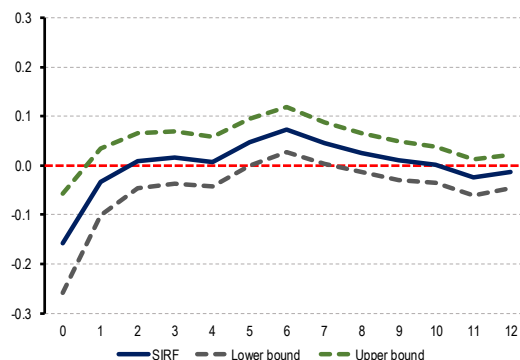
b) Impulse: TB91, Response: Interbank rate



c) Impulse: TB91, Response: Effective lending interest rate in national currency



d) Impulse: TB91, Response: IGAE

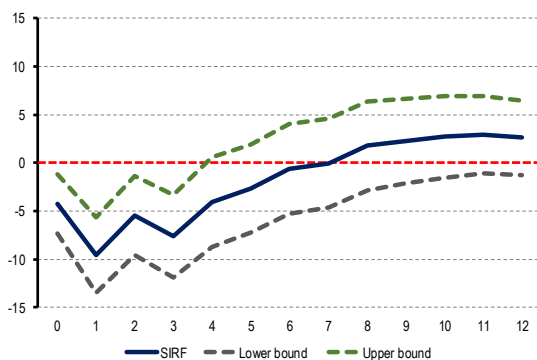


Just like in the case of the OMOs, the results suggest that when the monetary authority increases the yield rate on 91-day Treasury Bills (proxy of monetary regulation rate), the liquidity of the financial system contracts. One very interesting finding is that for the case of Bolivia, the evidence shows that the interest rate channel seems to work given that shocks increasing the monetary regulation rate would lead to higher interbank and lending interest rates³¹. On the other hand, the signal implied in a higher monetary regulation rate would lead to contraction of the economic activity. However, this would be reversed partially after a few months.

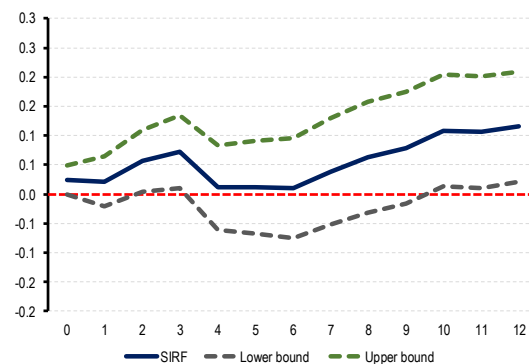
³¹ Similar evidence for the case of Bolivia can be found in Cernadas et al. (2010).

Graph 14: Effects of liquidity of the financial system in the system

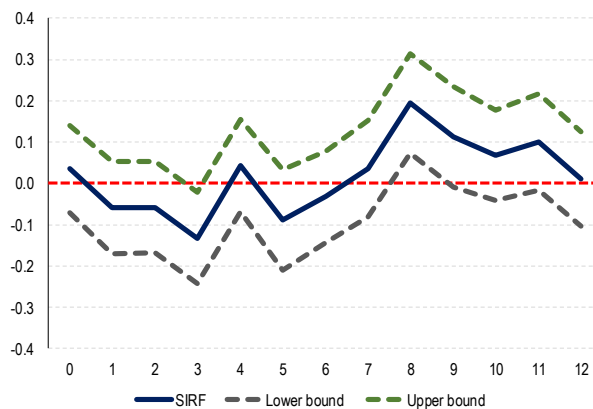
a) Impulse: Liquidity, Response: Interbank rate



b) Impulse: Liquidity, Response: CPI



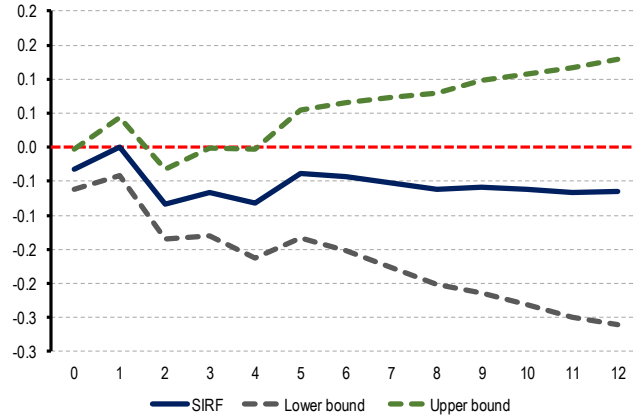
c) Impulse: Liquidity, Response: IGAE



The results show that higher levels of liquidity would lead to a decrease of the interbank rate, which may be associated to the fact that in a setting of high liquidity levels there is a lower demand for liquidity requirements in the short term among banks and so the interbank rate is adjusted downwards. In this case, the liquidity would have a direct impact on determination of the interbank rate, but an indirect impact on the portfolio because, as we will see later, the interbank rate would be a determinant of the financial system's portfolio. With regard to inflation, as economic theory points out, greater levels of liquidity in the financial system which are later internalized in the economy, would entail inflationary pressure. In the case of economic activity, faced with a shock that increases liquidity of the financial system, the reaction is not very clear and seems to have a statistically significant positive effect after seven months.

Graph 15: Effects of the interbank rate in the system

a) Impulse: Interbank rate, Response: Portfolio

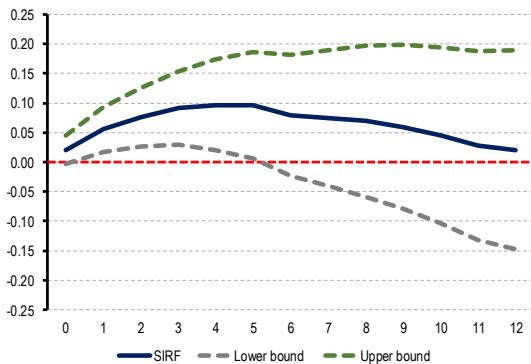


The results suggest that low interbank rates may give rise to the banks reducing credit rationing, for which the financial intermediation entities apply a series of measures to expand their portfolio (not necessarily a reduction of the lending interest rates). Within this framework, it could be understood that the credit channel in Bolivia’s financial system follows an indirect transmission logic from the OMOs and the monetary regulation rate to credit, through the interbank rate. Subsequently, the greater portfolio would have an impact on the final target variables, i.e. price stability and growth.

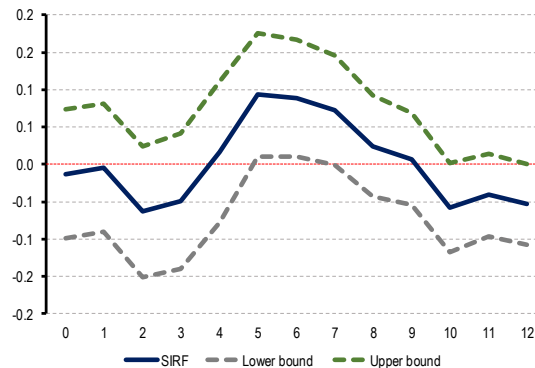
The effects of the effective lending interest rate, in national currency, are not clear in the system’s IRF. Moreover, based on economic theory, the expectations would be for this variable to inversely affect the financial system’s portfolio; however, the effect is statistically non-significant. This could be attributed to the low competitiveness in the financial system and the fact that the rates for productive and social housing loans, which account for a large percentage of the credit portfolio, are regulated by law.

Graph 16: Effects of the credit portfolio in the system

a) Impulse: Portfolio, Response: CPI



b) Impulse: Portfolio, Response: IGAE



Finally, shocks increasing the portfolio would have expansionary effects on inflation and in the economic activity. However, in the case of this last variable, within the framework of statistical significance, the effects would have a five month-lag. This closes the cycle of monetary policy transmission implemented through the financial system.

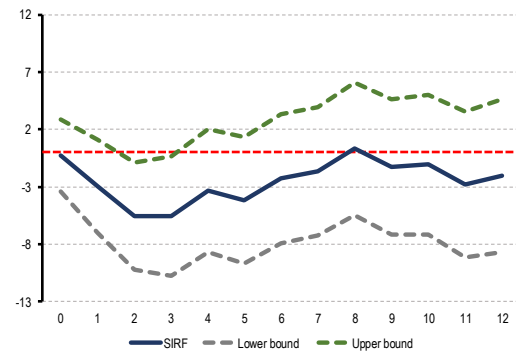
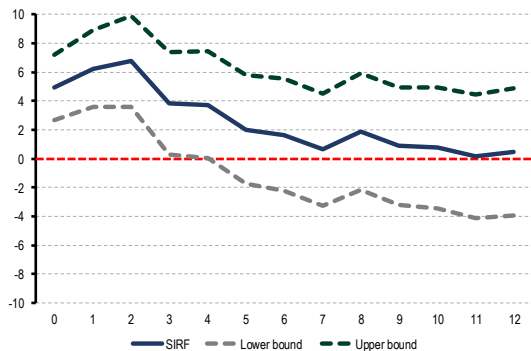
The results presented so far are also complementary to the evidence presented under the previous methodological approach. In the first place, because they show how the monetary policy is transmitted and, in the second place, although from an operational perspective the BCB affects liquidity of the financial system by means of its monetary policy instruments, this intervention is effective in terms of its final objectives related to inflation and output. Finally, since the BCB intervention is more effective on the determination of liquidity (evidenced in the first methodological approach), it can be concluded that the impacts of this variable on the rest of the monetary policy transmission system are greater.

Now, the most important results from this methodological approach are the ones approximating the relationship of bolivianization with the transmission mechanisms and the target variables of monetary policy. The IRFs explaining the interaction of these variables are:

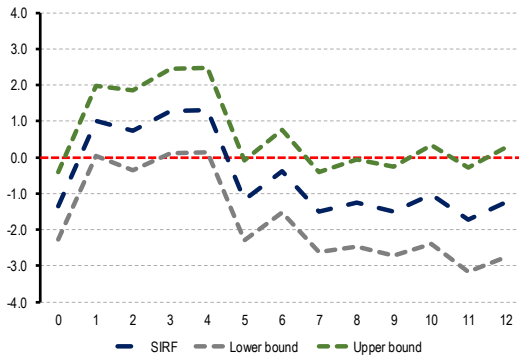
Graph 17: Effects of the bolivianization of deposits in the system

a) Impulse: Bol, Response: Liquidity

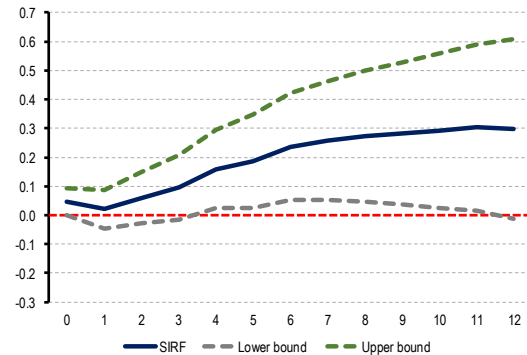
b) Impulse: Bol, Response: interbank rate



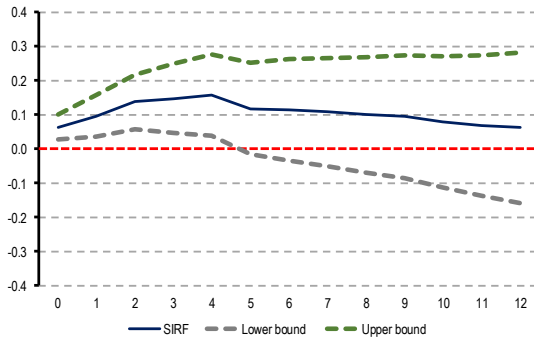
c) Impulse: Bol, Response: Lending interest rate



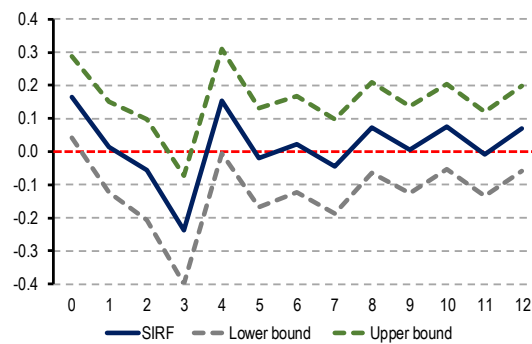
d) Impulse: Bol, Response: Portfolio



e) Impulse: Bol, Response: CPI



f) Impulse: Bol, Response: IGAE



This evidence is very important, given that it suggests that the bolivianization puts in place favorable conditions for a greater dynamism of the Bolivian economy thanks to the existence of a positive relationship between bolivianization and liquidity of the financial system. A shock that increases the degree of bolivianization of the deposits in the first instance increases liquidity of the financial system and exercises downward pressure on the interbank and lending interest rates. The greater availability of resources and the favorable rates lead to expansion of the credit portfolio. The greater availability of resources for investment and consumption derived from the portfolio expansion has a positive impact on the economic activity and, therefore, gives rise to an increase in prices.

In conclusion, within this methodological framework we could note that the bolivianization put in place more adequate conditions in the monetary policy transmission flow of a countercyclical nature, i.e. in a context of high bolivianization, effectiveness of the monetary policy increases to enhance dynamism of the economy.

VI. CONCLUSIONS

This research paper has developed an analysis to approximate the effects of the bolivianization in effectiveness of the monetary policy implemented by the BCB. For this purpose, based on the Generalized Method of Moments (GMM) an estimation was made of a function associated to liquidity of the financial system as the operational objective of the monetary authority. The explanatory variables considered were the interactions between monetary policy instruments—the OMOs and monetary regulation rates— and the bolivianization of the financial system. By incorporating the interaction variables, it was possible to calculate the variable effects of the monetary policy instruments in the control of liquidity of the financial system for each value of bolivianization in the period covered by the analysis.

The evidence obtained with this methodological approach suggests that effectiveness of the BCB's monetary policy concerning the control of liquidity of the financial system, instrumented through the OMOs, seems to have more than doubled between 2003 and 2015. In the case of instrumentation of the monetary policy based on the definition of the yield rate on 91-day Treasury Bills, the effectiveness of this variable to regulate the operational objective of the BCB's monetary policy is three times greater than that calculated for 2003.

Additionally, a Structural VAR was estimated, following the Cholesky decomposition, with the objective of evaluating the interrelations between bolivianization and the variables making up the instruments, transmission mechanisms and target variables of the monetary policy, which the BCB implements through the financial system. In this sense, based on this system, an approximation and analysis were made of the implications of the effects of bolivianization on these variables.

The results derived from this other methodological approach suggest that, with regard to the credit and interest rate channels, in Bolivia: i) increases in the levels of the monetary policy instruments (OMOs and yield rate on 91-day Treasury Bills) help reduce liquidity of the financial system; ii) there seems to be a transmission effect between the yield rate on 91-day Treasury Bills (proxy of the monetary regulation rate) on the interbank rate and the effective lending interest rate in national currency; iii) a greater level of liquidity of the financial system seems to imply a decrease of the interbank rate as well as more inflationary pressure and positive effects in the economic activity; iv) a lower interbank rate would derive in expansion of the portfolio, and this greater availability of resources for loans would entail an expansion of economic activity and inflation since there would be more resources to enhance the dynamism of consumption and investment (i.e. more liquidity in the economy). On the other hand, the most important element for the purpose of this study is that the results suggest that a context with a higher degree of bolivianization would impulse the monetary policy transmission mechanisms to enhance dynamism of the Bolivian economy, that is to say, it would generate a greater liquidity of the financial system, lower interbank and lending interest rates, and a larger portfolio; consequently, better conditions would be in place to apply a countercyclical monetary policy. In other words, a context of greater bolivianization would give rise to greater effectiveness of the monetary policy to boost the economy.

In conclusion, the findings of this research paper are technical inputs showing the benefits of expanding the degree of bolivianization of the financial system, in this case regarding effectiveness of the monetary policy instruments and the development environment of this policy in Bolivia. The proposal for future research is to link the results of this study to the effects of the exchange rate, a fundamental determinant of the bolivianization process which also plays a preponderant role in the monetary policy to anchor expectations.

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ANNEX 1

CAUSALITY TEST OF GRANGER BETWEEN THE BOLIVIANIZATION OF DEPOSITS AND PORTFOLIO

| | Chi ² | df | Prob > Chi ² |
|---|------------------|----|-------------------------|
| The "bolivianization of deposits" non-Granger causes "bolivianization of the portfolio" | 4.701 | 1 | 0.030 |
| The "bolivianization of the portfolio" non-Granger causes the "bolivianization of deposits" | 0.007 | 1 | 0.935 |

Note: The VAR was estimated with two lags. The variables are in logarithms and the trend was included as an exogenous variable.

ANNEX 2

UNIT ROOT TEST

| | Logarithm | | D(Logarithm) | |
|--|-----------|-----------------|--------------|-----------------|
| | ADF | Phillips-Perron | ADF | Phillips-Perron |
| | | - | | |
| Bolivianization of deposits | -4.14*** | 3.13*** | -8.66*** | -9.05*** |
| OMOs | -1.89 | -1.72 | -6.50*** | -6.25*** |
| Yield rate on 91-day Treasury Bills | -1.39 | -1.90 | -8.90*** | -9.07*** |
| Ratio (Excess liquidity/Required reserves) | -1.89 | -2.18 | -11.17*** | -11.24*** |
| Interbank rate | -2.33 | -2.31 | -12.91*** | -12.96*** |
| Effective lending interest rate in national currency | -5.38*** | 5.47*** | -15.11*** | -15.56*** |
| Portfolio | 5.42 | 3.91 | -9.71*** | 10.49*** |
| CPI | -0.78 | -0.62 | -7.43*** | -7.57*** |
| Required legal reserve | 0.28 | 0.09 | -10.29*** | -10.51*** |
| Gap | | | -7.97*** | -8.12*** |
| IGAE | -0.07 | 0.48 | -17.48*** | -21.49*** |
| Interaction D(ln(OMOs))*Bolivianization | | | -6.69*** | -6.91*** |
| Interaction D(ln(TB91))*Bolivianization | | | -9.68*** | -9.45*** |

Note: Ho: presence of unit root. ***implies rejection of Ho with a level of significance of 1%

PARTIALLYING OUT TO CHECK STATIONARITY OF VARIABLE BOLIVIANIZACIÓN

| | ADF | Phillips-Perron |
|---|-----------|-----------------|
| Dependent variable controlled by all explanatory variables and temporary controls, less bolivianization | -13.62*** | -13.58*** |
| Variable bolivianization controlled by all explanatory variables plus temporary controls | -6.38*** | -6.27*** |

Note: Ho: presence of unit root. ***implies rejection of Ho with a level of significance of 1%

ANNEX 3 TESTS ASSOCIATED TO THE UNDERLYING VAR

LAG SELECTION CRITERION

| Sample: 2003M06 2015M10 | | | | | | |
|----------------------------|---------|-----------|-----------|------------|------------|------------|
| Observations included: 149 | | | | | | |
| Lag | LogL | LR | FPE | AIC | SC | HQ |
| 0 | 829.506 | NA | 5.99E-15 | -7.268533 | -1.462248 | -4.909535 |
| 1 | 2469.51 | 2377.448 | 5.25E-24 | -28.19469 | -20.75539* | -25.17223 |
| 2 | 2613.85 | 191.8107 | 2.51E-24 | -29.04493 | -19.97261 | -25.35899 |
| 3 | 2716.2 | 123.6509 | 2.23E-24 | -29.33158 | -18.62624 | -24.98218 |
| 4 | 2866.97 | 163.9167 | 1.11E-24 | -30.26799 | -17.92964 | -25.25512 |
| 5 | 3017.01 | 145.0115 | 6.18E-25 | -31.19479 | -17.22342 | -25.51845 |
| 6 | 3192.35 | 148.2752* | 2.78e-25* | -32.46112* | -16.85673 | -26.12131* |

* Refers to the lag order selection criteria

LR: sequential modified LR test statistic (each test at 5% level)

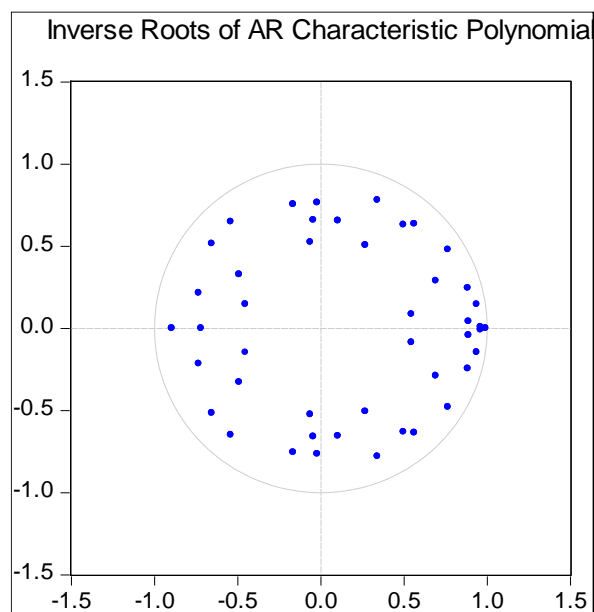
FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

STABILITY TEST



Note: The VAR satisfies the condition of stability.
No root is outside the unit circle.

CORRELATION TEST

| Ho: No serial correlation in lag h | | |
|------------------------------------|---------|--------|
| Sample: 2003M06 2015M10 | | |
| Observations included: 149 | | |
| Lags | LM-Stat | Prob |
| 1 | 90.195 | 0.2270 |
| 2 | 67.847 | 0.8513 |
| 3 | 99.343 | 0.0813 |
| 4 | 90.093 | 0.2293 |
| 5 | 82.957 | 0.4189 |
| 6 | 72.682 | 0.7338 |
| 7 | 75.198 | 0.6607 |
| 8 | 100.784 | 0.0675 |
| 9 | 92.279 | 0.1841 |
| 10 | 90.931 | 0.2112 |
| 11 | 78.825 | 0.5477 |
| 12 | 75.529 | 0.6507 |

Probabilities of χ^2 with 81 g.l.

NORMALITY TEST

| Ho: The residuals are normal | | | |
|------------------------------|-------------|------|-------|
| Component | Jarque-Bera | g.l. | Prob. |
| 1 | 2.423 | 2 | 0.298 |
| 2 | 7.928 | 2 | 0.019 |
| 3 | 3.223 | 2 | 0.2 |
| 4 | 0.633 | 2 | 0.729 |
| 5 | 2.231 | 2 | 0.328 |
| 6 | 0.874 | 2 | 0.646 |
| 7 | 3.007 | 2 | 0.222 |
| 8 | 0.906 | 2 | 0.636 |
| 9 | 3.86 | 2 | 0.145 |
| Joint | 25.085 | 18 | 0.123 |