DOCUMENTO DE TRABAJO N° 386

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Diciembre, 2014

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DOCUMENTO DE TRABAJO 386
http://files.pucp.edu.pe/departamento/economia/DDD386.pdf

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Inflation Targeting in Peru: The Reasons for the Success
Lima, Departamento de Economía, 2014
(Documento de Trabajo 386)

PALABRAS CLAVE: Política monetaria, tasa de interés, regla de Taylor, intervención esterilizada.

Hecho el Depósito Legal en la Biblioteca Nacional del Perú Nº 2015-01235.
ISSN 2079-8466 (Impresa)
ISSN 2079-8474 (En línea)

Impreso en Kolores Industria Gráfica E.I.R.L.
Jr. La Chasca 119, Int. 264, Lima 36, Perú.
Tiraje: 100 ejemplares

INFLATION TARGETING IN PERU: THE REASONS FOR THE SUCCESS

Oscar Dancourt

Abstract

The Peruvian central bank took two major decisions in the early 2000s: implementing an inflation target system and accumulating sufficient foreign-exchange reserves. These two decisions have allowed the central bank to preserve macroeconomic stability in favorable or unfavorable international environments.

The use and impact of the main monetary policy instruments over the period 2002-2013 is discussed; namely, the short term interest rate set by the central bank or reference interest rate, the reserve requirement ratio in local and foreign currencies and, finally, sterilized intervention in the foreign exchange market. The process of bank credit (de)dollarization is also reviewed.

Palabras clave: Política monetaria, tasa de interés, regla de Taylor, intervención esterilizada.
Códigos JEL: E520, E580

Resumen

El banco central peruano tomo dos decisiones principales durante los años 2000: instaurar el esquema de metas de inflación y acumular grandes reservas de divisas. Este sistema de política monetaria le permitió al banco central mantener la estabilidad macroeconómica en contextos externos adversos o favorables.

El texto discute el uso y el impacto de los instrumentos más importantes de la política monetaria peruana: la tasa de interés de referencia, las tasas de encaje en soles y en dólares, y la intervención esterilizada en el mercado cambiario. También se pasa revista al proceso de (des)dolarizacion del crédito bancario.

Keywords: Monetary policy, interest rate, Taylor rule, sterilized intervention.
JEL CODE: E520, E580

INFLATION TARGETING IN PERU: THE REASONS FOR THE SUCCESS[1]

Oscar Dancourt[2]

INTRODUCTION

The Peruvian economy's macroeconomic performance was notable throughout the decade that followed the decision of the Peruvian central bank (BCRP, Banco Central de Reserva del Peru) to set up an inflation targeting system. Inflation was at its lowest in decades (see Figure 1); GDP growth was at its highest in decades (see Figure 2); and there was no banking crisis.

However, attributing this good macroeconomic performance to the role played by monetary policy is not a simple operation, as the external context was exceptionally favorable over 2002-13[3]. A favorable external context stimulates GDP growth and enables a low rate of inflation because the local currency appreciates.

For an economy such as Peru's, higher commodity export prices lead to good times, while lower commodity export prices lead to bad times; these external prices directly influence private investment, public spending, and the exchange rate. The other key piece of the external context is capital flows, which also influences aggregate demand and the balance of payments. Since the financial liberalization of the 1990s, capital flows have been procyclical: inflows are associated with booms, and outflows are associated with recessions.

The external context has largely been favorable, but for a couple of periods. The first exception is the period of global financial crisis of 2008-09, and the second exception is the open period in mid-2013, marked by the adjustment of the US monetary policy and a worldwide fall in the price of metals.

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1 This paper was presented at the symposium on monetary policy in Latin America organized by CEDES held in Buenos Aires in August 2014.

2 Pontificia Universidad Católica del Perú, Department of Economics. I am grateful to Gustavo Ganiko for his impeccable assistance.

3 See Mendoza (2013).

The two most recent recessions (1998-2000 and 2008-09) coincided with a sharp worldwide downturn in the prices of the metals that the Peruvian economy exports, and a steep drop in the credit provided by the local banking system in foreign currency to firms and to families. This credit crunch is linked in both cases to the fact that the external financing sources of local banking suddenly dried up.

The price index of Peruvian exports was 3.2 times greater in 2008 than in 2002; went down between July and December of 2008; doubled from the start of 2009 to its August 2011 peak; and then fell again, by 16%, until May 2014. By the end of this period, this index was 3.4 times its initial value.

With respect to capital inflow or outflow, the best indicator is the 12-month growth rate of bank credit to the private sector in foreign currency. These loans established a direct link between internal demand and international financial conditions. In a first stage, from 2002-06, credit growth in dollars was negative or small due to the combined effect of new central banking regulations —which is explained herein— and the consequences of the banking crisis of 1998-2000. In a second stage, from 2007-2014, two large credit expansions took place (January 2007-September 2008, and January 2010-November 2012), as well as two sharp contractions (October 2008-November 2009, December 2012-March 2014), both determined by changes in international financial conditions (the global financial crisis of 2008-09 and the adjustment of the US monetary policy at the start of 2013). For the end of this period, foreign currency credit in the private banking sector accounted for 13.7% of GDP; that is, 3 percentage points higher than at the start of 2007.

In this favorable external environment, the BCRP took a second decision as important as setting the inflation targeting system. The central bank decided to accumulate large foreign exchange reserves on a scale that was without precedent in Peruvian economic history. Between January 2002 and April 2013, the BCRP's foreign exchange reserves,

measured by the foreign exchange position[4], grew 17 times, accounting for 24% of GDP at the end of this period. This decision changed the limits of what is possible in terms of monetary policy and macroeconomic stability. The BCRP was able to tackle the impact on the exchange rate of adverse external shocks and/or the speculative attacks that habitually accompany them, without applying a restrictive monetary policy. It did this during the 2006 presidential election campaign, during the 2008-09 global financial crisis, and, finally, during the tapering announced by Bernanke at the start of 2013.

In reality, the specific role played by monetary policy during this period can only be assessed if one questions why there was no great recession or banking crisis in 2008-2009 like that of 1998-2000. Moreover, one might also ask why inflation was not derailed during the negative supply shocks (petroleum price rise) of 2004 and 2008, which occurred when the economy was growing at a good pace[5]. But in truth, this is a secondary concern. Addressing the first question requires the comparison of two episodes with similar adverse external shocks and the same economic structure, and where the only relevant difference lies in the monetary (and fiscal) policies employed to tackle the adverse external shock.

This paper describes how the main instruments of the Peruvian monetary policy were used over the period 2002-2013. It focuses on two of the channels through which monetary policy influences economic activity and the price level: the credit channel and the exchange rate channel, which appear to be the most important in the Peruvian economy. In the context of an economic system dominated by the banks, the use and impact of the main monetary policy instruments is discussed; namely, the short term interest rate set by the central bank or reference interest rate, the reserve requirement ratio in local and foreign currencies and, finally, sterilized intervention in the foreign exchange market. The process of bank credit (de)dollarization is also reviewed.

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4 The foreign exchange position discounts two items of the net international reserves (RIN) managed by the BCRP: external assets that belong to the government, and external assets (reserve requirements in foreign currency and others) that belong to the private banking system.

5 On supply and demand shocks that explain the evolution of inflation during this period, see Lavanda and Rodriguez (2011).

To round off this introduction, a quote from Tobin (1998, p. 6) about the modern monetary policy:

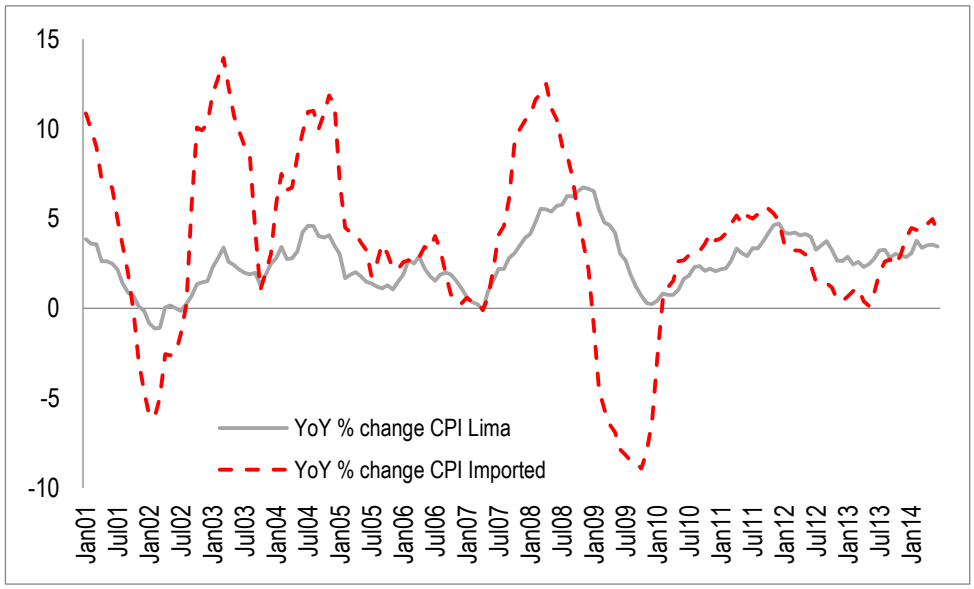
"The interest rate on overnight loans of federal funds is (…) the Fed´s instrument of policy. It is a market rate, which the Fed controls buying and selling Treasury bills (…) at its intervention rates, nowadays publicly announced. At scheduled meetings eight times a year (…the Fed …) reconsiders and sometimes change the intervention rate, generally by 25 or 50 basis points (…)"

"The tail wags the dog. By gently touching a tiny tail, Alan Greenspan wags the mammoth dog, the great American economy. Isn´t that remarkable? The federal funds rate is the shortest of all interest rates, remote from the rates on assets and debts by which businesses and households finance investment (…) and consumption (…). Why does monetary policy work? How? It´s a mystery (…)"

"There are two lines of explanations: substitutions chains and policy expectations. Expectations are very powerful, but they cannot work unless chains of assets substitution do really occur (…)"

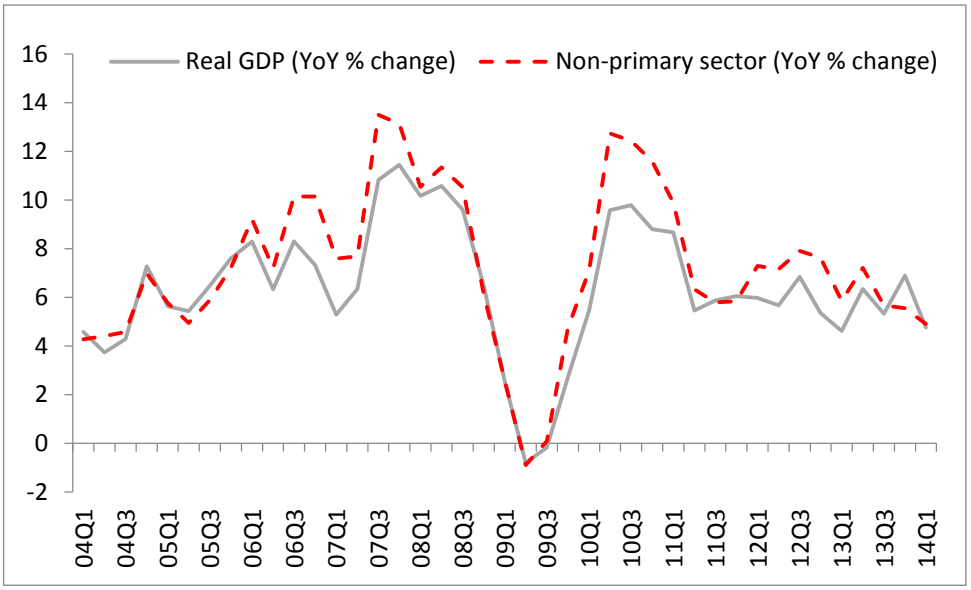
"We think we know from experience (…) that the Fed can if it wants take really big actions with immense consequences (…)"

Figure 1
Inflation and supply shocks



Source: BCRP

Figure 2
Total GDP and non-primary sector GDP
(Percentage change)



Source: BCRP

1. THE CREDIT CHANNEL

In this section, we will see how the BCRP determines its policy interest rates and what impact does this have on the banking system. We also discuss the role of reserve requirements in domestic currency and foreign currency in the scheme of monetary policy.

In an economy where the financial structure is dominated by commercial banks, the monetary policy arsenal contains a number of instruments. This arsenal, linked to the credit channel, includes the reference or target interest rate for the interbank funds market in local currency; the reserve requirement ratio for deposits in local currency; and the reserve requirement ratio for bank liabilities in foreign currency, local deposits and external debts.

Looking beyond the exchange rate, which we deal with in the next section, the hypothesis of this paper is that the main channel through which the monetary policy impacts the real sector of the Peruvian economy is the credit or bank lending channel. The credit channel refers here to the effect that the monetary policy instruments (reference interest rate and reserve requirement ratio for deposits in local currency) has on the quantity and price of bank loans[6].

Since 2003, the main monetary policy instrument has been the overnight reference interest rate for the interbank market. The adoption of the inflation targeting system occurred one year before, in 2002, while the transition[7] from control of a monetary aggregate, which was applied during the 1990s, toward control of a short term interest rate started in mid-2001. A second important instrument, which came to the fore from 2007-08, has been the reserve requirement ratio for deposits in local currency.

The Peruvian central bank (BCRP) has systematically utilized both instruments, as shown in Figure 3. The BCRP raised the reference rate and the reserve requirement ratio during the first half of 2008, when inflation went beyond the ceiling of the target range (3% per

[6] See Bernanke and Gertler (1995).

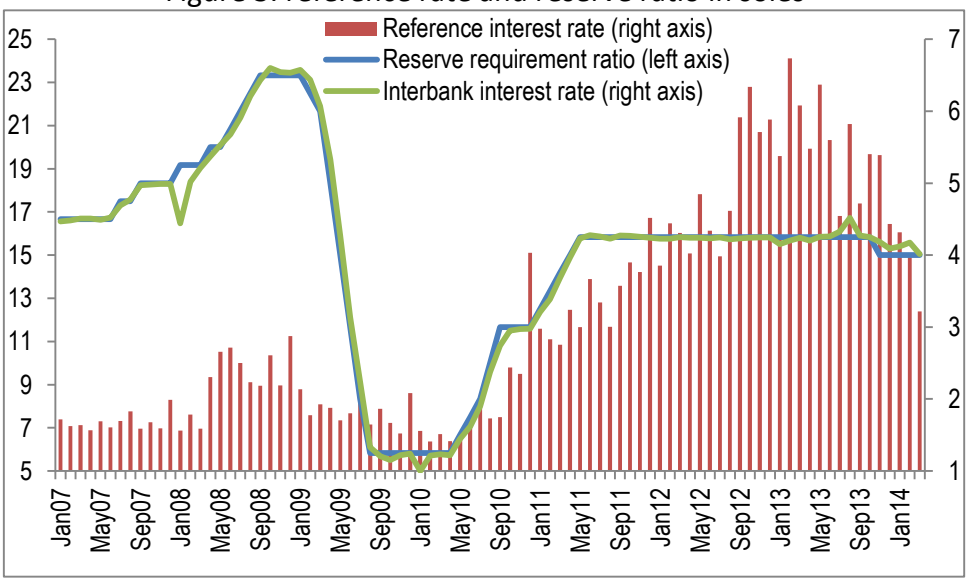
[7] See BCRP (2003), Armas and Grippa (2005).

year) and the Peruvian economy grew at a rate of 10% per year. Subsequently, at the end of 2008 and during the first half of 2009, the BCRP first reduced the reserve requirement ratio and then the reference rate when the Peruvian economy was subject to recessionary shocks from the world financial and economic crisis, through deterioration of its terms of trade and capital outflows. Finally, the BCRP again increased the reference rate and the reserve requirement ratio in mid-2010 when the revival of the Peruvian economy was vigorous. Figure 3 also shows that the reference rate has effectively guided the interbank market interest rate.

It should be noted that the central bank did not respond with a cycle of cuts to the reference interest rate in the face of the Peruvian economy's rapid slowdown in 2013-14, which was associated with a fall in international mineral prices and capital outflows linked with the adjustment of the US monetary policy. The monetary authority restricted itself to a progressive reduction in the reserve requirement ratio in local currency[8]. As well as cooling the economy, this adverse external shock deteriorated the balance of payments, thus exerting strong upward pressure on the exchange rate.

[8] The reference interest rate was 4.25% per annum from May 2011 until October 2013. It decreased to 4% between November 2013 and June 2014. Oddly, the central bank announced that this was not the start of a sequence of reductions in the reference interest rate.

Figure 3: reference rate and reserve ratio in soles



Source: BCRP.

In a flexible inflation targeting system[9] whose objectives are price stability and full employment, a Taylor rule (1993, 1999) to guide decisions on the reference interest rate serves to transparently connect the means and the ends of monetary policy[10]. As Janet Yellen (2012) says, "rules of the general sort proposed by Taylor (1993) capture well our statutory mandate to promote maximum employment and price stability by prescribing that the federal funds rate should respond to the deviation of inflation from its longer-run goal and to the output gap, given that the economy should be at or close to full employment when the output gap —the difference between actual GDP and an estimate of potential output— is closed". Ball (1994, p. 9-10) shows that "policies that attempt to achieve a target level of inflation (…) implicitly defines a rule for setting the interest rate".

9 See Ball (2012), cap. 16.

10 The 1993 Political Constitution of Peru establishes that "the purpose of the Central Bank is to maintain monetary stability". One of the functions of the Central Bank, according to the 1979 Constitution, was to "defend monetary stability". Ensuring monetary stability has been politically compatible with the BCRP's decision in 2002 to adopt the inflation targeting system. Given Peru's traumatic experience with the hyperinflation of the late 1980s, it is clear that a flexible inflation targeting system, which pursues both price stability and full employment, would give primacy to the objective of maintaining low inflation if there were a conflict between both objectives.

Figure 4 presents the interest rate that results from estimating a Taylor rule for Peru for the period 2000-2013 using quarterly data; the equation was estimated in a study by the IMF (2014). The estimated reference interest rate is a direct function of the output gap (GDP minus potential GDP) and the inflation gap (inflation measured by the consumer price index minus the central bank target); this estimated Taylor rule also contains a gradual adjustment mechanism that reflects the inertia of the reference interest rate[11]. Figure 4 also shows the reference rate set by the BCRP.

The Taylor rule equation is

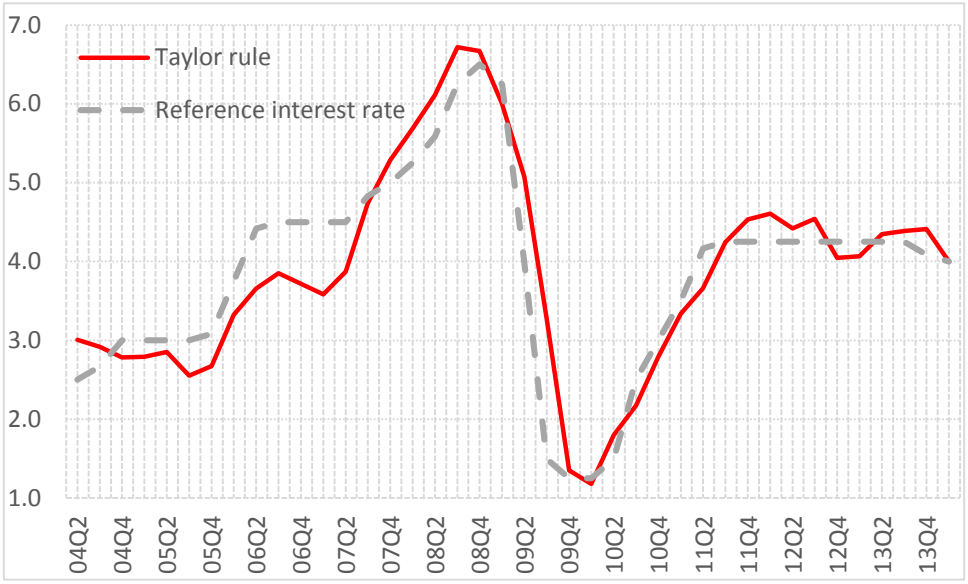
$$\text{(TR)} \qquad i_t = 0.7i_{t-1} + (0.3)(3.38 + 0.9y_t + 0.61\pi_t^d + 0.05\pi_t^e)$$

where i_t is the quarterly interest rate; i^e=3.38 is the equilibrium nominal interest rate, that is, the equilibrium real interest rate plus the inflation target; y_t is the quarterly output[12] gap; π^d_t is the difference between effective annual inflation and the inflation target; and π^e_t is the inflation expected by the public, measured through central bank surveys. The coefficient of the expected inflation (π^e_t) is the only one that is not statistically significant; see IMF (2014, p. 66).

[11] The IMF study (2014), which is based on Salas (2010), estimates a complete macroeconomic model (an aggregate demand curve, an aggregate supply curve, and an uncovered interest rate parity equation) for the Peruvian economy, in addition to this Taylor rule.

[12] To estimate the potential output, a Hoodrik-Prescott filter has been used.

Figure 4: Taylor rule and reference rate



Source: FMI, BCRP.

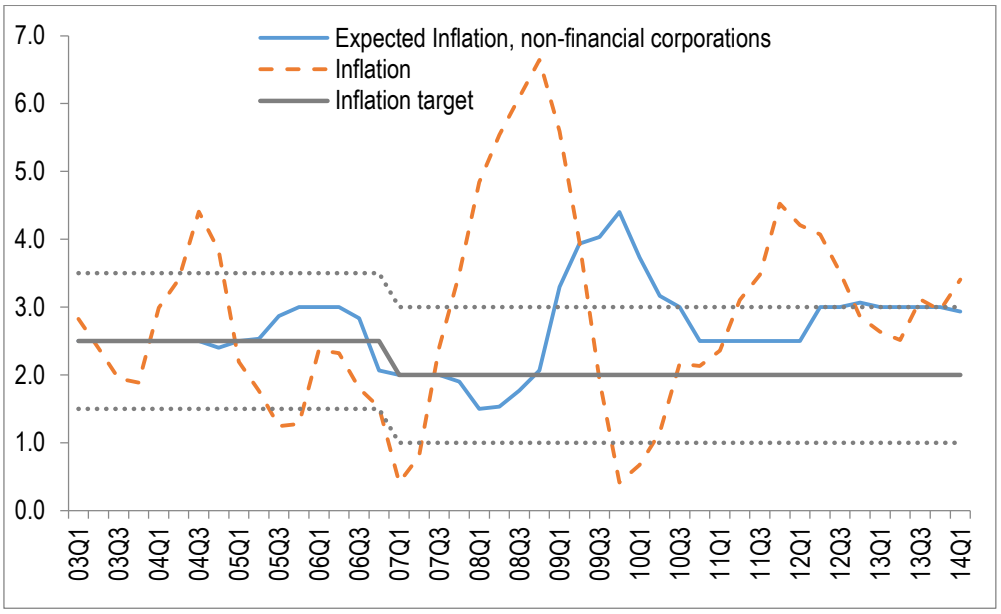
It can be concluded from the estimation of this Taylor rule and from Figure 4 that the inflation and output gaps have been the main, systematic factors that determined the BCRP's decisions on the reference interest rate over the period 2004-14. This is not to say that these two gaps are the only factors that influenced these decisions in this historical period, as there may be further specific reasons for steering the interest rate in one direction or another, in certain situations. For example, according to Figure 4, it seems clear that the reference interest rate was between 50 and 75 basis points above what the Taylor rule suggested during the election campaign prior to the presidential election in mid-2006. This election campaign was associated with a strong speculative attack on the exchange rate, which the central bank faced up to partly by selling dollars from its foreign reserves, and partly by raising the policy interest rate somewhat more.

To make a final comment on the estimated Taylor rule, that the rate of inflation expected by the public is not a determinant of the reference interest rate makes theoretical sense[13] and reflects central bank practice at one stage of this historical period. But this does not imply that the inflation targeting system applied since 2002

[13] See Bernanke and Woodford (1997).

has not anchored inflation expectations if these are measured through the surveys conducted by the central bank itself, as can be seen in Figure 5.

Figure 5
Expected and realized inflation



Source: BCRP.

What is the connection between instruments and objectives? The transmission mechanism that connects, in the short term, these policy instruments (the reference interest rate and the reserve requirement ratio in local currency) with economic activity and the price level consists of four links. The first is that which connects the monetary policy instruments with nominal lending interest rates and the quantity of bank loans. Given the expected inflation, if the central bank increases, for example, the reference interest rate, this is expected to push up nominal and real lending[14] interest rates and/or to reduce the volume of bank credit. Moreover, if the central bank increases, for example, the reserve requirement ratio, this is also expected to push up nominal and

[14] The lending interest rates that influence aggregate demand are long term rates. The central bank controls a very short term interest rate (the typical interbank loan term is overnight). This implies, following the expectation theory of the term structure, that expected reference interest rates for the future are a key determinant in various lending interest rates, as well as the current reference interest rate. It also implies that the central bank usually changes the reference rate in cycles of increases and decreases so that the current and expected future reference rates move in the same direction; see Ball (2012), cap. 13.

real lending interest rates and/or to reduce bank credit. The second link is that aggregate demand depends inversely on real lending interest rates and directly on the quantity of bank loans[15]. The third is that production and employment depends on aggregate demand. Finally, the fourth link is that the price level depends directly on the gap between effective and potential output, with the latter taken as given.

It is clear that the first link of this monetary policy transmission mechanism via commercial banks is crucial. If this link were to break there would be no connection through this credit channel between the monetary policy instruments and their final objectives, such as inflation and economic activity.

Dancourt (2012), using panel data[16] for Peru, finds that the short-term interest rate and the reserve requirement ratio have a negative impact on the growth rate of loans extended by commercial banks and *cajas municipales* (small financial intermediaries) considered together over the period 2003-2011[17]. Second, excluding *cajas municipales*, it is found that reserve requirements do not have a statistically significant influence on the growth of bank loans, while the reference interest rate does. In 2009, commercial banks and *cajas municipales* accounted for 74% and 10% respectively of total private sector credit in local currency, which, in turn, amounts to half of all credit, in local and foreign currency, extended to the private sector by the financial system[18].

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15 This includes the case of rationing in credit markets; if there is no rationing, the aggregate demand only depends on the interest rates. See Stiglitz and Greenwald (2003), Cap. 6.

16 The methodology utilized is that of Gambacorta (2001) or Worm (2001), which employ dynamic panel models to determine whether the reference interest rate influences the growth of bank loans in different European countries, controlled by the macroeconomic context and the specific characteristics of the banks; see Erhman et al (2001). In Brazil, Takeda et al (2005) simultaneously incorporate the interest rate and the reserve requirement ratio set by the monetary authority in a dynamic panel with monthly data over the period 1994-2001; the result is that only the reserve requirement ratio has a negative and significant impact on the growth of credit extended by banks.

17 The period 2003-2011 encompasses two stages of recovery from recession (2003-05 and 2009-10), a boom (2006-08) without precedent in the Peruvian economy, and a recession (2008-09) caused by an adverse external shock when an expansive monetary policy was applied for the first time.

18 Another option is to measure the impact that the reference rate or the reserve ratio have on the interest rate charged by individual commercial banks and *cajas municipales* throughout the period; see Gambacorta (2004) and Weth (2002). No study of this kind has yet been

Armas et al (2014), utilizing aggregated data, find that a rise (fall) in the reserve requirement ratio in local currency increases (decreases) the lending interest rates of commercial banks and *cajas municipales*; however, the impact of this reserve ratio on local currency loans extended by banks is not statistically significant[19].

1.1 The role of the reserve ratio in local currency

Armas et al (2014, p. 8-9) hold that "in recent years, RRs [reserve requirements] have been used by the BCRP as a complementary tool to its short-term interest rate. As such, it has helped to break the trade-off between macro and financial stability. In particular, the RR-induced QT [quantitative tightening] dampened the expansionary effects of capital inflows on domestic credit conditions and, through this channel, also reduced output gap and inflationary pressures. In the presence of RR policy, this QT effect on the output gap implies that the policy rate may not need to rise as much. Therefore, the use of QT under persistent capital inflows is analogous to a fiscal policy tightening that also allows a lower monetary policy rate and a less appreciated domestic currency (…)".

What can be done with the reserve requirement ratio in local currency in a financial system dominated by commercial banks that cannot be done with the reference interest rate? Apparently, the idea is that the reserve requirement ratio does not affect the exchange rate, in contrast to the reference rate, which does.

In a Bernanke-Blinder model[20], the reference interest rate affects the cost of borrowing in the banking system and in the local bonds market, while the reserve requirement ratio only affects the cost of borrowing in the banking system. A rise in the reference

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conducted on the Peruvian economy. Existing studies estimate pass-through coefficients that connect the changes in the reference interest rate with the changes to average or aggregate bank lending or deposit interest rates, of differing terms and in local currency. As the BCRP (2009) documents, these coefficients have been on the increase over the last decade and are greater for short term interest rates.

[19] On assessing the effect that the reserve requirement ratio in local currency has on volumes loaned and the interest rates set by commercial banks and *cajas municipales*, Armas et al (2014) do not control for the possible impact that the reference interest rate may have.

[20] See Appendix 1.

interest rate operates on the commercial bank lending rate through two channels: it reduces loan supply (the public prefers to have more bonds and less deposits) and increases loan demand (firms prefer to borrow more through the banking system and less via the bond market). A rise in the reserve requirement ratio operates on the commercial bank lending rate only through one channel: it reduces loanable funds (the deposits minus the reserves) and loan supply.

A rise in the reference interest rate causes the commercial bank lending rate to increase and economic activity to decrease, as well as improving net exports and fostering capital inflow (local firms prefer to borrow abroad, as it renders credit in the banking system and the local bond market more expensive). Thus, the exchange rate also has to fall for both reasons if the central bank does not intervene in the foreign exchange market.

A rise in the reserve requirement ratio also causes the commercial bank lending rate to increase and economic activity to decrease, improves net exports and fosters capital inflow (local firms prefer to borrow abroad and in the local bond market before doing so in the banking system). The exchange rate has to fall for both reasons.

A restrictive monetary policy, implemented via the reference interest rate or via the reserve requirement ratio, qualitatively produces the same results: it slows up the economic activity, reduces the price level, and appreciates local currency.

Finally, the Bernanke-Blinder model[21] implies that the impact of the reference interest rate on economic activity (and on the price level) inversely depends on the reserve requirement ratio. If we refer to the reserve requirement ratio in local currency, it is not true —as pointed out by Armas et al (2014, p. 9) or the *Reporte de Inflación*[22]— that "the use of RRs contributes to monetary policy effectiveness".

[21] See Appendix 1.

[22] See BCRP (2013), page 100.

One reason is that a rise in the reference interest rate operates on the commercial bank lending rate through two channels: it reduces loan supply and increases loan demand. The strength of the first channel is negatively dependent on the reserve requirement ratio. The higher the reserve ratio, the lower the impact that a given reduction in deposits, caused by a rise in the reference rate, has on loanable funds and the loan supply.

1.2 The (de)dollarization of credit

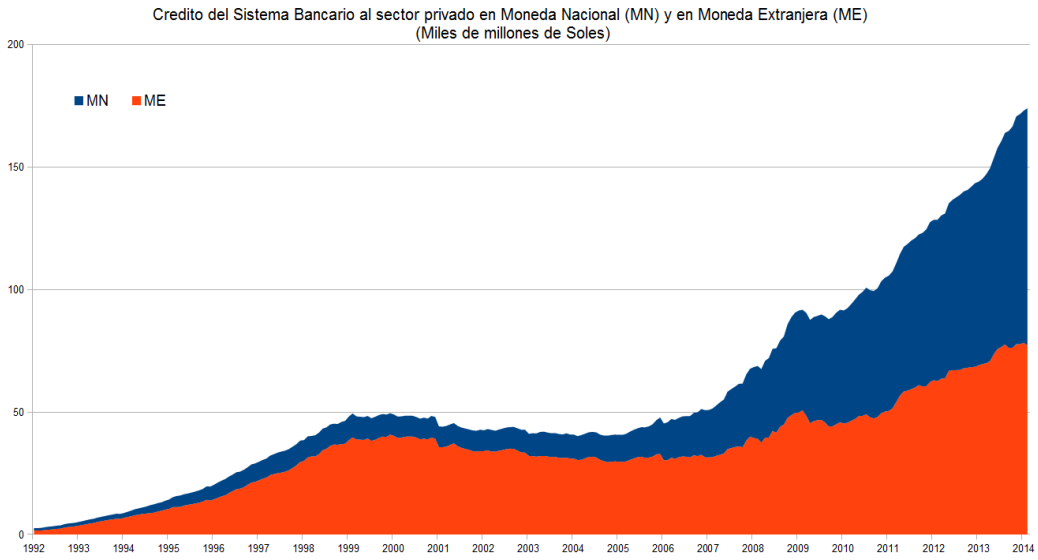
From 1992 to 2014, there are three stages in the evolution of bank credit to the private sector, as can be seen in Figure 6. In the first stage, which ran from 1992 to 2000, the credit system re-emerged following its almost total destruction during the hyperinflation that took place at the end of the 1980s, in a context of macroeconomic stabilization where economic activity expands and inflation falls below 10% per year. This revival of bank credit predominantly occurs in foreign currency, led by a handful of big banks that obtain a good deal of their loanable funds abroad. Between January 1992 and the peak achieved in September 1998, nominal credit in dollars increased sevenfold. This first stage came to an end with the recession of 1998-2001 and the associated banking crisis, precipitated by the sudden cessation of short-term external financing to the banking system due to the Russian crisis. The degree of bank credit dollarization peaked (80%-82%) towards the end of this first stage.

In the second stage, which ran from 2001 to mid-2006, nominal credit in dollars decreased steadily, by 27%, between the peak of September 1998 and the trough of March 2004. The value posted in 1998 was only recovered in 2007. Meanwhile, nominal credit in local currency rapidly expanded, after having contracted by 16% between the peak of February, 1999 and the trough of June, 2001. During this stage, between mid-2001 and mid-2006, nominal credit in soles doubled and credit dollarization fell to 66%. In this second stage, the economy recovered from the recession of 1998-2000 (the GDP rose to a yearly average of 4.7%) with low inflation (2% annual average).

During this recovery of economic activity, total bank credit to the private sector dropped from 22% to 17% of GDP between 2003 and 2006 due to the contraction of credit in foreign currency, while credit in local currency started to expand, as shown in Figure 7.

In this second stage, the inflation targeting system was established for the management of monetary policy, and commercial banks' external debt was subject for the first time to a similar reserve requirement ratio to that which is applied to deposits in dollars; the reserve requirement ratio on deposits in dollars has always been considerably higher than that which is imposed upon deposits in soles. The objective was to reduce the level of banking system dollarization so as to increase the power of monetary policy and avoid the repetition of a banking crisis such as that of 1998-2000. These changes in the monetary policy regime and the reserve requirement system, as well as the consequences of the 1998-2000 banking crisis, explain the contraction of credit in dollars and the expansion of credit in soles that typify this second stage[23].

Figure 6:
Banking system credit in soles and dollars
(Billions of soles)

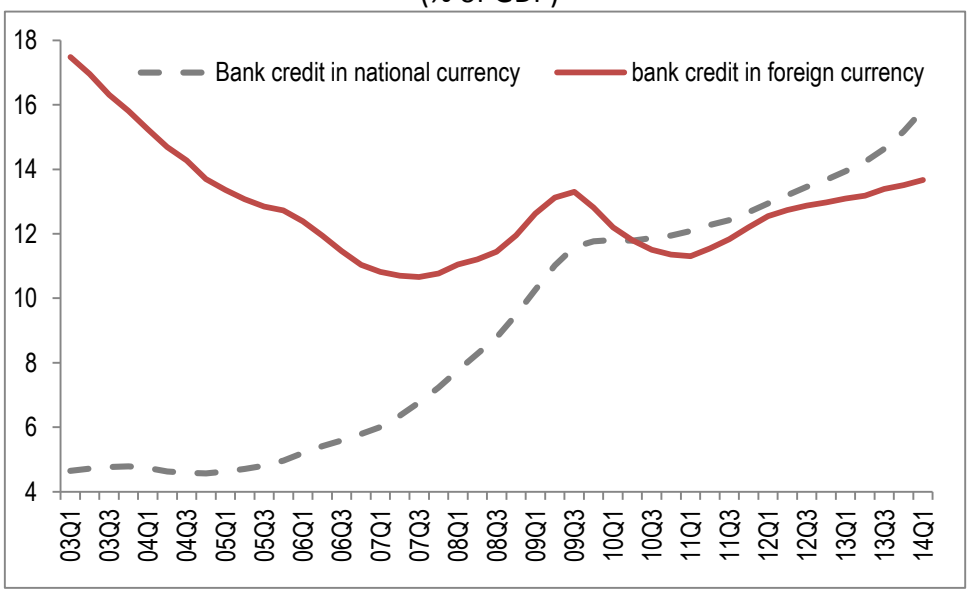


23 According to García–Escribano (2010), the component of total credit that accounts for most de-dollarization is commercial credit for firms, especially manufacturing, trade, and real estate. Garcia-Escribano (2010) shows that "dollarization of loans with longer maturities (mortgages and commercial) is higher than loans with shorter maturities (consumer and small businesses)."

With the inflation targeting system, a short term interest rate becomes the main monetary policy instrument. A crucial consequence of this new monetary regime is that the conduct of commercial banks, their propensity to lend, becomes a main determinant of the level of bank credit to the private sector in local currency. The other basic determinant of bank credit in local currency is monetary policy, which sets the reference interest rate and the reserve requirement ratio in local currency.

The optimism or pessimism of bankers, expressed in their propensity to lend, is an essential determinant of bank credit supply and economic activity when the central bank sets the interest rate in a Bernanke-Blinder model[24]. A rise in the propensity to lend increases the credit supply, reducing the commercial bank lending rate while increasing economic activity and the price level. The quantity of money increases in response to a rise in the bankers' propensity to lend, given the monetary policy.

Figure 7:
Banking system credit in soles and dollars
(% of GDP)



Source: BCRP, prepared by the author.

[24] See Appendix 1.

This is a reasonable explanation of the continuous expansion of banking credit in soles that characterizes the second (2001-06) and third (2007-14) stages of this historical period. This scenario also implies that the strategy of banking system de-dollarization applied by the central bank, especially with reserve requirements on external debt, may be successful because aggregate credit in local currency responds to the impulses of the private banking system.

The new reserve requirements on external debt applied in 2004 significantly increase the cost of external funding, limit the volume of loans in foreign currency, and increase local interest rates[25]. Certainly, the contraction of loans in foreign currency that occurred during the second stage also reflects the consequences of the 1998-2000 banking crisis in which 11 of a total of 26 banks went bust or were bailed out, including the second and fifth-biggest banks by amount of deposits.

The third stage, which ran from mid-2006 to May-June 2013, is characterized by a notable expansion in loans in both dollars and soles. During this stage there was a fivefold increase in nominal credit in soles, while nominal credit in dollars grew 2.7 times. In this way, despite the significant growth of loans in foreign currency, by the end of this third stage the level of dollarization of banking system credit to the private sector had fallen by 48%.

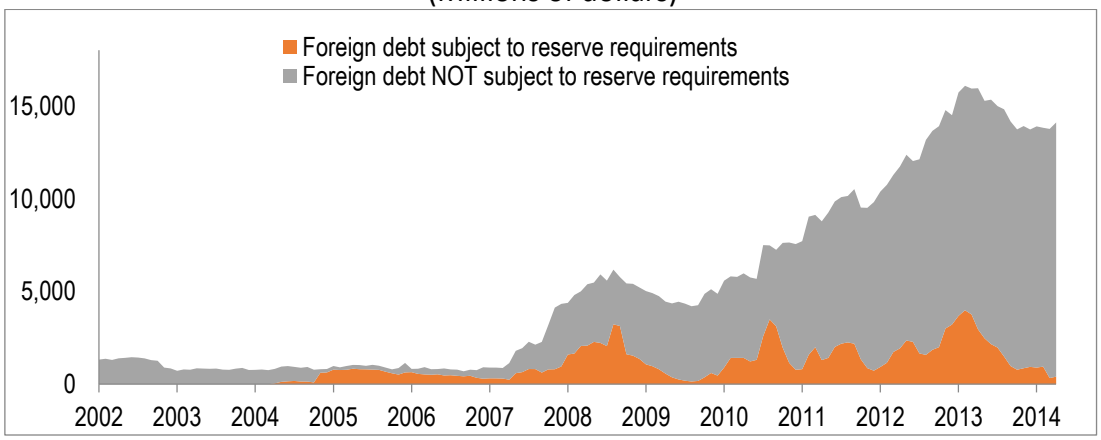
Total banking system credit to the private sector expanded from 17% of GDP at the end of 2006 to 29% of GDP at the end of 2013. Figure 7 shows that, in contrast to the second stage, foreign currency credit increased in the third stage, from 11% to 14% of GDP, while local currency credit increased from 6% to 15% of GDP. This strong credit expansion is associated with an economy that grows by a yearly average of 6.5% with low inflation (annual average of 3.3%).

[25] The introduction of these reserve requirements on foreign liabilities of commercial banks can be represented as a rise in the foreign interest rate, which implies a reduction in aggregate demand and economic activity. See Appendix 1. According to Armas et al (2014), the BCRP's macroeconomic model "assumes that changes in this instrument increase bank lending rates. The estimated impact of a one percent rise on the average RR (reserve requirement) rate is about 0.3 percent on the average lending rates denominated in domestic currency and 0.1 percent on lending rates denominated foreign currency".

Behind the expansion of credit in dollars that characterizes this third stage lies the central bank's new policy of exempting[26] an increasing fraction of the external debt of the banking system from the reserve requirements that were established in 2004.

As is shown in Figure 8, this policy was applied from 2007, which meant that external debt not subject to reserve requirements grew explosively until May-June 2013, multiplying over these 7 years more than 35-fold compared with the average posted in 2006. As a percentage of GDP, external debt grew from a minimum of 1% of GDP in 2004-06 to a maximum of 8% of GDP from 2012-13[27]. As a fraction of loanable funds in foreign currency (deposits plus external debts), external debt not subject to reserve requirements grew from a minimum of 2% in 2006 to a maximum of 33% in May, 2013.

Figure 8
Foreign debt of the banking system
(Millions of dollars)



Source: BCRP, prepared by the author.

26 The total (short and long term) external debt of the banking system figures are set out in table 7B of the BCRP's *Nota Semanal*. The figure for the external debt of the banking system subject to reserve requirements is set out in table 18 of the BCRP's *Nota Semanal*. The external debt of the banking system that are NOT subject to reserve requirements is calculated by difference. The figures from table 18 are daily averages for the month, and those of table 7B are end of period data, but we have not been able to resolve this issue. For an analysis of the successive amendments to regulations on the foreign currency reserve requirements that characterize the third stage, see Dancourt and Jiménez (2010).

27 See *Reporte de Inflación de diciembre de 2013*, page 101.

This new policy benefits the big banks, those that have a high level of loan dollarization and where the largest proportion of external debts are concentrated. In April 2013, the three biggest banks accounted for 78% of bank loans in foreign currency, while 65% of loans in local currency. As at the same date, the external liabilities of the three biggest banks comprised 81% of short and long term external liabilities.

The main determinant of the evolution of local banking credit in foreign currency is the availability and cost of external funding; that is, of external debt. Cost and availability depend on prevailing conditions in international financial markets[28]. In times of crisis or external panics, as in 1998, 2008 and 2013, local banks' sources of external financing suddenly dry up, and local credit in foreign currency abruptly falls[29]. Internal factors, the propensity to lend and monetary policy are secondary determinants, unless, when the reserve requirement ratio in foreign currency has been applied to external debts without exceptions, as in the years 2004-06.

The expansion of credit in soles that occurred during this third stage is explained by the characteristics of the new monetary regime, which typify both the second and the third stage based on control of the interbank interest rate by the central bank; this monetary regime gives commercial banks a leading role in the process of credit expansion.

An important factor that also explains the expansion of credit in soles during the second and third stage is the development of the local public bond market, followed thereafter by private and corporate bonds denominated in local currency. This development was induced by the Ministry of the Economy and Finances at the start of 2000, and led to the appearance of a yield curve with interest rates in local currency for debts of increasingly lengthy terms; see Jiménez (2008) and Armas and Grippa (2005).

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[28] Herrman and Mihaljek (2010) study "the determinants of cross-border banks flows to emerging markets in periods of crises". They find that in the Asian crisis of 1997-98 and in the 2008-09 international crisis, "global risk factors (…) made the largest contribution to the reduction in cross-border bank flows".

[29] The 12-month growth rate of credit in foreign currency fell from 26% in July 1998 to -4% In July 1999; from 30% In October, 2008 to -1% in October, 2009; and from 18% In November, 2012 to 2% in March, 2014.

Garcia-Escribano (2010) utilizes a vector autoregression (VAR) approach, with monthly data for the period 2000-09, to find the determinants for the ratio of credit and deposit dollarization in the Peruvian economy. Garcia-Escribano (2010, p.13) finds that a) "higher RR [reserve requirements] spreads lower dollarization, specifically, for commercial credit"; b) "the issuance of long-term treasury bonds in soles promotes de-dollarization of credit. The coefficients on treasury bonds with terms of 10−15 years and 15−20 years are significant for commercial credit"; and c) "the increase in the share of [private] bonds issued in soles raises dollarization of credit, in particular, of credit extended to the commercial sector, which supports the explanation that some of the private debt instruments issued in soles compete with banks loans in soles".

Garcia-Escribano (2010, p. 14) concludes that "Peru has successfully pursued market-driven financial de-dollarization during the last decade, which has been based on a three-prong approach. The lines of action have included ensuring macroeconomic stability, effective management of reserve requirements (…) and the development of a capital market in soles. As a result, dollarization ratios of credit and deposit —across all sectors and maturities— have declined, with larger decline for commercial credit and time and saving deposits"[30].

2. THE EXCHANGE RATE CHANNEL

In this section, we will discuss the macroeconomic significance and the particular characteristics that BCRP intervention in the foreign exchange market has had during 2002-13.

As we have seen, the reference interest rate for the interbank market has been the main instrument of Peruvian monetary policy during the inflation targeting regime, except perhaps in the last period of 2012-14. The other key monetary policy instrument during this monetary regime has been sterilized intervention in the foreign exchange market[31].

[30] García-Escribano (2010) does not utilize the external debt of the banking system as an additional variable that contributes to explaining the (de)dollarization of banking credit.

[31] See the detailed description of the use of this instrument in Rossini et al (2013).

The Peruvian economy is a small open economy, with exports of raw materials and free capital mobility, and a dollarized banking system. The main macroeconomic challenge that it faces is managing adverse external shocks, as in 1998-2000, due to the Asian and Russian crises; in the global crisis of 2008-09; or in the period of 2013…, with the adjustment of the US monetary policy and the simultaneous fall in the external price of metals[32].

These external adverse shocks reduce the aggregate demand and deteriorate the balance of payments. The first component of these adverse external shocks (fall in commodity prices and/or capital outflow) is a negative demand shock. The fall in commodity prices reduces private investment and, typically, also reduces tax collection and public investment. Capital outflow; that is, an abrupt cut in external funding of local banking, such as in 1998-2000, 2008-09, or 2013, causes contraction of foreign currency bank loans to the private sector.

The second component of these adverse external shocks is a negative supply shock[33] due to the rise in the exchange rate caused by the deterioration in the balance of payments. Falls in commodity prices or capital outflows pushes up the exchange rate. Moreover, price level and inflation tend to increase in response to this negative supply shock. In addition, adverse external shocks typically precipitate a strong speculative attack that exacerbates the upward pressure on the exchange rate[34].

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[32] See Williamson (2013), cap 10, on commodity export price volatility and long term economic growth.

[33] On the exchange rate pass-through coefficient, see *Reporte de Inflación* (2013, setiembre) page 119, Maertens et al (2012) and IMF (2014).

[34] A leading actor in the speculative attacks associated with the external crises of 2008 and 2013 has been private pension funds (AFPs) that manage a financial asset portfolio, without regulatory limits by currency, of a magnitude only comparable to the central bank's foreign exchange position. For example, in the *Presentación del Reporte de Inflación de diciembre de 2013*, slide 41, it is reported that the highest local demand for dollars between May and November 2013 was generated by AFPs. From 2006 to mid-2014, the percentage of this financial portfolio invested in foreign assets increased from below 10% to close to 40%; the operating limit on AFPs' foreign investments is set by the central bank.

The rise in the exchange rate also causes a balance sheet effect (families and firms that obtain their income or makes sales in local currency borrow in foreign currency), which may be equal to or greater than the competitiveness effect[35] (domestic goods become cheaper relative to foreign goods) in an economy such as Peru's.

Finally, a rise in the exchange rate may precipitate a banking crisis with runs by external creditors and local depositors, as in 1998-2000, because non-performing loans in foreign currency are a direct function of the exchange rate[36].

What should the monetary policy response be to an adverse external shock? A decrease in the reference interest rate (which may be accompanied by an expansive fiscal policy) can mitigate the negative demand shock caused by a fall in commodity prices or by capital outflow. Nonetheless, this reduction in the reference rate strengthens the upward pressure on the exchange rate because it promotes capital outflow.

Conversely, an increase in the reference interest rate may attenuate the rise in the exchange rate and the intensity of the negative supply shock, even if it is also a negative demand shock. In the seven large recessions that the Peruvian economy has experienced in the last 60 years, all of them associated with adverse external shocks, a restrictive monetary policy was opted for, thus exacerbating the recessive impact of the external shock. The exception was the crisis of 2008-09, when the reference interest rate was cut.

If the central bank seeks to maintain price stability and full employment (which characterizes the initial situation), another instrument is required to combat the negative supply shock triggered by the rise in the exchange rate. This other instrument is the sterilized intervention in the foreign exchange market. The sterilized sale of

35 See Krugman (1999).

36 See the work by Rojas and Costa (2002), which analyses the banking crisis of 1998-2000. Espino (2013) shows the basic stylized facts of the banking system, which include this link between non-performing loans and the exchange rate. Herrmann and Mihaljek (2010) find that a rise in the exchange rate causes reductions in external debt flows to commercial banks in emerging market economies.

dollars relieves the upward pressure on the exchange rate, caused by the adverse external shock and the expansive monetary policy[37]. The central bank loses foreign exchange reserves until the transitory external shock is reverted; it is assumed that the central bank has enough foreign exchange reserves.

The exchange rate floats cleanly if the central bank does not have foreign exchange reserves. Price stability and full employment cannot be maintained if an adverse external shock occurs. There is only one instrument (the interest rate) to achieve two objectives. Let's say that a global recession occurs. If the central bank prefers to maintain full employment, the reference interest rate has to go down to counteract the fall of net exports; the exchange rate influences the price level but not economic activity if the balance sheet effect is equal to the competitiveness effect. The balance of payments is deteriorated by the decrease in net exports and capital outflows while the exchange rate goes up, which increases the price levels. Thus, full employment is maintained but the price level goes up[38].

If the central bank prefers to maintain price stability, it will focus its efforts on limiting the rise in the exchange rate, which responds to the fall in net exports caused by the global recession. Let's say that the central bank increases the interest rate[39] to an extent that is sufficient to promote capital inflow so that the exchange rate is kept constant. In this case, the global recession and the rise in the local interest rate cause a local recession, but the price level does not go up.

In conclusion, the central bank requires two independent instruments (interest rate and sterilized intervention) to achieve their two objectives (price stability and full employment)[40]. In response to temporary adverse external shocks, these two objectives cannot be achieved if the central bank lacks sufficient foreign exchange reserves[41].

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37 See Appendix 1.

38 See Appendix 1.

39 For the 1998-2000 recession and the tight monetary policy that was applied, see Mendoza (2013).

40 See Tobin (1999).

41 According to Tobin (1999), a combination of fiscal policy (greater public spending that reactivates the economy) and monetary policy (higher interest rate that causes an

In practice, the exchange rate is not fixed; rather, an exchange rate intervention rule that leans against the wind is employed. The instrument is not the exchange rate, but sterilized buying and selling of dollars. The practical problem is that a fixed exchange rate system is excessively vulnerable to speculative attacks. Referring to Latin America in the 1990s, Frenkel and Rapetti (2010, p.43) point out that limited exchange rate flexibility "has shown to be highly valuable. The lack of commitment to the level of the NER [nominal exchange rate] provides the economy flexibility to adjust to external shocks without resulting in reputational costs for the monetary authorities. The lack of commitment also eliminates the incentives of one-way bets in the foreign exchange market by speculators. In their portfolio choices between domestic and foreign assets (and liabilities), private agents have to assume the exchange rate risk. Therefore, a lower exposure to NER variations and lower financial fragility to external shocks is likely to be observed".

Exchange rate interventions are sterilized so that the short term interest rate does not change. This allows two independent instruments: the reference interest rate, and sterilized buying or selling of dollars. If the sale of dollars by the central bank is not sterilized, this implies that the amount of money held by the public is reduced and that the short term interest rate goes up. If the purchase of dollars by the central bank is not sterilized, the quantity of money in public hands is increased and that the short term interest rate goes down. In this way, the central bank could not respond to an adverse external shock by selling dollars and lowering the interest rate; or in response to a favorable external shock by buying dollars and putting up the interest rate.

The experience of the 2008-09 crisis, where this combination of policies was applied for the first time (cut in the reference interest rate and sterilized dollar sales) in response to

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appreciation in local currency) could also maintain price stability and full employment, despite the adverse external shock. With a small government and without automatic fiscal stabilizers, as in Peru, it is doubtful that the combined recessionary effect of the adverse external shock and a restrictive monetary policy could be counteracted in time by an expansive fiscal policy. It is also doubtful that a practicable rise in the local interest rate could prevent the exchange rate from going up if the price of gold and copper fall, or if Bernanke announces that the Fed will reduce its long term bond purchases.

an adverse external shock, shows that this monetary policy noticeably mitigates the recessionary impact of the external shock while price stability is maintained.[42]

Moreover, this monetary policy fundamentally contributes to maintaining the financial stability of the dollarized banking system. This is especially true if compared with the banking crisis of 1998-2000, where a similar adverse external shock was associated with a restrictive monetary policy (rise in the interbank interest rate), and a very small foreign exchange intervention that did not place any limit whatsoever on the rise in the exchange rate[43].

Because —up to the crisis of 2008-09— the orthodoxy on inflation targets was that the exchange rate should float cleanly, Blanchard (2010) asked: "Isn't it time to reconcile practice with theory, and to think of monetary policy more broadly, as the joint use of the interest rate and sterilized intervention, to protect inflation targets while reducing the costs associated with excessive exchange rate volatility?"

This sterilized exchange rate intervention has to be anti-cyclical. If the central bank is going to sell dollars when adverse external shocks occur (when prices of raw materials fall and/or capital flows out), it will have to buy them when favorable external shocks occur (raw material prices increase and/or capital flows in). While the central bank does not have sufficient foreign exchange reserves to respond to a major adverse external shock with reasonable ease, buying and selling cannot be symmetric. Finally, while the central bank has not reached its foreign exchange reserves target, it will take advantage of all opportunities that present themselves and will likely seek to do so without too much impact on the exchange rate.

An exchange intervention rule (RI) for the central bank could be

$$\text{(RI)} \qquad \Delta RIN = \alpha_6(E^M - E) + \alpha_{15}(RIN^M - RIN)$$

[42] Also an expansionary fiscal policy was applied; see Rossini et al (2013) and Mendoza (2013).

[43] See Dancourt and Jiménez (2010).

According to (RI), the central bank leans against the wind; it buys dollars when their price goes up, and, in addition, sells dollars if it does not have sufficient reserves. The central bank buys dollars ($\Delta RIN>0$) if the market exchange rate (E) is below its desired or target exchange rate (E^M), or if its foreign exchange reserves (RIN) are below the desired or target reserves (RIN^M). Symmetrically, the central bank sells dollars ($\Delta RIN<0$) if $E>E^M$ or if $RIN>RIN^M$. What happens if there is conflict between both objectives? What does the central bank do if $E^M<E$ but $RIN<RIM^M$? It is most likely that the central bank will not buy dollars.

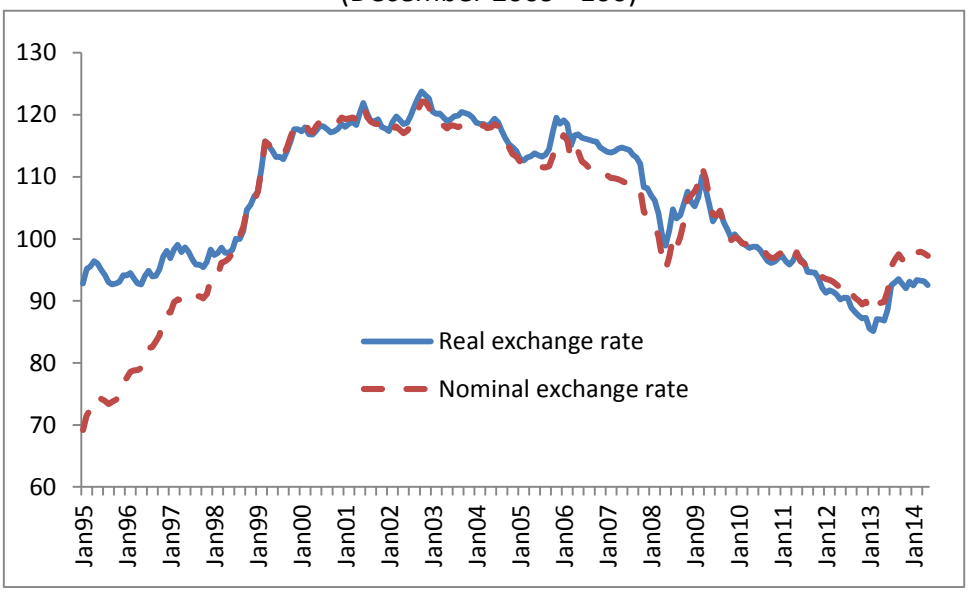
If $E = E^M$ in the initial situation, with $\alpha_{15}=0$, this intervention rule implies that foreign exchange reserves are lost when adverse external shocks increase E and are gained when they are favorable and decrease E. The higher that α_6 is in equation (RI), the more this hybrid system will be like a fixed exchange rate regime. Conversely, the smaller that α_6 is, themore the hybrid system will be like a clean floating exchange rate regime.

This desired exchange rate (E^M) for the central bank could change for short term reasons. For example, the BCRP sold US$ 600 million when the exchange rate was 2.82 soles per dollar, on August 21, 2013; but, two years earlier, the BCRP had bought US$ 209 million when the exchange rate was also 2.82 soles per dollar, on July 8, 2010. If inflation is above target, the central bank can sell dollars instead of increasing the reference interest rate. A reduction of E^M gives rise to an exogenous sale of dollars; that is, a sale not linked to exchange rate development.

This target exchange rate (E^M) can also be altered more permanently by changes in the long term viewpoint of the monetary authority. According to Blanchard et al (2010), “a large appreciation may squeeze the tradable sector and make it difficult for it to grow back if and when the exchange rate decreases. Also, when a significant portion of domestic contracts is denominated in foreign currency (or is somehow linked to its movements), sharp fluctuations in the exchange rate (especially depreciations) can cause severe balance sheet effects with negative consequences for financial stability, and thus, output”. Presumably, these considerations should also be taken into account to determine the central bank's target exchange rate.

Figure 9 shows the real bilateral exchange rate and the nominal bilateral exchange rate[44]. The joint fall of both variables since 2007 coincided with a reduction in the inflation target (the target range fell from 1.5-3.5% per year to 1-3% per year) by the new central bank authorities[45] and with a temporary rise in inflation, which reached a peak of more than 6% in the second half of 2008.

Figure 9
Nominal and real exchange rate index
(December 2009 =100)



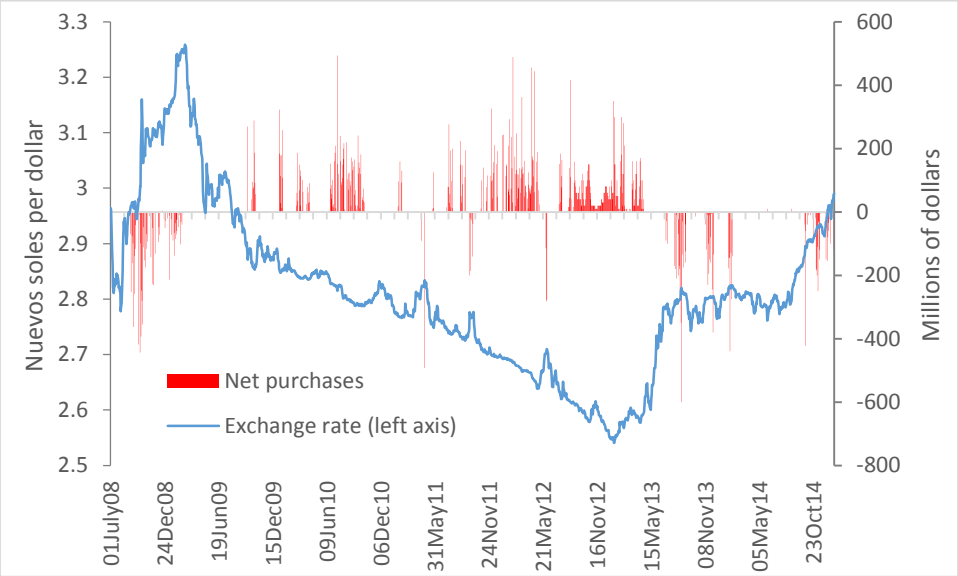
Source: BCRP, prepared by the author.

In Peru, the target exchange rate that, more realistically, could consist of a tolerable target range characterized by a floor (minimum target exchange rate) and a ceiling (maximum target exchange rate), is not announced. Williamson (2010), on describing the Brazilian foreign exchange rate intervention system, criticizes the fact that the target exchange rate or tolerable range is not announced. It is clear, nonetheless, that the force and frequency of the central bank's foreign exchange rate interventions indicate to market operators the approximate location of this target exchange rate or tolerable range.

44 The real exchange rate is reduced by one third between the peak of September 2002 and the floor of January 2013; the bulk (70%) of the fall of the real change happens from 2007.

45 If the monetary authority takes the decision to reduce the inflation target in an economy like Peru, the central bank should raise the reference interest rate or sell foreign currency; see Dancourt (2012b).

Figure 10
Exchange rate and net purchases of dollars



Source: BCRP, prepared by the author.

How was this second tool of the Peruvian monetary policy used before and after the crisis of 2008-09? Figure 10 shows that the central bank's purchases or sales of foreign currency on the exchange market depend on the evolution of the exchange rate. In the midst of the global financial crisis, between July 2008 and the start of 2009, the exchange rate went up and the central bank sold foreign currency; before and after this period, the exchange rate fell and the central bank bought foreign currency. The Peruvian central bank's foreign exchange position, which rose to 19% of GDP per year at the start of 2008, fell by 27% between April 2008 and April 2009, while the exchange rate rose by 20% between the floor and the peak of this period.

At the start of 2013, a new episode of upward pressure on the exchange rate, caused by the adjustment of the US monetary policy, obligated the central bank to sell foreign currency again. Between May and December 2013 the central bank lost many foreign exchange reserves (measured by the foreign exchange position, which are the BCRP's own reserves), as in the crisis of 2008-09.

In Figure 11, the monthly total of net dollar purchases made by the BCRP is related to the monthly percentage variation of the exchange rate for the period, which runs from

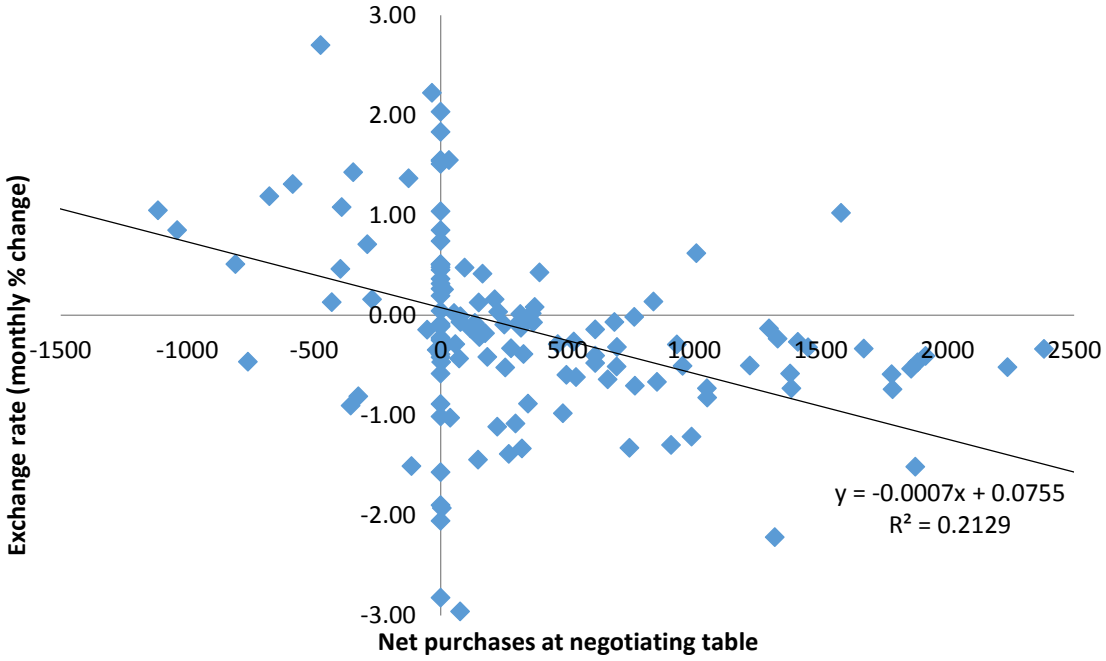
June 2002 to May 2014. An alternative graph with daily amounts and exchange rate changes is similar. Various points are highlighted in Figure 11. Firstly, sales of dollars (negative net purchases on the x axis) generally occur when the exchange rate goes up (positive percentage on the y axis) and purchases (net positive purchases on the x axis) occur when the exchange rate falls (negative percentage on the y axis). Sales associated with an exchange rate that falls or purchases associated with an exchange rate that goes up are scanty.

Secondly, purchases are a much more frequent phenomenon (64% of months) than sales (16% of months) that are associated with periods of crisis. Nonetheless, these sales are essential to judge whether this limited flexibility exchange rate system achieves its objectives. Thirdly, the magnitude of purchases of dollars is not clearly linked to the magnitude of the fall in the exchange rate; there are big purchases of dollars associated with small drops in the exchange rate. Purchases occur not only because the exchange rate falls, but also to gradually close the gap between the reserves desired by the monetary authority and those that exist[46].

Fourthly, the central bank did not intervene (the points located on the y axis) in 20% of months, even if the exchange rate rose or fell. The central bank would not intervene in our intervention rule (RI) if the market exchange rate (E) is the same as the desired exchange rate (E^M) and if, additionally, it has the desired reserves. One gets the impression, nonetheless, that these periods without exchange intervention tend to be associated with points of inflection in the exchange rate trend, when depreciation changes into appreciation, or vice versa. If the central bank has been buying (selling) dollars while the exchange rate falls (rises), it withdraws from the market if E suddenly starts to rise (fall).

[46] In the period 1992-2001, foreign currency sales were scarce, even in the 1998-2000 crisis phase, because there were not enough foreign exchange reserves (foreign exchange position). Purchases of dollars occur, mainly, when the exchange rate increases.

Figure 11
Net purchase of dollars and monthly % change in the exchange rate
(June 2002-June 2014)



Source: BCRP, prepared by the author.

An IMF study (2014) estimates this exchange intervention rule, or BCRP reaction function, with intraday data from January, 2010 to November, 2013, utilizing a probit model. The factors that determine whether a buying intervention or a selling intervention occurs are estimated separately; the intervention amounts are not considered. The hypothesis of the study (IMF 2014) is that "the BCRP intervenes to prevent excessive appreciations and depreciations (...and…) to contain excessive volatility".

The IMF study (2014, p.38-40) finds that: a) "deviations of the level of exchange rate from the lower and upper bounds of the BCRP's tolerable range are positively and significantly associated with FX purchases and FX sales, respectively indicating that such deviations prompt FX interventions"; b) "two-day lags of the dependent variables are found to be statistically significant indicating the tendency of intervention clustering"; c) "the deviation of the exchange rate volatility from the BCRP's target is positively and

significantly associated with FX sales"; and d) "the results are robust to changes in the definition of the target and tolerable range of the exchange rate".

The IMF study (2014) also addresses the question of how effective the central bank's exchange interventions are for the same period and with the same intraday data. It is found that dollar sales are effective in limiting the extent of local currency depreciation, but that purchases are not effective in limiting the magnitude of local currency appreciation.

According to Malloy (2013, p. 17), "over the last decade there has been significant accumulation of foreign exchange assets by emerging market central banks. However, the rate of accumulation differs greatly between EMs [emerging market economies]… There have also been studies that test whether short-run exchange rate movements (and other fast moving variables) impact an EM central banks' decision to intervene in foreign exchange markets (often using daily data and single country equations). (…) The limitation of…[this] approach is that does not attempt to address why central banks accumulate foreign exchange reserves at different rates, for example by using a panel structure and including slower moving macroeconomic variables".

Malloy (2013, p. 17) "develop[s] a hybrid of these two types of models including both short-run exchange rate variables as well as broader macroeconomic variables to account for the *rate* of foreign exchange accumulation within and between EMs. The limitation of…[the] approach is that foreign exchange intervention data is not publicly available for all EM central banks". The data is monthly and the sample is 2001-12.

By only taking into account EMs that publish foreign exchange intervention data (Brazil, Colombia, India, Israel, Mexico, Peru, and Turkey), Malloy (2013, p. 10-11) finds that foreign exchange intervention as a share of GDP: a) depends inversely on the VIX monthly % change, ("as global investor sentiment becomes more risk averse, the VIX increases, capital tends to flow out of most EMs putting pressure on exchange rates to depreciate. Thus, the VIX is expected to have a negative coefficient if proxying well for short-run exchange rate changes."); b) depends inversely on the nominal exchange rate

monthly % change, lagged one month, ("confirms results in previous studies that central banks tend to buy and sell foreign exchange to lean against the wind of short-term exchange rate movements"); c) depends inversely on the real exchange rate (% change from a five year rolling average), lagged two months, ("to model a central banks' response to medium-term real exchange rate pressures"); d) depends inversely on the CPI inflation year on year, ("the rationale for this, is that an EM with higher inflation may prefer to allow more appreciation by reducing its net foreign exchange purchases, which could help reduce inflation"); e) depends directly on the export to GDP ratio. These independent variables have the correct sign and are statistically significant at the 5% or 1% level.

According to Malloy (2013, p. 12-13), "exports to GDP is the most important independent variable in the equation for explaining the different rates of reserve accumulation [between economies]. For example, an EM [emerging market economy]…with an exports to GDP level of 60% is expected on average to purchase 4% of GDP more of net foreign exchange than an EM with an export ratio of 10%. Over time, assuming similar rates of nominal GDP growth, this much higher rate of accumulation would likely lead to persistently higher level of reserves (…) Exports to GDP is highly correlated with other reserve adequacy metrics such as M2/GDP and short-term debt to GDP. One rationale for this is that EMs that are more open and have more financial sector development hold more foreign exchange reserves for precautionary purposes to mitigate their higher potential exposure to balance of payment pressures".

3. CONCLUSIONS

The Peruvian central bank took two major decisions in the years 2002-13: implementing an inflation target system with a reference interest rate as a main policy instrument, and accumulating sufficient foreign-exchange reserves. These two decisions have allowed the central bank to preserve macroeconomic stability (low inflation, high GDP growth, or impeding severe recessions) in favorable (most of the time) or unfavorable (for a limited period of time) external contexts.

The prescription is simple. Firstly, the lessons of 2008-09 cannot be forgotten; the central bank must reduce the interest rate and sell foreign currency in response to adverse external shocks. Secondly, the central bank must raise the interest rate and buy foreign currency in response to favorable external shocks. It remains to be seen whether this monetary policy scheme, which has served Peruvian society so well over the last decade, can provide the same good services in a more prolonged unfavorable external context. And it remains to be seen whether this monetary policy regime can operate without the reference interest rate as the main instrument of the central bank.

To prevent banking crises, the central bank should limit external borrowing from commercial banks. Without this, dedollarizing bank credit is not possible. Higher reserve requirements for dollar deposits relative to reserve requirements for deposits in local currency do not stop the dollarization of bank loans. The only effective tool is to impose higher reserve requirements to foreign debt of commercial banks.

A crucial point is whether the systematic fall of the real exchange rate posted from 2007 is an organic result of this monetary scheme, or whether it can instead be attributed to errors in the management of monetary policy. This paper has posited that this fall is linked to the error of reducing the inflation target in 2007, and that a symmetrical exchange intervention rule allows these falls in the real exchange rate to be avoided while the inflation target is complied with, as was demonstrated in 2002-06.

If this is the case, a monetary policy such as that put forward by Blanchard et al (2010) —which combines a Taylor rule for managing the interest rate, directed at internal

equilibrium, with an exchange rate intervention rule that leans against the wind, directed at external equilibrium— could stabilize price levels and economic activity without liquidating the long-term productive diversification so necessary to an economy such as Peru's.

Appendix 1
An open Bernanke-Blinder model

This appendix sets out an open version of the Bernanke-Blinder model (1988), similar to the IS-LM or Mundell-Fleming models that can be found in the macroeconomics textbooks, in order to discuss the use and impact of Peruvian monetary policy instruments with at least a modicum of consistency[47].

The Bernanke-Blinder model (1988) could be described as an IS-LM model with banks. A linear version of the model has 5 equations, as shown in Table 1. An IS curve where the level of economic activity (Y) is determined, given the bank loan interest rate (R); an LM curve where the quantity of money (M) is determined if the domestic bond interest rate (i) is set by the central bank; an aggregate supply or AS curve where the price level (P) is a function of the exchange rate (E) and the output gap ($Y-Y^P$); an LL curve, which represents the equilibrium in the bank loan market, where the loan interest rate (R) is determined, given the economic activity and the exchange rate; and finally, an balance of payments equation or BP curve, which determines the exchange rate (E), expressed as the local currency price of one unit of foreign currency. By Walras' law, the domestic bond market is ignored.

[47] The Bernanke-Blinder model has been open to international trade in only one way, introducing an IS curve that is part of the Mundell-Fleming model; but it has been open to capital flows in different ways.
For example, Spiegel (1995) adds a balance of payments equation, assuming a fixed exchange rate. The capital inflows occurs through the banking system as additional deposits that depend on the spread between the domestic and foreign interest rates. Neither local businesses nor families access the external bond market. The price level is fixed. Chiades and Gambacorta (2000) add an uncovered interest parity equation and capital flows occurs implicitly through access of local firms to the foreign bond market. Kierzenkowsky (2004) also adds a balance of payments equation to determine the exchange rate. Usually, it is assumed that the central bank sets the monetary base and not the interest rate of the domestic bond; the only exception is Kierzenkowsky (2004). Chiades and Gambacorta (2000) include an aggregate supply equation where the price level also depends on the exchange rate.

Table 1

(IS) $$Y = k[I_0 + G + m^* Y^* - b(R + i + i^*)]$$

(LM) $$M = \theta\,(P + Y - \alpha_1 i)$$

(LL) $$\lambda(1-\theta)(P + Y - \alpha_1 i) = P + Y - \alpha_2(R - i - i^*) + \alpha_3(E^* - E)$$

(AS) $$P = \alpha_4 E + \alpha_5(Y - Y^P)$$

(BP) $$\alpha_6(E^M - E) = \alpha_8(E - P) - mY + m^* Y^* + \alpha_9(R + i - i^* - E^*)$$

Let us start by describing the Bernanke-Blinder (B-B) model with the LL curve, which is its distinguishing feature. In this B-B model, $(P + Y - \alpha_1 i)$ are bank deposits that do not yield interest; there is no currency. The public divides its financial wealth into bank deposits and domestic bonds; for simplicity, we do not consider foreign bonds. The demand for bank deposits depend directly on the price level (P) and economic activity (Y) and, inversely, on the interest rate on local bonds (i), which is set by the central bank. The loanable funds, the deposits minus the bank reserves, are $(1-\theta)(P + Y - \alpha_1 i)$, where (θ) is the reserve requirement ratio. With these loanable funds, banks acquire government bonds or lend money to firms, according to whatever bankers' propensity to lend (λ) may be, which is between zero and one[48]. Thus, the stock loan supply (L) is given by $L = \lambda(1-\theta)(P + Y - \alpha_1 i)$.

The stock loan demand (L^d) is given by $L^d = P + Y - \alpha_2(R - i - i^*) + \alpha_3(E^* - E)$, where (R) is the loan interest rate, and where firms are supposed to have two sources of substitute funding: one in the domestic bond market at cost (i), and another in the foreign bond market[49] at cost $(i^* + E^* - E)$, where i^* is the foreign interest rate, E^* is the expected exchange rate, and E is the market exchange rate. Moreover, loan demand is assumed to depend directly on the price level (P) and economic activity (Y). The LL curve implies that the supply of loans (L) is equal to the demand for loans (L^d).

[48] In the original Bernanke and Blinder model (1988), the propensity to lend depends on the interest rates on bonds and bank loans.

[49] In 2013, firms from the Peruvian non-financial sector issued bonds in the external market equivalent to 3% of GDP; see IMF (2014).

With regard to the IS curve, if private investment depends inversely on three interest rates —the bank loan interest rate (R); the interest rate of the domestic bond market (i); and the interest rate of the foreign bond market (i*)— we have a macro textbook investment (I) function given by $I = I_0 - b_1R - b_2i - b_3i^*$, where I_0 is autonomous investment. We assume that expected inflation is zero. As in Krugman (1999), we add a balance sheet effect so that private investment is also an inverse function of the foreign debt burden, which depends directly on the real exchange rate (E – P). Therefore, the investment function would end up as: $I = I_0 - b(R + i + i^*) - \alpha_7(E - P)$, if $b_1=b_2=b_3=b$.

The consumption function is C = c(1-t)Y, with (c) being the propensity to consume. Net exports (X) depend directly on the real exchange rate (E – P) and on global economic activity (Y*), and inversely on domestic economic activity (Y); that is, $X = \alpha_8(E - P) - mY + m^*Y^*$, with (m, m*) being domestic and foreign propensities to import. Public spending (G) and the tax rate (t) on income are policy variables and the government finances its budget deficit by issuing domestic bonds.

Equating production (Y) and demand for domestic goods (C + I + G + X), we get an IS curve

(IS) $$Y = k[I_0 + G + m^* Y^* - b(R + i + i^*) - (\alpha_7 - \alpha_8)(E - P)]$$

with k=1/[1-c(1-t)+m] being the Keynesian multiplier. If the balance sheet effect (α_7) is equal to the competitiveness effect (α_8) of the exchange rate, which is a reasonable assumption for a highly dollarized and under-industrialized economy like Peru's, the real exchange rate no longer determines the level of aggregate demand, just its composition. With ($\alpha_7 = \alpha_8$), we get the IS curve of Table 1.

The price level (P) is given by the aggregate supply curve (AS), where ($Y-Y^P$) is the gap between effective and potential output. The supply shocks are associated with the exchange rate (E) with $0<\alpha_4<1$.

The LM curve serves to determine the quantity of money if the central bank sets the local bond interest rate (i). Here, the LM represents equilibrium in the monetary base

market, and equalizes the monetary base (M) with the bank reserve demand given by $\theta(P+Y-a_1 i)$.

Finally, we need a balance of payments equation, a BP curve, to determine the exchange rate. The change in the central bank's foreign exchange reserves (ΔRIN) is equal to the sum of net exports plus capital inflows. Capital inflows occur here because firms contract more external debt (or because families reduce their holdings of foreign bonds, which we ignore); and capital outflows occurs because firms reduce their external debt (or because families increase their foreign bond holdings, which we ignore). The factors that explain the capital flows via domestic firms are: the cost of debt in the banking system (R) and in the domestic bond market (i) and the cost of external borrowing in foreign currency (i * + E* − E). Thus, the net inflow of capital depends directly on local interest rates (R, i) and inversely on the foreign interest rate and the expected devaluation (i* + E* − E). Capital inflows are given by $\alpha_9(R + i - i^* - E^*)$[50]. That is,

(BP) $$\Delta RIN = \alpha_8(E - P) - mY + m^*Y^* + \alpha_9(R + i - i^* - E^*)$$

If the central bank intervenes in the foreign exchange market with the following intervention rule (RI),

(RI) $$\Delta RIN = \alpha_6(E^M - E)$$

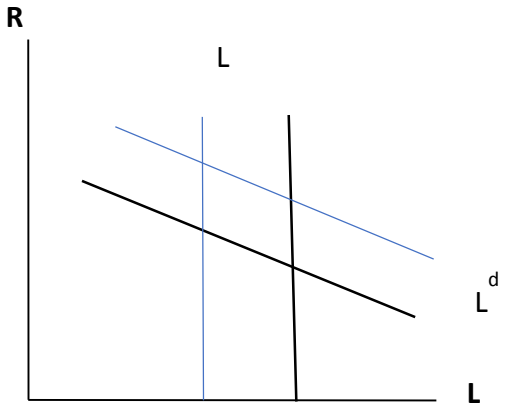
where the central bank leans against the wind, in such a way that it sells dollars (ΔRIN<0) if the exchange rate (E) is above its target (E^M) and conversely, buys dollars (ΔRIN>0) if the exchange rate (E) is below its target (E^M). By inserting (RI) into (BP), we get the BP equation of Table 1.

In Figure 12, which shows partial equilibrium in the loan market, a rise in the reference interest rate or policy rate (i) shifts the loan supply to the left (blue), because it reduces deposits and loanable funds; moreover, it shifts demand for loans to the right (blue),

[50] Capital inflow should also depend directly on the market exchange rate (E); we have omitted this effect to simplify the notation. The balance of payments already depend directly on the exchange rate via net exports.

because it increases the cost of alternative financing in the local bond market; hence the volume of bank loans decreases and the interest rate on loans rises.

Figure 12
Rise in the reserve requirement ratio and the reference interest rate



An increase in the reserve requirement ratio (θ) of sufficient magnitude only shifts the loan supply to the left (blue) in Figure 12, which reduces the volume of loans and increases the loan rate (R), albeit less than in the previous case. It is assumed that the price level (P), economic activity (Y) and exchange rate (E), are given.

The reference interest rate affects the cost of borrowing in the banking system and in the domestic bond market, while the reserve requirement ratio only affects the cost of borrowing in the banking system.

This conclusion does not change if we consider the impact that these two monetary policy instruments have on P, Y, or E. By inserting the AS equation in the LL curve, we obtain the equation for the LL curve in Figure 13. This LL curve represents equilibrium in the loan market for different combinations of economic activity (Y) and the loan interest rate (R). The LL curve has a positive slope because an increase in economic activity (Y) generates excess demand for loans, which increases the loan interest rate (R), given the exchange rate (E).

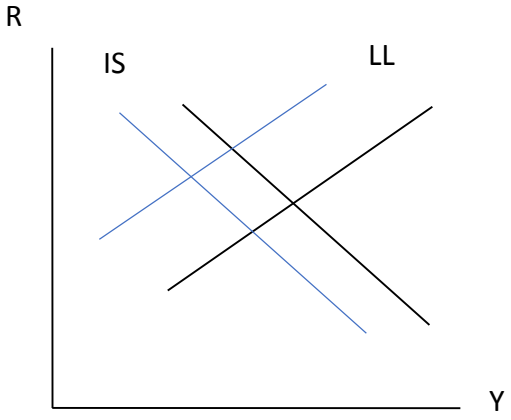
The equation for the LL curve in Figure 13 is

$$\text{(LL)} \qquad R = i^* + \left(1 + \frac{\alpha_0\alpha_1}{\alpha_2}\right) i + \frac{\alpha_3}{\alpha_2} E^* - (1-\alpha_0)\frac{\alpha_5}{\alpha_2} Y^P + (1+\alpha_5)(1-\alpha_0)\frac{1}{\alpha_2} Y$$

where $0<\alpha_0<1$ with $\alpha_0 = \lambda(1-\theta)$. The exchange rate affects the LL curve through the price level and the expected cost of alternative financing in foreign currency. Via the price level, represented by the $(1-\alpha_0)\alpha_4 E$ term, a rise in E increases excess demand for loans. Via the cost of financing in foreign currency, represented by the $\alpha_3 E$ term, a rise in E reduces the excess demand for loans. The equation for the LL curve in Figure 13 assumes that both effects are equal; that is, that $(1-\alpha_0)\alpha_4 - \alpha_3 = 0$.

A rise in the reserve ratio (θ) or a rise in the reference rate (i) shifts the LL curve to the left (blue); that is, it increases the loan interest rate (R) for any level of economic activity (Y), because it reduces the loan supply; the rise in the reference rate (i) also increases the demand for loans.

Figure 13
Rise in the reserve ratio and the reference rate



In Figure 13, the IS curve has a negative slope because a rise in the loan interest rate (R) reduces private investment, and, because of the multiplier, economic activity (Y). The IS curve shifts to the left (blue) if the reference rate (i) goes up, because it increases the cost of borrowing on the bonds market and thereby reduces private investment and economic activity for any bank loan interest rate (R); the IS does not depend on the reserve requirement ratio.

A higher reference rate (i) shifts both IS and LL curves to the left (blue), as in Figure 13. Economic activity (Y) falls, and we have assumed that the loan interest rate goes up. For this to occur, the condition is that the demand for loans be sensitive enough to the spread between R e i; a sufficient condition is, $\alpha_2=(1+\alpha_5)kb$. This parameter α_2 measures, say, the degree of competition between the banking system and the local and external bond markets.

A rise in the reserve requirement ratio (θ) of sufficient magnitude only shifts the LL curve to the left (blue), in Figure 13, so that the level of economic activity falls (less than with the rise in the reference rate) and the loan interest rate increases (more than with the rise in the reference rate). In summary, with the reference rate, the same, or more, can be done that with the reserve requirement ratio if the objective is to influence Y or P.

Finally, we use the balance of payment (BP) equation to determine the exchange rate. By inserting AS into BP, we find that

$$\text{(BP)} \quad E = \frac{1}{(1-\alpha_4)\alpha_8+\alpha_6}[\alpha_6 E^M + \alpha_9(i^* + E^* - R - i) - m^* Y^* - \alpha_5 Y^P + (m+\alpha_5)Y]$$

The increase in R and the fall in Y caused by a rise in the reserve requirement ratio improve net exports and foster capital inflow (local firms prefer to borrow abroad and in the local bond market before doing so in the banking system). The exchange rate has to fall for both reasons. The central bank buys dollars if $E=E^M$ in the initial situation.

A rise in the reference rate also causes R to increase and Y to decrease, as well as improving net exports and fostering capital inflow (firms prefer to borrow abroad, as it renders credit in the banking system and the local bond system more expensive). Thus, the exchange rate also has to fall. As with the previous case, the central bank buys dollars if $E=E^M$ in the initial situation.

A restrictive monetary policy, implemented via the reference interest rate or via the reserve requirement ratio, qualitatively produces the same results: it slows up the

economic activity, reduces the price level, appreciates local currency, and increases foreign exchange reserves.

This B-B model implies that the impact of the reference interest rate on economic activity (and on the price level) inversely depends on the reserve requirement ratio. The total derivative of economic activity (Y) with respect to the reference rate (i), or multiplier of the reference rate, is given by

$$\frac{dy}{di} = \frac{-(2\alpha_2 + \alpha_1\alpha_0)Kb}{\alpha_2 + (1+\alpha_5)(1-\alpha_0)Kb} < 0$$

As $\alpha_0=\lambda(1-\theta)$, the absolute value of the numerator of this multiplier decreases if the reserve requirement ratio (θ) goes up, while the denominator increases. Therefore, the absolute value of the multiplier of the reference interest rate decreases as the reserve requirement ratio increases.

It should be mentioned that the manipulation of the reserve requirement ratio (θ) does not allow the central bank to control the bank loan supply (L) against the will of bankers if the local bond interest rate (i) is constant. In this Bernanke-Blinder model, for example, an increase in the reserve requirement ratio (θ) accompanied by an appropriate rise in the propensity to lend (λ) only leads to a rise in the monetary base (and deposits), without affecting the loan supply or the loan interest rate. For this to occur, the condition is that α_0 does not vary, with $\alpha_0=\lambda(1-\theta)$. The LL and IS curves do not shift in Figure 13.

The introduction of the reserve requirements on external liabilities of commercial banks can be represented as a rise in the foreign interest rate (i*); local banks do not lend in foreign currency in this open B-B model. A rise in the foreign interest rate, shifts the IS and LL curves to the left (blue), such as in Figure 13; the economy goes into recession and the loan interest rate (R) can increase or decrease. The loan interest rate rises if loan demand is sufficiently responsive to the foreign interest rate; a sufficient condition is, $\alpha_2=(1+\alpha_5)kb$. In the balance of payments, despite the recession, the exchange rate rises if capital outflows are the dominant force (α_9 is large).

Finally, an exogenous purchase or sale of dollars by the monetary authority can be represented here as an increase or decrease in the central bank's target exchange rate (E^M), as a change in the intervention rule. An increase in E^M raises the exchange rate (E) and the price level (P), without changing economic activity (Y) or the bank loan interest rate (R).

To analyze the impact that real and financial external shocks have on domestic economy, this open Bernanke-Blinder model can also be represented in its version of aggregate supply and demand. Aggregate supply, which we reproduce for convenience, is given by

(AS) $$P = \alpha_4 E + \alpha_5 (Y - Y^P)$$

The price level (P) directly depends on the output gap ($Y-Y^P$) and the exchange rate (E), with $0<\alpha_4<1$.

Aggregate demand (AD), which results from combining the IS and LL curves, has a negative slope because the rise in the price level (P), given the exchange rate (E), generates an excess demand of credit that increases the bank loan interest rate (R) and reduces economic activity (Y). As before, we have assumed that $(1-\alpha_0)\alpha_4 - \alpha_3 = 0$. That is,

(AD) $$\mathrm{P} = \frac{\alpha_2(\mathrm{I_0}+\mathrm{G}+\mathrm{m^*Y^*})}{\mathrm{b}(1-\alpha_0)} - \frac{(2\alpha_2+\alpha_0\alpha_1)\mathrm{i}+2\alpha_2\mathrm{i^*}+\alpha_3(\mathrm{E^*}-\mathrm{E})}{1-\alpha_0} - \left[1 + \frac{\alpha_2}{\mathrm{kb}(1-\alpha_0)}\right]\mathrm{Y}$$

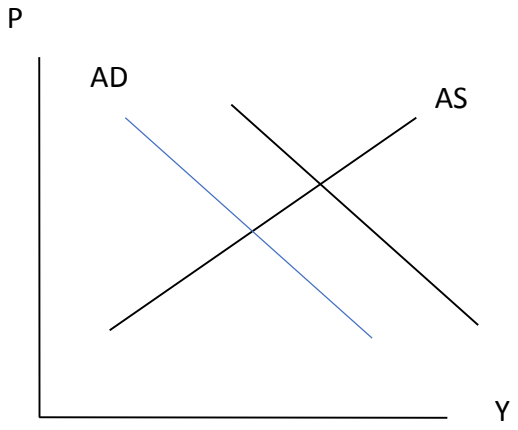
Adverse external shocks (an international recession or a rise in the foreign interest rate) have a twofold impact: they reduce aggregate demand and deteriorate the balance of payments[51]. The exchange rate rises due to the worsening of the balance of payments in a flexible exchange rate regime. Therefore, an adverse external shock is a negative demand shock and a negative supply shock. There is a recession and the price level may rise or fall.

[51] Aggregate demand decreases and the balance of payments deteriorates, along with a fall in the external prices of raw material exports, which is the classic adverse external shock in Peru. See Dancourt (2010).

With a fixed exchange rate, an adverse external shock (an international recession or a rise in foreign interest rate) is only a negative demand shock. There is a recession and the price level falls. The loss of foreign exchange reserves by the central bank dampens or eliminates the upward pressure in the exchange rate.

We can represent this AS-AD model in Figure 14, if the central bank sets the interest rate (i) and the exchange rate (E), which is feasible here because the impossible trinity[52] does not apply. The model is completed with the BP and LM equations, which determine the central bank's foreign exchange reserves and the quantity of money.

Figure 14
Adverse external shock (i* goes up or Y* goes down);
central bank sets interest rate (i) and exchange rate (E).



A global recession (Y*) or a rise in the foreign interest rate (i*) constitute a negative demand shock. The AD curve shifts to the left (blue); economic activity and the price

[52] According to Blanchard et al (2010), "imperfect capital mobility endows central banks with a second instrument in the form of reserve accumulation and sterilized intervention. This tool can help control the external target while domestic objectives are left to the policy rate". In this Bernanke-Blinder model with a BP curve, the central bank can set the exchange rate, let it float cleanly, or utilize a foreign exchange intervention rule.

level fall. If the central bank sets the exchange rate (E), these transitory adverse external shocks do not cause a negative supply shock. The AS curve does not shift[53].

The central bank loses foreign exchange reserves until the transitory external shock is reverted. It is assumed that the central bank has enough foreign exchange reserves and that the balance of payments was equilibrated in the initial situation.

To keep the price level and economic activity constant despite the adverse external shock, the central bank has to lower the policy interest rate so that the AD curve returns to its initial location; this reinforces the loss of foreign exchange reserves.

Symmetrically, a rise in global economic activity (Y*) or a fall in the foreign interest rate (i*) constitute a positive demand shock. The AD curve shifts to the right; economic activity and the price level go up. If the central bank sets the exchange rate (E), these temporary external shocks do not cause a positive supply shock. The central bank gains foreign exchange reserves until the temporary external shock is reverted, if in the initial situation the balance of payments was equilibrated. To keep the price level and economic activity constant despite the favorable external shock, the central bank has to raise the interest rate so that the AD curve returns to its initial location; this reinforces the gain of foreign exchange reserves.

If the central bank does not have foreign exchange reserves, the exchange rate should float freely. This AS-AD model is no longer easy to use[54]. So, we will return to the IS-LL model with $\alpha_6=0$.

Let us say that an international recession ($dY^*<0$) occurs that shifts the IS curve to the left (blue) in Figure 15. The LL curve does not shift. The domestic economic activity (Y)

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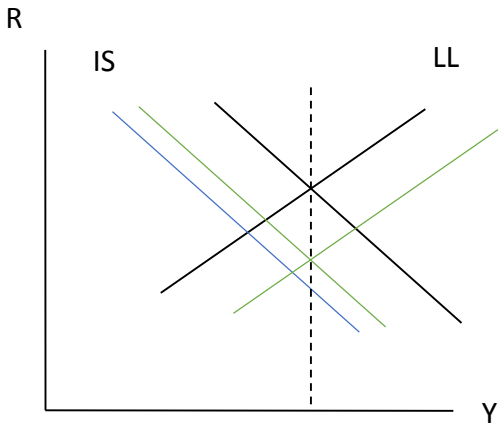
53 If the central bank utilizes an exchange intervention rule, such as $\Delta RIN=\alpha_6(E^M-E)$, the negative supply shock is not canceled out, but moderated. It can be canceled out if the central bank lowers E^M by a sufficient magnitude.

54 If the exchange rate is not fixed, the AS and AD equations can determine economic activity (Y) but not the price level (P). We require the AS and BP equations, in which we have previously inserted the LL equation, to simultaneously determine the price level (P) and the exchange rate (E). If the central bank does not have foreign exchange reserves, then $\alpha_6=0$.

and the interest rate of bank loans (R) fall. If the central bank seeks to avoid this recession and maintain full employment, indicated by the vertical dotted line, the reference interest rate (di<0) has to go down to increase investment and thus counteract the fall of net exports. The IS and LL curves shift to the right (green). The loan interest rate is reduced even more.

Figure 15
Adverse external shock (Y* falls); the central bank maintains full employment (i falls).



The balance of payments is deteriorated by the global recession and by the expansive monetary policy. In the BP equation, the fall in Y* reduce net exports. The decrease in R and i, reduce net exports and capital inflows (local firms prefer to borrow in the banking system and in the local bond market before doing so abroad). The exchange rate has to rise for both reasons.

(BP) $$E = \frac{1}{(1-\alpha_4)\alpha_8}[\alpha_9(i^* + E^* - R - i) - m^*Y^* - \alpha_5 Y^P + (m + \alpha_5)Y]$$

Full employment is maintained but the price level goes up.

In conclusion, the central bank requires two independent instruments (interest rate and exchange rate or sterilized intervention) to achieve their two objectives (price stability and full employment). In response to temporary adverse external shocks, these two objectives cannot be achieved if the central bank lacks sufficient foreign exchange reserves.

The dollarization of the banking system.

The banking system can be connected to international financial markets in two different ways. One is that local banks do not lend in foreign currency and firms have access to the foreign bond market, as in the B-B model seen above. The banking system compete with both foreign and domestic bond markets; the demand for bank loans depend on the expected yield of foreign bonds.

Another is that local banks are those that borrow in the foreign bond market. Firms (and households) does not have access to the foreign bond market. In this case, the loanable funds from local banks would depend on their foreign debt; local banks could evade foreign exchange risk lending in foreign currency to its customers. The banking system would compete with the domestic bond market but not with the foreign bond market; neither the demand for bank loans nor the demand for bank deposits depend on the expected yield of foreign bonds.

In this dollarized version of the open Bernanke-Blinder model[55], shown in Table 2, commercial banks also make loans and take deposits in foreign currency; deposits and loans in domestic and foreign currency are imperfect substitutes. Thus, there are two bank loans interest rates, in domestic (R) and foreign currency (R*). And there are two LL curves in Table 2. This is the basic difference between the models in Tables 1 and 2. One (LL) curve implies that the supply of loans in domestic currency is equal to the demand of loans in domestic currency. The other (LL*) curve implies that the supply of loans in foreign currency is equal to the demand of loans in foreign currency. If commercial banks match assets and liabilities by currency and do not speculate with the future path of the exchange rate, it is as if there were two banking systems, one operating in domestic currency and the other in foreign currency. This is what is assumed in Table 2.

[55] See Dancourt (2012) and Dancourt y Mendoza (2002) cap. 6.

Table 2

(IS) $\mathrm{Y} = \mathrm{k}[\mathrm{I}_0 + \mathrm{G} + \mathrm{m}^* \mathrm{Y}^* - \mathrm{b}(\mathrm{R} + \mathrm{i} + R^*)]$

(LM) $\mathrm{M} = \theta\,[\mathrm{P} + \mathrm{Y} - \alpha_1 \mathrm{i} - \alpha_{10}(E^* - \mathrm{E})]$

(LL) $\lambda(1-\theta)[\mathrm{P} + \mathrm{Y} - \alpha_1 \mathrm{i} - \alpha_{10}(E^* - \mathrm{E})] = \mathrm{P} + \mathrm{Y} - \alpha_2(\mathrm{R} - \mathrm{i} - R^*) + \alpha_3(\mathrm{E}^* - \mathrm{E})$

(AS) $\mathrm{P} = \alpha_4 \mathrm{E} + \alpha_5(\mathrm{Y} - \mathrm{Y}^{\mathrm{P}})$

(BP) $\alpha_6(\mathrm{E}^{\mathrm{M}} - \mathrm{E}) = \alpha_8(\mathrm{E} - \mathrm{P}) - \mathrm{mY} + \mathrm{m}^* \mathrm{Y}^* + \alpha_9(\mathrm{R} + \mathrm{i} - R^* - \mathrm{E}^*)$

(LL*) $(1-\theta^*)[P + Y - \alpha_{11} i + \alpha_{12}(E^* - E) + D^*] = P + Y - \alpha_{11}(R^* - i - R) - \alpha_{12}(E^* - E)$

(R*) $R^* = i^* + \alpha_{13}\theta^*$

According to the (LL*) curve, the stock loan demand in foreign currency depends directly on the economic activity (Y) and the price level (P), inversely on the interest rate of loans in foreign currency (R*) and the expected devaluation (E*- E), and directly on the interest rate of loans in local currency (R) and the cost of borrowing in the domestic bond market (i). Loanable funds equals deposits in foreign currency, [P+Y-α_{11}i+α_{12}(E*-E)], plus the external debt of the banking system (D*) minus reserve requirements (θ*). Loan supply in foreign currency equals loanable funds; it is assumed that the propensity to lend in foreign currency is one (λ*=1).

Table 2 also supposes that bank deposits in both currencies do not yield interest. The demand for bank deposits in local (foreign) currency depends inversely (directly) on the expected devaluation (E*-E), as can be seen in the LM, LL and LL* curves. Deposits in both currencies are a medium of exchange and a store of value.

Equation (R*) states that interest rate on foreign currency loans (R*) depends directly on the foreign interest rate (i*) and reserve requirements (θ*) levied on foreign currency deposits and external debt of the banking system. This implies that the (LL*) curve serves basically to determine the external debt of the banking system and, thus, the supply of loans in foreign currency. The elastic component of the funding of the

banking system in foreign currency is the external debt (D*). In Table 2, it is assumed that local banks are not subject to credit rationing in the foreign bond market[56].

The (LL*) curve implies that the demand for foreign debt (D*) depends directly on the loan interest rate in domestic currency (R) and the domestic bond interest rate (i), inversely on loan interest rate in foreign currency (R*), adjusted by expected depreciation (E*-E), and directly on the price level and economic activity. Finally, it is suppose that the demand for external debt is an inverse function of reserve requirements in foreign currency (θ*) through its impact on R*.

Capital inflows (outflows) occur here because local banks increase (reduce) their external debt. Thus, capital inflows are given by $\alpha_9(R + i - R^* - E^*)$. This is the only change in BP equation[57].

Table 2 assumes that the competitiveness effect (α_8) is equal to the balance sheet effect (α_7). In Table 2, the curve LL does not depends on the exchange rate (E) if we assume that $(1-\alpha_0)\alpha_4-\alpha_3-\alpha_0\alpha_{10} = 0$. This allows the comparison of Tables 1 and 2. Under these conditions, the main comparative static exercises with the model of Table 2 basically give the same results as those obtained with the model of Table 1.

For example, a higher reference rate (i) shifts both IS and LL curves to the left (blue), as in Figure 13. Economic activity (Y) falls and the loan interest rate in domestic currency (R) goes up if $\alpha_2=(1+\alpha_5)kb$. The interest rate on bank loans in foreign currency (R*) is not altered and supply of foreign currency loans could increase.

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[56] During the crises of 1998-2000, 2008-09 and 2013-14, Peruvian banks suffered an abrupt cut in their external credit lines. These circumstances can be represented imperfectly in this framework, as an increase in the foreign interest rate.

[57] It is assumed a) that an increase in the exchange rate improves the balance of payments, b) that an increase in economic activity or in the price level deteriorate the balance of payments through the trade balance, although they induce capital inflows as well. An increase in the exchange rate improves the trade balance in dollars if the Marshall-Lerner condition holds, and if the coefficient of the exchange rate on aggregate supply is less than unity, assuming that the balance was in equilibrium in the initial situation. It is also assumed that foreign currency reserve requirements are not deposited at the central bank, but remain in the hands of commercial banks.

The restrictive monetary policies implemented via the reference interest rate or the reserve requirement ratio in domestic currency have the same effects in Table 1 and Table 2. These policies raise the bank loan interest rate in domestic currency, reduce economic activity and the price level, and appreciate the national currency. An exogenous purchase of dollars by the central bank (an increase of E^M) only increases the exchange rate and the price level.

An increase in the interest rate of bank loans in foreign currency (R*), either because the external interest rate (i*) rises or because reserve requirements in foreign currency (θ*) rise, raises the bank loan interest rate in domestic currency if $\alpha_2=(1+\alpha_5)kb$, causing a recession and depreciates the national currency if capital outflows are the dominant force (α_9 is large); the price level may rise or fall.

Finally, it should be noted that all these instruments of monetary policy alter the size of the banking system in foreign currency.

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