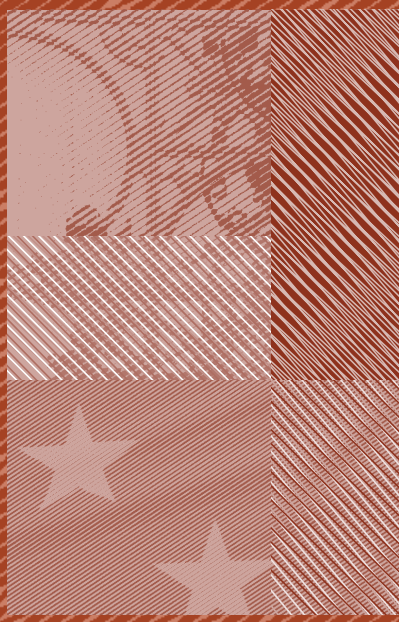
# GLOBAL FINANCIAL INTEGRATION, MONETARY POLICY AND RESERVE ACCUMULATION. ASSESSING THE LIMITS IN EMERGING ECONOMIES

2007



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BANCO DE ESPAÑA
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**Abstract**

This paper assesses whether domestic costs of reserve accumulation –and in particular monetary costs– constitute an eventual limit to the process in emerging markets. We find that sterilization is the first measure to deal with these costs. Then, we turn to study whether diminishing ability to deal with the monetary inflows through sterilization is an effective limit to the process, Indeed, when the scope for sterilization is reduced, accumulation diminishes. However, this constraint, albeit relevant in practice, has not constituted an effective limit to accumulation, hitherto.

**JEL Classification:** E58, F36, G15

**Keywords:** international reserves, monetary policy, central banks, sterilization, internal costs.

## 1 Introduction

Globalization has fostered a large increase in the financial flows among countries in the last fifteen years. Although the increase in flows has been particularly acute among developed countries, developing countries and in particular emerging market economies have also experienced an important increase in the magnitude of flows, which are characterised by their volatility. In parallel with these developments, as shown in graphs 1 and 2, the level of accumulated reserves, in particular in emerging countries has registered unprecedented growth since 1997, leading the global stock of foreign exchange reserves to unknown magnitudes and to a marked concentration.

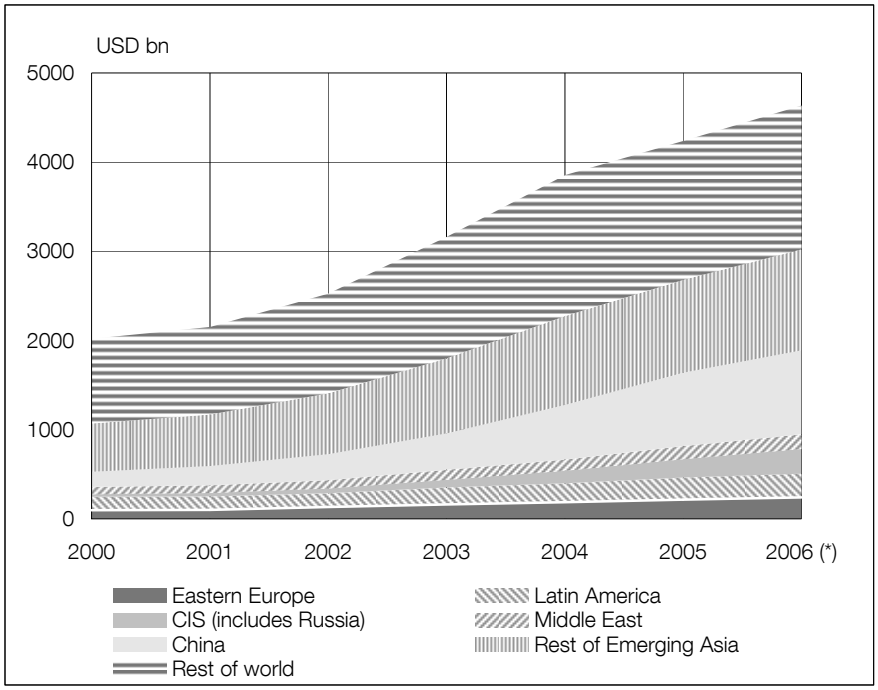
This process of reserve accumulation has arguably had an important impact on the global economy, in particular, through its perceived contribution to global imbalances. The demand of dollar treasuries would have helped to maintain long run interest rates relatively low for the current cyclical expansion and prevented the dollar from adjusting. Both elements would have facilitated the persistence of a situation of twin deficits– current account and fiscal balances– in the US. Since the countries which accumulate reserves do not seem to internalize the costs they impose on global financial stability and multilateral negotiations for a coordinated adjustment progress slowly, the sustainability of the process –and of global imbalances– basically rests on the perceived balance of costs and benefits by the reserve accumulating countries.

In a first stage, the main driver for reserve accumulation in most emerging countries was to replenish the stock of reserves in the aftermath of severe financial crises in order to reduce financial vulnerabilities for the future. Nowadays, however, the magnitudes largely surpass in many cases this precautionary aim, so that the persistence of the process is seen as driven generally by the objective of managing the exchange rates at a certain desired level or range.

However, it is well known that reserve accumulation entails also some domestic costs –monetary, financial, fiscal,…– but they have remained absent in much of the recent discussions on the issue, although they are becoming an increasing concern in some countries. Moreover, the empirical analyses have focused on the drivers of reserve accumulation, but not on its limits. Given these considerations, *the goal of this paper is to explore to what extent economic costs are or may become an effective determinant –and eventually a constraint– of reserve accumulation in the context of increasing global flows*. This is done both through an empirical analysis, whose results are not conclusive, and through the examination of several country cases which highlight the costs of the process. We hope the results may shed some light on the eventual limits on the reserve accumulation process currently underway.

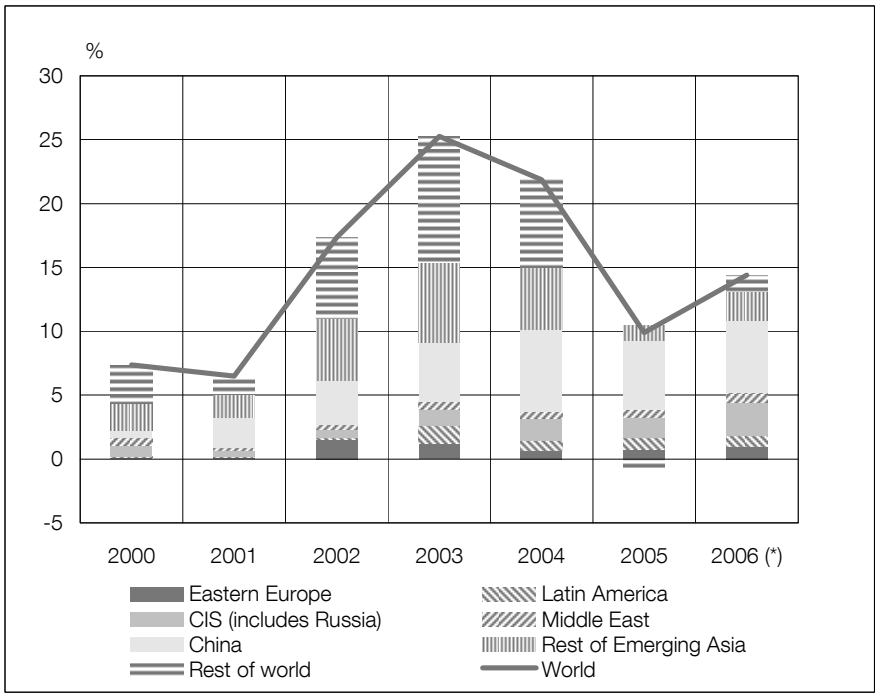
The rest of the paper is structured as follows: section 2 discusses recent empirical work on the drivers of reserve accumulation; section 3 discusses the main costs of reserve accumulation; section 4 presents three case studies –China, Russia and Argentina–, section 5, tests empirically the main hypothesis –that the costs of reserve accumulation, together to the benefits of reserve accumulation, explains the current process of reserve accumulation; the final section presents the main conclusions.

**RESERVE ACCUMULATION. LEVELS BY REGION** GRAPH 1




SOURCE: International Monetary Fund (International Financial Statistics)
(*) Until second quarter

**RESERVE ACCUMULATION.**
**RATES OF GROWTH AND REGIONAL CONTRIBUTIONS** GRAPH 2




SOURCE: International Monetary Fund (International Financial Statistics).
(*) 2Q 2006 relative to 2Q 2005.

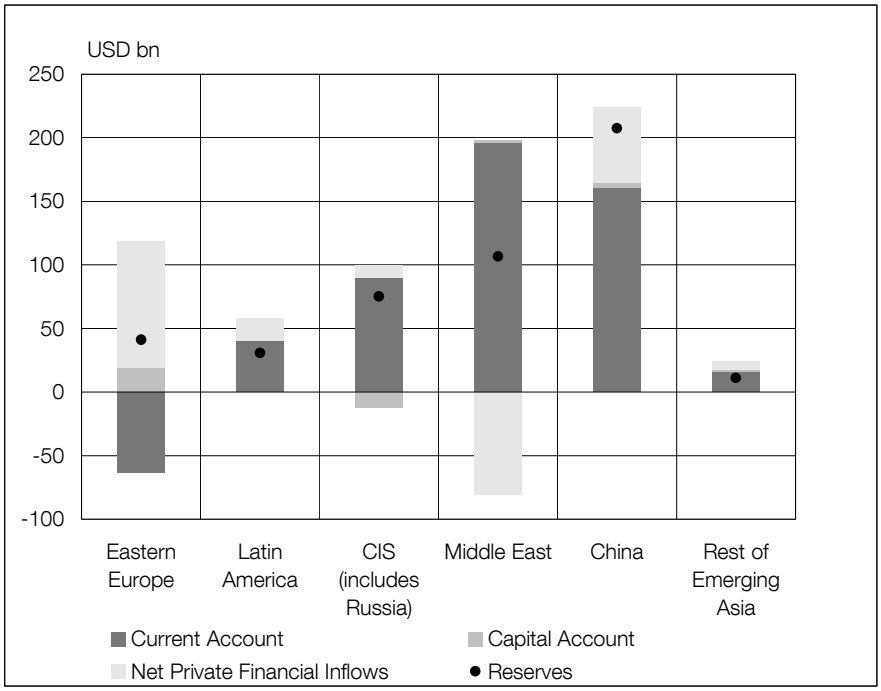
## 2 Drivers of reserve accumulation. Recent empirical evidence

From a financial accounting point of view, the process of reserve accumulation is given –in a number of countries– by the co-existence of large current account surplus and private financial inflows. More precisely, the following equality approximately holds

> Reserve accumulation = Net private financial inflows + Current account balance + +Capital Account + Errors and omissions

As shown in the graph 3 all emerging regions –but Eastern Europe– display a remarkable current account surplus and some of them also large net private financial inflows.

**CURRENT ACCOUNT, CAPITAL FLOWS AND RESERVES** GRAPH 3



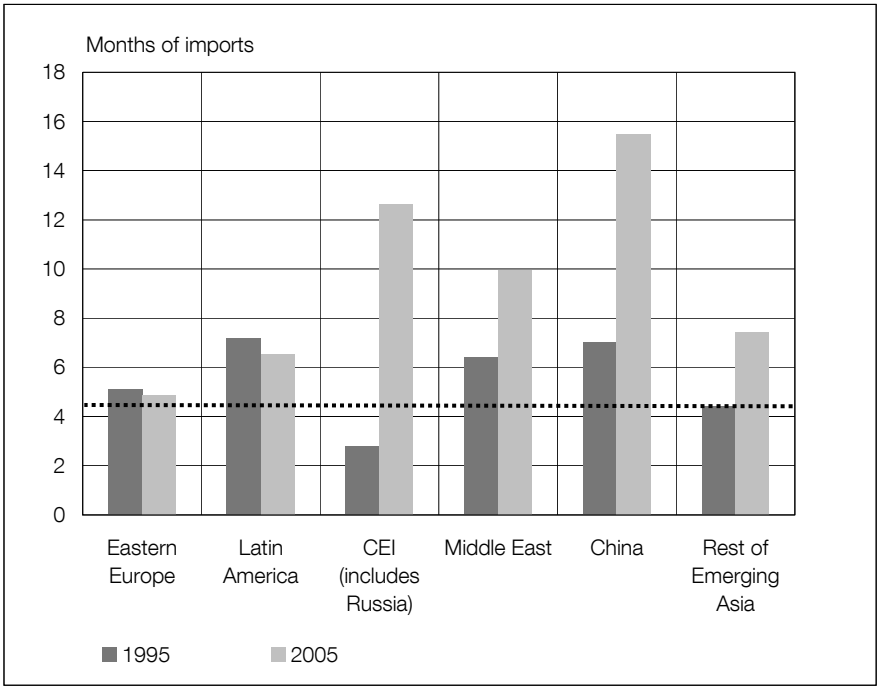

SOURCE: International Monetary Fund (International Financial Statistics and World Economic Outlook [June 2006]).

Beyond accounting, this evidence uncovers the two main drivers for reserve accumulation: the desire to keep the exchange rate around a desired level and the desire to self-protect against sudden stops of financial flows, and to attain a healthier country balance sheet. Implicitly, reserves are accumulated in order to counteract appreciation pressures, which are driven by capital inflows and, as a consequence, the current account surpluses are prevented from adjusting. Note that this surplus external position also entails a reduction in vulnerability since the country as a whole is a net exporter of capital, not being reliant on the foreign capital. This suggests that the drivers of accumulation are rooted in such identity.

A number of recent papers, which in general focus on the precautionary motive, have re-estimated reserve demand equations. The econometric evidence (Edison, 2003; Gosselin and Parent, 2005) suggests that traditional determinants of the demand of international reserves –imports and short term to GDP, etc,– fail to explain the very large volume and distribution of reserve accumulation. The graph 4 shows that the months of

imports covered by reserves is much higher than the precautionary level (four, according to the literature), while in graph 5, it is observed that the ratio of short-term external debt by 2004 was larger than 1 in all the cases, the threshold suggested by the Guidotti-Greenspan rule as enough to counteract liquidity needs in case of financial turmoil.

**RESERVES OVER IMPORTS** GRAPH 4



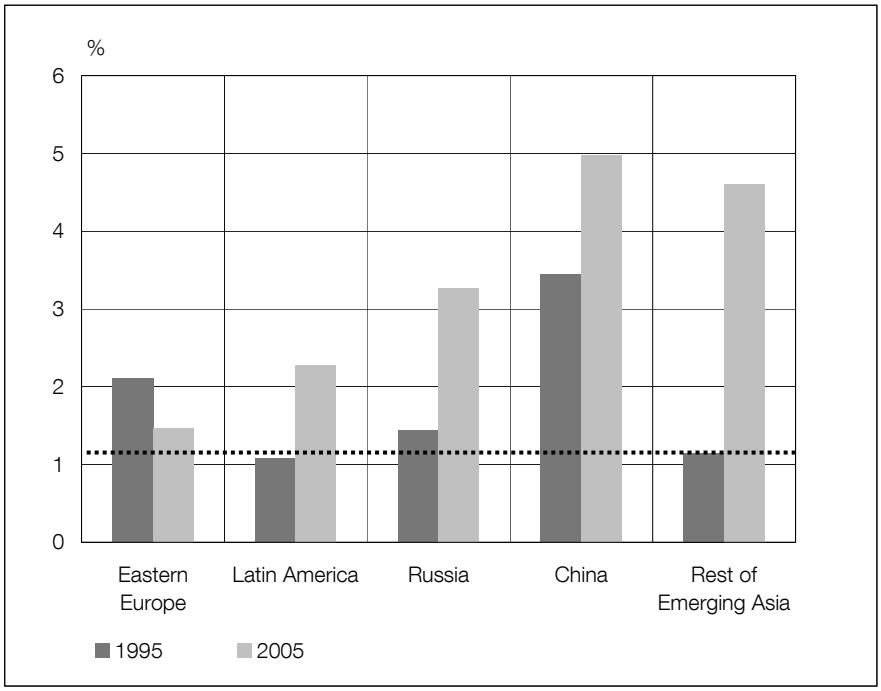

SOURCE: International Monetary Fund (International Financial Statistics).

One problem with this sort of evidence is that the optimal level of reserves is made contingent on the current economic situation. Since the precautionary motive aims at insuring against prospective crises, it is more interesting to conjecture whether the current level of reserves would be enough to effectively face a crises. However, when these considerations have been taken into account (Jeanne and Ranciere, 2006)– the finding is still that the level of reserves is beyond the optimal in many countries. In particular, according to their findings, international reserves would be adequate in Latin America, and excessive in Asia. The main shortcoming of these results is that they assess reserve adequacy until 2003, and since then the vulnerability has been further reduced, the fundamentals have improved and in spite of it reserves have go on increasing.

Some authors (Aizenman and Marion, 2002a, 2002b; Aizenman and Lee, 2005; García and Soto, 2004; Kim et al, 2004) have explained this failure (and also the differences in the patterns of reserve accumulation among emerging countries) by suggesting that the emphasis is now higher on precautionary motives. Furthermore, it is also argued that increasing financial globalisation and the higher magnitude and volatility of capital flows that it entails, probably call for a higher scale of accumulation, regardless of the underlying motives, On the one hand, the quantity of reserves to manage the exchange rates is increasing in the magnitude and volatility of capital flows; on the other hand, the potential reversal of flows within a financial crises is also larger, requiring also a higher level of reserves to guarantee effectiveness. Redrado et al. (2006) point out that the huge reserve accumulation of countries in an intermediate level of development, in a context of global financial integration, can be explained by self-protection motives due to the inexistence of a

lender of last resort, and find that inertia and regional imitation are other relevant drivers of the process.

**RESERVES OVER SHORT-TERM EXTERNAL DEBT** GRAPH 5



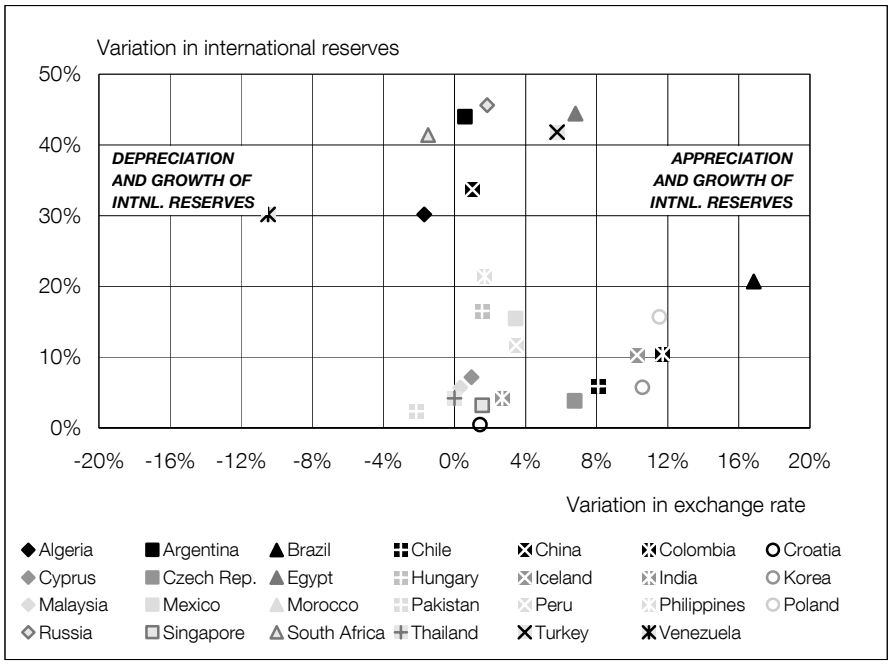

SOURCE: International Monetary Fund (International Financial Statistics).

All in all, the magnitude and persistence of the current process suggest that the exchange rate management motives may be increasingly relevant. This is most clear in Asia, but it also applies to other countries, like some Latin American countries and oil producers, where the desire to limit exchange rate appreciations is evident. The stability of exchange rates in countries with high reserve accumulation can be observed in graph 6, where are displayed the variation in international reserves and exchange rates for the countries in our sample within the period 2004-2005.

A quite suggestive theory explaining the process in Asia, and mainly, the perspective that it will continue for a long time has been advocated by Dooley, Folkerts-Landau and Garber (2005). They state that the process of reserve accumulation by Asian countries is a consequence of an export-led growth strategy that, by maintaining the exchange rate depreciated with respect to the rate that would emerge had the central bank not act in the markets, generates current account and financial account surpluses, thanks to trade balance surplus and expectations of appreciation of the exchange rate. If a central bank wants to maintain the exchange rate at the desired level, it has to act in financial markets, consequently accumulating reserves.

The possibility that, based on the strategic incentives of the accumulating countries, the process of accumulation could persist in the long run –as Dooley et al. defend for Asia–, and the implications for the global economy, raise the issue of the factors that may call a halt to the process, that is, whether the implied costs of accumulation may eventually outweigh the perceived benefits.

**EXCHANGE RATE AND RESERVE ACCUMULATION (2004-2005)** GRAPH 6




SOURCE: International Monetary Fund (International Financial Statistics).

## 3 The costs of reserves accumulation

Much of the attention devoted to the costs of reserve accumulation focus on the fiscal costs of *holding* reserves (Hauner, 2005; Rodrik, 2006; Summers, 2006). However, the most immediate impact of reserve accumulation is on the monetary aggregates. It is convenient to make a digression to briefly explain how reserve accumulation can be managed by the central bank, through sterilization, and then assess the costs differentiating between costs arising when reserve accumulation is non-sterilized, and costs that arise when there is sterilization. The interest of this distinction rests on the fact that empirically we observe that at the beginning of the process of reserve accumulation, sterilization is more scarce and less important, but as the process goes on, and increases in reserves threatens domestic monetary policy, sterilization becomes more intensive until, eventually, the central bank is faced has to give priority either to domestic monetary policy or to exchange rate targeting. This implies that the type of costs arising vary at different stages of the process.

### *3.1 A conceptual framework: Management of monetary policy under reserve accumulation*

Foreign exchange reserves accumulate as an asset of the Central Bank. In the balance sheet of the Central Bank (table I), the asset side is completed with the domestic credit of the central bank, which includes domestic credit to the banking system, and other assets. The liability side includes, roughly, bonds and monetary base (*M*), which comprises both currency in circulation and deposits (reserves) of the commercial banks, obtained mostly through reserve requirements. Net International reserves (NIR) are defined as foreign exchange reserves minus foreign liabilities, and Net Domestic Assets (NDA) of the central bank are the sum of credit to the banking system and other domestic assets minus bonds[1].

**Table I: Central Bank Balance Sheet**

| **Assets** | **Liabilities** |
|---|---|
| Credit to the Banking System (NDA) | Foreign Liabilities (-NIR) |
| Foreign Exchange Reserves (NIR) | Currency in circulation (M) |
| Other domestic assets (NDA) | Reserves of the banking system (M) |
| | Bonds (-NDA) |

Therefore, the following identity holds:

$$M = NDA + NIR$$

**1.** We will use the terms net international reserves (NIR) and net foreign assets (NFA) alike. Given the way in which we have constructed the variable -see data appendix- they represent the same concept. Alternative constructions of NIR and NFA might lead to differences between the concepts -for instance, if liabilities with international financial institutions are included in NFA, but not in NIR.

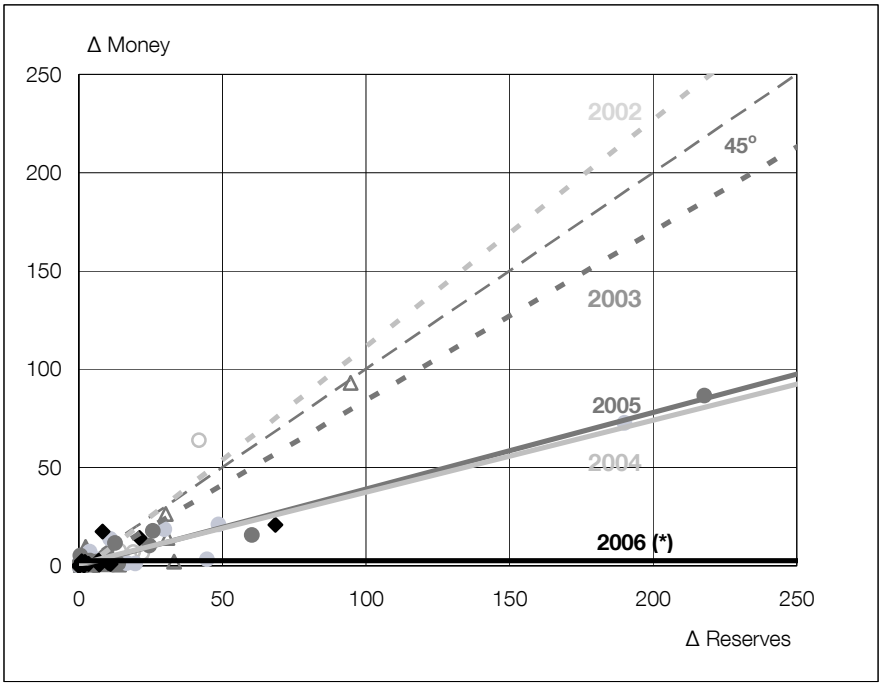
and

$$\Delta NIR = \Delta M - \Delta NDA$$

With no further action of the Central Bank, reserve accumulation (an increase in NIR) implies an increase in the currency in circulation and thus on the liquidity of the economy. The liquidity so injected into the economy may lead to an expansion of credit and inflationary pressures and threaten the monetary policy targets of the Central Banks.

Therefore, the Central Bank can decide to sterilize the reserve accumulation to prevent it from filtering into higher liquidity in the system. This is done either through a reduction in the net domestic assets, which can be carried out in different ways, or through an increase in the mandatory reserve deposits of banks (which increase the monetary base, without expanding the currency in circulation.) The net reduction in net domestic assets can be achieved in different ways. Sterilization can be done through market instruments, by issuing bonds –either central bank or government paper– (which implies an increase in the liabilities, more precisely) or the use of repos and swaps and the overnight deposit facility, and also through non-market instruments such as government deposits on the central bank or sales of reserves to the government (in order to reduce its external debt, for instance). In all these cases, increases in currency circulation are less than the increase in reserves (partial accumulation) or is nil (complete sterilization).

**INCREASES IN RESERVES AND STERILIZATION 2002-2006** GRAPH 7




SOURCE: International Monetary Fund (International Financial Statistics).
(*) 2Q 2006 relative to 4Q 2005

In the current process, sterilization is being implemented mainly through market instruments –open market operations– and to less extent through fiscal policy management (deposits of the government on the central bank, stabilization funds, and so on). However, historical evidence shows that when capital inflows are sustained for a prolonged period of time, it may become so cumbersome and costly to sterilize through open market operations that central bank can turn to sterilization through non-market instruments, such as reserve

requirements. In particular, non-market instruments were used intensively in the nineties (see Reinhart and Reinhart, 1999; Montiel and Reinhart, 2001), but in the recent episode, few countries have raised reserve requirements to sterilize, with the relevant exception of China (see the case study)[2].

The magnitude of sterilization can be assessed in the scatterplot in graph 7, where the increase in currency in circulation is plotted against the increase in reserves. Points below the 45º line (increases in reserves higher than increases in currency in circulation) evidence sterilization. Different colours are used for the years, being China the extreme right observation in every year. The parameter of a regression between both variables (pooling all the observations) is 0.37, implying that 63% percent of the increase in reserves is sterilized on average. The evidence presented in graph 7, that allows disentangling the evolution of sterilization over time, suggests that countries are sterilizing increasing proportions of the additional reserves, as since 2002 the sterilization curve becomes flatter every year. In 2006, as it turns out from the horizontal line, the accumulation of reserves did not translate into increases of the monetary base, on average, due to the large sterilization efforts by China. It is also noteworthy to see in graph 8 the evolution of sterilization and how countries reduced NDA as they accumulated NIRs, either from the beginning (negative slope) or after some time (the curve shifts from positive to negative). Examples of the first case are the Asian countries and of the second case is China: at the beginning it did not sterilize inflows, but it has started to sterilize them. By the moment, China seems able to sterilize the increases in reserves, as the pace of reserve accumulation does not seem to slowdown.

The sterilization policy by the central bank is determined by several factors. First, the link between the increase in the monetary base and the expansion of credit and inflationary pressures is not equal in all countries, and depends very much on the different features of the domestic financial systems and of the growth of the economy. In economies where money holders tend to deposit their money in commercial banks, and where there is a well developed domestic banking system, able to channel domestic saving into an increase in credit, therefore causing inflationary pressures and asset bubbles, reserve accumulation can produce more problems with domestic monetary policy objectives than the problems that would be caused in an economy with a less developed domestic banking system. In compensation, the deeper the domestic financial market the larger the number of potential sterilization instruments. Second, if the economy is growing at a fast pace, the demand for money tends to be high, which implies that the increase in prices is lessened. Thus, in some cases monetary authorities do not face a trade-off between implementing an autonomous monetary policy and allowing the increase of capital inflows

Given the preeminence of the exchange rate management motives in the current process of reserve accumulation, it is important to recall the proposition that in a framework of high capital mobility, it is not feasible to peg the exchange rate and manage domestic monetary policy autonomously…in the long run. Actually, sterilization is an attempt to bypass this basic proposition, at least for some time. As a matter of fact some central banks are being able, to some extent, to manage exchange rates and accumulate reserves without losing control of domestic monetary policy objectives, but this is an increasingly difficult challenge. Sooner or later the costs and limitation on monetary policy will come to the fore.

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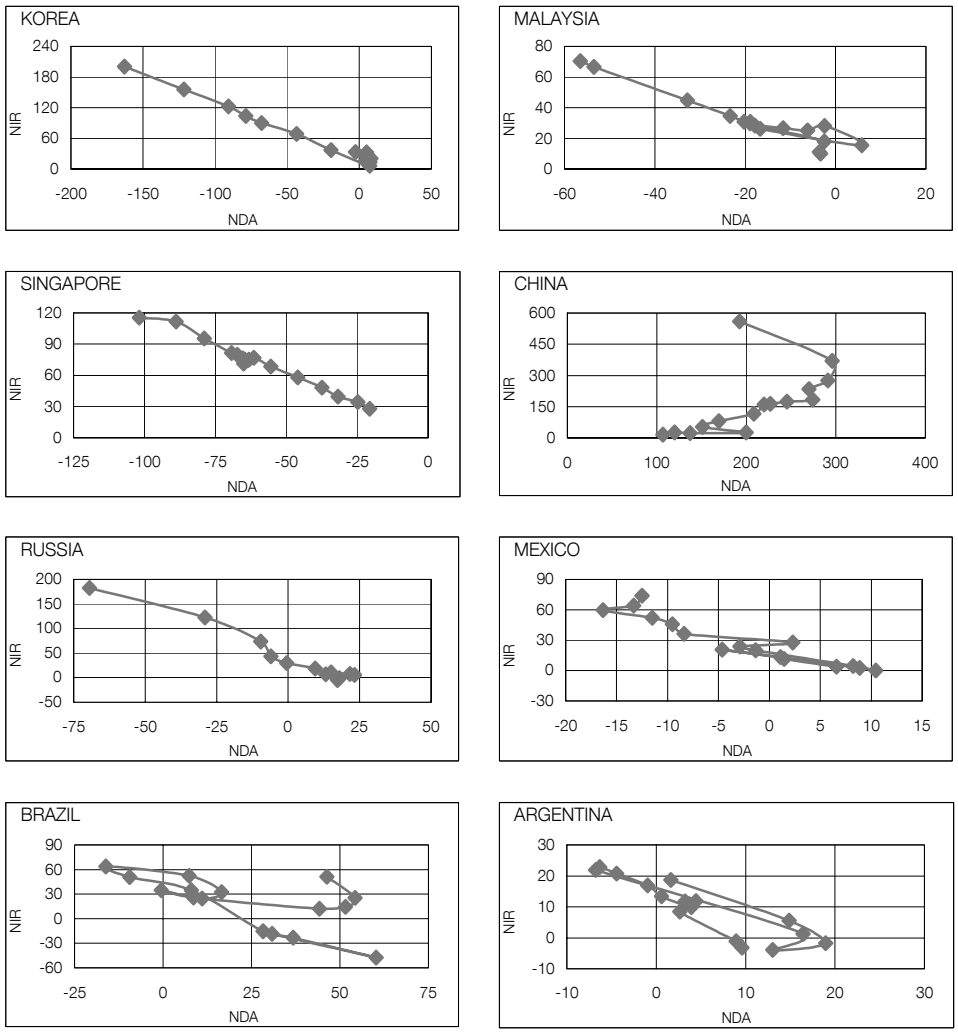
**2**. An interesting issue is, therefore, whether sterilization is firstly implemented through market instruments, and when it becomes too costly, non-market instruments are used until, finally, central banks give up sterilization and their foreign exchange market intervention.

### *3.2 Perceived costs from accumulation and sterilization*

The main problem of non-sterilized intervention is that expansion of the monetary base can disrupt monetary policy management and feed into inflation. Central banks are expected to care about inflation, so *before* inflationary pressures deriving from non-sterilized intervention could arise, they turn to sterilize interventions. Therefore, sterilization may become a sign that domestic monetary policy objectives are jeopardised and therefore, usually the costs of non-sterilized intervention remain latent through sterilization –which poses a challenge for a rigorous empirical approach.

**RESERVE ACCUMULATION AND STERILIZATION (4Q 1990 - 4Q 2005)** GRAPH 8
USD bn




SOURCE: International Monetary Fund (International Financial Statistics).

Sterilization, in turn, generates a wide array of problems, whose nature depends on whether they sterilize through market or non-market instruments.

When sterilization is done through market instruments[3], there is an increase in the debt of the central bank, which is remunerated at a given interest rate –the one fixed

**3.** In the following discussion we restrict to issuance of debt to drain liquidity.

in the auction of the debt. Part of these costs are reflected in prices, while others are disturbances on the financial system that are more difficult to identify. When there is an interest rate differential between the return on assets and the return on liabilities, there is an explicit cost, sometimes called quasifiscal cost of holding reserves. Table II provides the interest rates of intervention of the central banks that, compared with the returns on US Treasuries, are usually considered as proxies of these costs. Domestic interest rates differ substantially among countries, from the 15.5% interest rate in Brazil to the zero interest rate in Japan. This implies that while some countries enjoy benefits after sterilizing accumulated reserves, other countries suffer important losses.

Sterilization through open market operations can lead to increases in interest rates if the supply of funds is high in relation to the demand for them. Both increases in debt and in interest rates generate potential risks of debt monetization. As Mohanty and Turner (2003) point out, unlike in other periods, during the current episode of foreign exchange market intervention, large scale issuance of sterilization bond has not pressed the interest rates up, as the domestic demand for these assets has been high. However, this does not imply that sterilization is absent of problems, Indeed, large scale sterilization coupled with high domestic demand by the banking system and pension funds can generate different problems even when the financial system seems to absorb the issuances without pressing the interest rates up. For instance, the large-scale issuance of sterilization bonds can create a crowding out on the private sector if there is a large appetite for these bonds given that as domestic bonds gain importance within the portfolio of financial intermediaries, they decrease other investment, and this way there might arise of problem of lack of credit, increases in interest rates for private loans, and so on (see the case of Argentina). Moreover, if the portfolio of the banking sector gets concentrated in government debt, there might be problems for domestic financial stability and conflicts between monetary policy and financial stability. In any case, all in all, these hidden costs differ substantially between countries.

Even if it is difficult to provide general lessons, it can be concluded that large scale sterilization (through debt issuance) creates problems of crowding out and reduction in credit to the private sector, and problems of either increases in domestic interest rates, risks of monetization and increasing quasifiscal costs (if there is low demand for them), or domestic financial stability, if there is demand for these assets and gain importance in the portfolios of the domestic financial intermediaries, in particular the banking sector.

The main costs of sterilization through reserve requirements are the distortions introduced in the commercial banking system. Reserve requirements act as a tax on the banking system, and contribute to a widening in the gap between loans and deposits interest rates[4]. Perhaps because of the distortions they introduce, central banks are avoiding to the extent of possible their use.

Sterilization through fiscal policies, such as deposits of the government on the central bank, does not introduce direct distortions on the economy. However, it might lessen the independence of the central bank, and exposes the central bank to a sudden increase in the monetary base if the government changes its commitment and asks back the deposit. Sales of foreign reserves to the government that are paid with cash are a good way of sterilization, as drain liquidity in a permanent manner. However, it can pose problems such as

**4.** See Reinhart and Reinhart (1999) for a discussion of the distortions caused by sterilization through reserve requirements.

the ones discussed before: possible reduction in central bank independence or dependence on the government to get involved in such an operation.

**Table II: Interest rates and reserve accumulation**

| Country | Interest rate (average 2003-2005) | Accumulation of NFA (total 2003-2005) –billions US $ | Total NFA – end 2005 billions US $ |
|---|---|---|---|
| Japan | 0.12% | 373 | 834 |
| China | 1.95% | 478 | 778 |
| Turkey | 24% | 20 | 13 |
| Brazil | 19.5% | 39.5 | 51 |
| Argentina | 3.2% | 22.7 | 18 |
| Korea | 3.6% | 86 | 203 |
| Singapore | 1.3% | 32 | 115 |
| Malaysia | 2.72% | 35 | 70 |
| Thailand | 1.71% | 16 | 52 |
| South Africa | 8.23% | 11 | 16 |
| Mexico | 7.8% | 20 | 68 |

SOURCE: International Monetary Fund (International Financial Statistics).

Looking forward, it is obvious that more sterilization has been done in past years, the more costly the process can be. This derives from the fact that distortions do accumulate, and that, when sterilization is done through issuance of government or central bank paper, it has to be sterilized once again when the debt matures. Moreover, large scale sterilization can be technically unfeasible in some countries, so sterilization costs can go together to growing expansion of liquidity and their consequences.

## 4 Case Studies

While the costs of accumulation can be easily described, to put our hypothesis to test in a panel becomes even more contentious when we take into account the diverse determinants, drivers, environments in which different countries accumulate. This is clearly seen in the annex where three of the most relevant cases of reserve accumulation in the last years –China, Russia and Argentina– are described in detail.

China is the largest holder of international reserves, having recently surpassed the trillion dollars of reserve holdings. Although the authorities state that the exchange rate floats, it is evident that keeping a controlled exchange rate is the overwhelming goal of the monetary policy, not only for competitiveness reasons but also to manage with more degrees of freedom the transition to a more open economy from a financial point of view. Russia epitomises accumulation related to the oil price and commodities boom and here the process is justified by the need to smooth out a shock which may be transitory. Argentina, finally, conveys both rationale; a positive terms of trade shock plus a strong wish to maintain a competitive exchange rate.

To be sure, all three countries are facing increasing costs. Explicit inflationary pressures are only clearly evident in Argentina; authorities are facing increasing difficulties to manage the increase in reserves, also because monetary policy is not completely independent. In China, the large excess in liquidity has not transferred into headline inflation, due to the peculiarities of the financial system, but concerns of overheating of the economy and distortions in the financial system are increasing. In Russia, the problems have also a monetary dimension, but they are intertwined with fiscal concerns, since the sterilisation instruments are of fiscal nature and held in the central banks. Such big quantities of money are really tempting and they generate tensions between the central bank and the fiscal and political authorities.

These different typologies do not hide a common fact. Despite the increasing difficulties the accumulation of reserves continues at a strong pace. All three countries have resorted to strategies to reduce the opportunity costs of reserves, like investment in alternative assets –like China or Russia– or helping to solve financial problems in other spheres of the economy –debt repayment in Argentina, bank recapitalisation in China. Moreover, in all of them the normal functioning of monetary policy and institutions is being jeopardised. China has resorted to controls and quantitative limits to credits, while Argentina has imposed tight price controls and disuassive actions to control inflationary pressures. In Russia, central bank autonomy is obviously threatened by potential clashes with politicians.

All in all, there seem to persist leeways, actions or measures which allow the process of accumulation to go on. This, along the variety of experiences makes testing the question we posed a challenge, indeed.

## 5 Testing the limits of reserve accumulation

After reviewing the potential costs of accumulation and the three cases above, it is remarkable that the literature has taken a very limited approach to assess the costs of reserve accumulation. To be fair, most past works trying to identify the determinants of reserve holdings did try to take into account the costs of holding reserves, but they just contemplated the quasifiscal costs (usually including interest rates differentials with the Treasury rates). Therefore, the main focus of this part is to asses the other costs, mostly in the monetary sphere since the actual costs of accumulating reserves arise predominantly from the monetary implications.

We thus turn now to test whether current or prospective costs of the increase in reserves impinge on the process of accumulation. The testing strategy is not straightforward. We start by constructing a benchmark model for reserve accumulation. We proceed next to determine whether sterilization is the first measure to deal with the monetary effects of reserve accumulation. We turn finally to test whether the prospective monetary costs are a determinant of reserve accumulation.

### *5.1 Benchmark model*

In order to construct a benchmark model, we choose as dependent variable the increases in reserves –ΔNFA– and not the level of reserves, since we are interested in understanding the determinants of reserves accumulation and not of reserve adequacy, unlike most previous work. The basic benchmark equation is the following

$$\Delta NFA_{it} = \alpha + \phi' y_{it} + \eta_i + \varepsilon_{it} \quad (1)$$

where $y_{it}$ is the set of explanatory variables and $\eta_i$ are fixed effects. It should be first noted that estimating the model with fixed effect, together to the fact that the period of interest (1999-2005) is quite short, implies that variables such as, for instance, dummies for recent export-led growth policies, new precautionary motives after the financial crisis in the late 90s or scale variables (GDP) cannot be properly identified as are time invariant or display low variation over time. In the vector $y_{it}$ , we first include the lagged level of NFA to control the time-variant trend in the growth of reserves. As proxies of precautionary motives we include two variables. First, a real exchange rate index, that allows to compute the importance of more or less aggressive export-led growth policies on reserve accumulation within each country. Second, a measure of the (in)flexibility of the nominal exchange rate, that roughly controls for possible interventions to avoid appreciation. Finally, the precautionary motives are captured including, as usual, imports and short term external debt.

The results of the estimation of the model are displayed in Table III.

**Table III: Determinants of reserve accumulation: equation 1**

| DETERMINANTS OF RESERVE ACCUMULATION *(Dependent variable is ΔNFA)* | | |
|---|---|---|
| | [1] | [2] |
| **NFA(-1)** | 0.354*** | 0.378*** |
| | 0.000 | 0.000 |
| **RER** | -0.131** | -0.126** |
| | 0.044 | 0.047 |
| **Short term external debt** | 0.762*** | 0.841*** |
| | 0.000 | 0.000 |
| **NER flexibility** | -0.063 | |
| | 0.727 | |
| **Imports** | 0.083 | |
| | 0.151 | |
| **Constant** | -4.449 | -3.474 |
| | 0.499 | 0.579 |
| **Observations** | 162 | 166 |
| **Number of country** | 29 | 29 |
| **R-squared** | 0.879 | 0.874 |

*p values in parentheses*
** significant at 10%; ** significant at 5%; *** significant at 1%*

As expected, after controlling for the scale variable, conveyed in the lagged level of reserves, countries with higher holdings of short term external debt accumulate more reserves –see column [1]. The effect of the real exchange rate is negative, something that implies that the more aggressive the export-led growth strategy (the lower real exchange rate) the higher reserve accumulation. Neither imports nor the degree of flexibility of the nominal exchange rate are significant, albeit both display the expected sign. In column [2] the non-significant variables are dropped, and we will use this results as benchmark.

### *5.2 Sterilization and determinants*

Before using this benchmark model we have to assess whether central banks engage in systematic sterilization when they face an undesirable expansion of liquidity. We consider that all central banks try to avoid the undesirable expansion of liquidity, and its effects, so we would expect sterilization to be more intense the greater the monetary problems. In graph 7 we indeed saw that sterilisation rates were getting overall more intense. We start by identifying the determinants of sterilization through the estimation of equation (2):

$$\Delta NDA_{it} = \alpha + \beta \Delta NFA_{it} + \eta_i + \varepsilon_{it} \qquad (2)$$

This equation is related to the literature on sterilization, which attempts to identify the coefficient of sterilization, that is, the coefficient of ΔNFA in a regression of ΔNDA on ΔNFA and a set of controls. Here the rationale, and also the functional form, is different.

We are interested in identifying the determinants of sterilization, and in obtaining a quantitative measure of their importance, so we include interactions of the vector **x** and ΔNFA. Such vector includes lagged inflation and lagged ratio of increases in M2 to GDP. Inflation is included because the central bank is considered to be more reluctant to allow further expansions of the monetary base when the inflation is relatively high, and therefore sterilizes more on those cases. The ratio of ΔM2 to GDP is a potential explanation of reserve accumulation in two dimensions. First, it is a measure of latent risks of inflation, and central

banks with inflation targeting focus on it as a forward looking measure of inflation. Second, some central banks do not have inflation but money targets. For both reasons, central banks should be more reluctant to let the monetary base expand when the ratio of ΔM2 to GDP is high. In consequence, a high ratio should be associated with more sterilization. The reason why these variables are interacted with ΔNFA is that what makes compelling sterilization is the joint effect of potential monetary problems and high ΔNFA.

A potential problem is to obtain consistent estimators of the vector **β**, because of the endogeneity of the variables of the vector **x**, that arise from the reverse causality –reserve accumulation, unless completely sterilized leads to inflation, credit and asset booms– and from the fact that the increase of reserves depends on the ability to sterilize (a shock on the ability to sterilize would probably affect the increase in reserves, so that). $\mathrm{cov}\left(\Delta NFA_{it}, \varepsilon_{it}\right) \neq 0$ The exogeneity of the vector **x** has been preserved using lagged variables, so that $x_{it} = \left[1, \pi_{it-1}, \frac{\Delta M2_{it.1}}{GDP_{it-1}}\right]$ but, still, contemporaneous ΔNFA would remain endogenous. In order to overcome this problem, we use as instruments the lagged values of ΔNFA. All in all, if the coefficients of the vector β were negative, this would be evidence that sterilization depends on these factors in the expected way: for a given ΔNFA, the higher the inflation or ΔM2 to GDP, the more large-scale sterilization is.

Table IV displays the results of the estimation of equation (3) by within groups estimation and taking into account endogeneity with the instrumental variable discussed. Column [2] and [3] show that both inflation and growth in money aggregates are significant explanatory variables of sterilization: for a given ΔNFA, sterilization is larger the higher are inflation and growth of money aggregates.

**Table IV: Results of sterilization determinants model –equation (2)**

| DETERMINANTS OF STERILIZATION | | | |
|---|---|---|---|
| *(Dependent variable is ΔNDA)* | | | |
| | **[1]** | **[2]** | **[3]** |
| **ΔNFA** | -0.768*** | 0.437* | |
| | 0.000 | 0.080 | |
| **ΔNFA*π(-1)** | | -0.190*** | -0.133*** |
| | | 0.000 | 0.000 |
| **ΔNFA*ΔM2(-1)/GDP(-1)** | | -1.386*** | -0.910*** |
| | | 0.000 | 0.000 |
| **Constant** | 2.027*** | 1.316 | 2.147*** |
| | 0.000 | 0.134 | 0.004 |
| **Observations** | 166 | 137 | 137 |
| **Number of country** | 29 | 29 | 29 |
| **R-squared** | 0.8044 | 0.7748 | 0.8166 |

*p values in parentheses*
** significant at 10%; ** significant at 5%; *** significant at 1%*

### *5.3 Assessing the limits*

From these results it follows that, as conventional wisdom suggests, all central banks care about the monetary effects of reserve accumulation, and their first measure in order to maintain monetary policy independence is sterilization. The remaining question is whether costs of accumulating reserves are relevant explanatory variables. As explained in section 3

the costs are of two principal types –fiscal and monetary. Other costs– to the financial system, conflicts among authorities, etc, are even more difficult to measure empirically.

We include a measure for quasifiscal returns, based in the difference between the return on reserves and the domestic cost of opportunity. If these returns are positive, reserves yield a benefit, otherwise they imply a cost (see data appendix). Given this definition we would expect our measure of quasifiscal benefits/costs to display a positive sign –net fiscal benefits would be positively related to reserve accumulation, net costs would be negatively related to it. Less obvious is how to proxy the prospective monetary costs. We do not include directly any measure of (undesired) expansion of liquidity as possible deterrent of the process, because such measures are plagued with reverse causation problems. Inflation is not included either in this last equation, as their effects are taken into account through the real exchange rate. However, we have shown that the sterilization efforts are related to potential excess liquidity and inflationary pressures, conveyed in the interaction with the reserve accumulation, as shown in table IV.

This means that monetary costs may be reflected in the sterilisation effort rather than in the accumulation process itself. Therefore, the previous analysis on sterilisation sets the basis for the variables conveying monetary costs. More precisely, we consider, on the one hand, the stock of net domestic assets as a proxy of *ability* to sterilize, as all sterilization is reflected in the central bank balance sheet as a reduction in NDA, no matter whether sterilization is done through government deposits, reduction in loans to the banking system or –as usual– open market operations.[5] Thus, central banks with higher NDA are expected to be more able to accumulate more reserves, meaning a expected positive sign. We include this variable lagged, as what we expect to explain reserve accumulation at time t is NDA in the previous period, known at t-1.

On the other hand, we include a rather general proxy of the *need* to sterilise by including the moving averages of effective sterilisation, both in absolute and relative levels. In particular, we consider two variables:

- *Absolute Moving Average of sterilization (AMA need), with a two-year window:*

$AMA_{it} = \frac{\left(\Delta NDA_{it-1} + \Delta NDA_{it-2}\right)}{2}$, which is a measure of sterilization in the previous two periods.

- *Relative Moving Average of sterilisation (RMA need)*:

$RMA_{it} = \frac{\Delta NDA_{it-1} + \Delta NDA_{it-2}}{\Delta NFA_{it-1} + \Delta NFA_{it-2}}$ , which takes into account the total reserve accumulation.

In both cases a negative value of the variables indicates sterilization. We conjecture that a negative coefficient for these variables in the regression indicates that central banks

**5.** For those central banks that sterilize with open market operations and cannot issue their own notes to sterilize, NDA can be taken as a quite adequate measure of ability to sterilize. Less tight is the link between NDA and ability to sterilize in those countries where the central bank implements open market operations issuing its own debt, or thanks to government deposits.

implement sterilisation and this allows for continued accumulation of reserves. On the contrary, if the sign were positive this would evidence that previous sterilisation is limiting current accumulation, yielding complementary evidence to limits of the ability to sterilize. In other words, if the sign revealed in the regression is negative we infer that the sterilisation needs are there but they not impinge on the process of accumulation so far.

The extended model is the following:

$$\Delta NFA_{it} = \alpha + \beta' X_{it} + \gamma qf_{it} + \lambda_1 NDA_{it-1} + \lambda_2 AMA\_need_{it} + \lambda_3 RMA\_need_{it} + \upsilon_{it} \quad (3)$$

The results of the extended model are displayed in table V. Quasifiscal returns are significant when they are included in the basic model (column [1]), and display the expected sign, albeit become non-significant in the fully extended model, where we include the three proxies of prospective monetary-sterilization costs. As expected, the higher are the (lagged) NDA –the higher the ability to sterilize– the more reserves are accumulated. *AMA* and RMA are both significant and display a negative sign: the higher is sterilization in absolute terms, and relative to the growth in reserves, the more intense is reserve accumulation. This suggests that, so far, sterilisation provides extended scope for further accumulation, rather than limiting it. To sum up, the empirical evidence points to the notion that that monetary effects matter insofar as the ability to sterilize –as measured by NDA– is jeopardised, but that they are not effectively binding, since countries go on accumulating reserves by increasing sterilisation.

**Table V: Results of the estimation of the extended model –equation 3**

| DETERMINANTS OF RESERVE ACCUMULATION *(Dependent variable is DNFA)* | | | | | |
|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] |
| **NFA(-1)** | 0.383*** | 0.525*** | 0.471*** | 0.433*** | 0.438*** |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **RER** | -0.123* | -0.112* | -0.173*** | -0.115** | -0.112** |
| | 0.054 | 0.059 | 0.005 | 0.044 | 0.046 |
| **Short term external debt** | 0.851*** | 0.663*** | 0.785*** | 0.688*** | 0.672*** |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Quasifiscal results** | 0.145** | 0.074 | 0.089 | 0.054 | |
| | 0.045 | 0.284 | 0.187 | 0.382 | |
| **NDA(-1)** | | 0.269*** | 0.202*** | 0.392*** | 0.408*** |
| | | 0.000 | 0.002 | 0.000 | 0.000 |
| **RMA_need** | | | -0.023*** | -0.016** | -0.016** |
| | | | 0.004 | 0.023 | 0.025 |
| **AMA_need** | | | | -0.323*** | -0.328*** |
| | | | | 0.000 | 0.000 |
| **Constant** | -4.714 | -7.855 | -1.793 | -6.190 | -6.054 |
| | 0.456 | 0.187 | 0.770 | 0.273 | 0.275 |
| **Observations** | 162 | 162 | 162 | 162 | 166 |
| **Number of country** | 29 | 29 | 29 | 29 | 29 |
| **R-squared** | 0.878 | 0.895 | 0.902 | 0.919 | 0.918 |

*p values in parentheses*

** significant at 10%; ** significant at 5%; *** significant at 1%*

## 6 Conclusions

In this paper we have assessed, in two different ways, whether domestic costs are imposing a limit on reserve accumulation. Fiscal or quasi-fiscal costs, which have been the main focus of the literature do not seem to be of overwhelming concern in most cases, due to the environment of low global interest rates. More important seem to be the challenges within the *monetary sphere*. There, rather conventional problems are being faced, such as inflationary pressures and credit booms; difficulties to carry out proper sterilization are also issues in countries with less developed financial system. Other less known nuisances are arising, such as the potential conflict of interest with fiscal authorities (when the sterilization instruments are government paper or when the central bank paper compete with government bonds) or/and a greater dependence on governments –and thus need to coordinate– to sterilize inflows. The impact of sterilization on domestic financial stability and restructuring is also an important concern in countries with underdeveloped financial system. The case studies have highlighted the wide array of challenges reserve accumulation imposes on domestic monetary policy, and the different solutions that are being taken.

Indeed, countries seem to keep accumulating reserves with no respite, and the empirical approach taken in this paper suggests that the perceived cost have not in general impinged on the process of reserve accumulation. On the one hand, fiscal costs are not relevant in the panel. To this may have contributed, in practice, the more active reserve management carried out in recent times by central banks, in search of higher profitability and/or diversification of reserve holdings. On the other hand, the analysis of monetary costs faces some important challenges which have been addressed throughout the empirical part. We have shown that indeed, excess liquidity and inflationary pressures determine the degree of sterilisation –that is perceived monetary costs, call for a reaction of the authorities. Therefore, accumulation is not inocuous in terms of costs, but we have also shown that the policy reaction has not entailed an obstacle for the accumulation process; rather the central banks through increased sterlisation are able to manage the situation –at least in the short to medium run– since we have not found that higher sterilisation is associated to limits to reserve accumulation.

Thus, at this stage, central banks are able to contain the monetary costs of reserve accumulation through sterilization and without resorting to a change of policy. This does not mean that the concern about the consequences –and, therefore, the degree of sterilization, has increased over time. The reason is probably that the final goal of reserve accumulation– increasingly identified with exchange rate management– is of overwhelming importance, so that, before changing this overriding goal a wide battery of policy measures –sterilisation, alternative investments and, eventually in some countries, capital controls, credit ceilings, price controls are being instrumented to limit the arising costs and to maintain the process. Looking forward, the perceived scope to manage increases in reserves, does not point at drastic changes in policies, but, if anything to a very gradual shift.

## ANNEX. THREE CASE STUDIES: CHINA, RUSSIA, ARGENTINA

In this annex three cases are described. Each focuses on how the central bank has managed to deal with the associated potential problems, and with the domestic consequences of reserve accumulation.

### A. CHINA: Exchange Rate Undervaluation and Overheating

#### Description

In 2001, just before its accession to the World Trade Organization (WTO), China's international assets represented 169 billions. In contrast, China has currently become the top holder of international reserves and it has by 2006 surpassed the trillion dollars of reserve holdings nearly six times higher than in 2001, and one fifth of the world total. After growing smoothly from 1998, the pace of the reserve accumulation process fostered in 2001 when the negotiations with the WTO were near to end and, and since when the effective real exchange rate began to depreciate. The acceleration of reserve holding reached a peak in November 2003, when the first signals of economic overheating arose. Between 2004 and 2006, the holdings increased by 550 billions US $ (graph A.1, panel 1) and the pace of the accumulation remained very high within a range of 30-50%, boosted mainly by trade flows due to the discretional capital controls (graph A.1, panel 2).

#### Drivers

Because of the size of the reserve holdings and the persistence of accumulation, it is widely recognized this phenomena is closely related to China's exchange rate policy and the well-known and increasing renminbi undervaluation in real effective terms[6]. Over the last decade, the exchange rate of the renminbi, although theoretically flexible, has been closely tied to the dollar. As a result, the Chinese currency underwent significant depreciations in real effective terms during the period from end-2001 to 2004. In 2005, the Chinese authorities took successive steps to reform the exchange rate regime, which highlights the renminbi revaluation against the dollar by 2.1% and the formal pegged to a basket of currencies. These reforms had the effect of reversing the renminbi's depreciation and, between December 2004 and August 2006, the currency appreciated 3.8% against the dollar and 7% in real effective terms over this period and the pace of reserve accumulation slowed from 52% to 30% year-over-year. From a broader perspective, however, in real effective terms the renminbi still depreciated by 3.7% compared with 2001.

#### Consequences and policy response

In the past three years, the export led strategy and the consequent reserve accumulation has caused a substantial and growing liquidity in the economy (graph A.1, panel 3). In 2004, the loose monetary conditions fed overinvestment in certain sectors, a residential price bubble in high growth cities and a substantial rise in inflation, fuelling a more generalized overheating of the economy like the one in the early 1990s. The associated rapid growth in bank credit also raised the spectre of substantial wave of nonperforming loans (NPLs) in the mid-term, adding to the large stock of existing NPLs. When the problem was identified, the Central Government

**6.** A number of indications lend weight to this view, namely the substantial dynamism of the Chinese economy, export growth, its growing trade surplus, the increase in its share of international markets and its massive accumulation of foreign reserves.

settled a series of administrative controls to contain investment. The People's Bank of China (PBC), the central bank, increased interest rates, reserve requirement and began to sterilize the rise in net foreign assets (graph A.1, panels 1 and 3). Nonetheless, these efforts to cool the economy through administrative controls on lending and property investment reached limited success: the series of tightening measures slowed the pace of investment growth, although it remained high and substantial liquidity persisted in the banking system. In 2005, the central bank continued with the sterilization operations in the inter-bank market through open market operations (OMOs) and the issuance of central bank bills (C-bills) in a regular basis (graph A.1, panel 4). In the second quarter of 2006, new signs of overheating arose: investment, credit and monetary aggregates grew at very fast pace. Monetary policy responded with a further tightening in order to avoid that a continued rise in credit growth would fuel a further increase in investment growth and affect financial stability in the medium term. Thus, on one hand, it increased the reference rate on loans twice in 54 basic points and on deposits in 27bp. On the other hand, it intensified OMOs by accelerating the issuance of C-bills and raising the reserve requirement in order to sterilize the raise in reserves, which leaded an increase the interest rate in the inter-bank market in 110 basic points in the last year.

**Perceived problems**

In addition to other pernicious effects of the China's exchange rate export-led policy, the accumulation of reserves inherent in this strategy has important domestic consequences. First, instead of contributing to fostering investment or, especially, consumption, or to the repayment of external debt, it is channelling a portion of domestic savings abroad. Second, as previously seen, the growth in foreign assets also is creating problems for the operation of monetary policy, as the assets have to be sterilised, at least partially, to prevent excess liquidity and credit expansion will boost investment generating overcapacity, feed inflation of consumer prices or asset price bubbles and, in the medium term, exacerbate the problem of NPLs. Third, sterilization's operations have increased interest rates in the inter-bank market, which could be translated to public debt market –introducing fiscal costs– or, even, to the rest of securities –crowding-out investment–. Moreover, sterilization operations could lower even more the commercial bank's profitability. In fact, commercial banks' balance sheet structure have changed recently, in 2005 loans represented 52% of the assets, 8 points less than in 2001, reflecting the increase of their acquisition of sterilization instruments[7]. Then, the efforts to set up a commercially driven, profitable, efficient and solvent banking system could be jeopardized. Moreover, the economic authorities' attempts to restrain indirectly bank lending also contradicts the government's goal of creating a sound banking sector. Fourth, other reserve accumulation costs that affect a central bank's balance sheet, such as foreign exchange risk or interest rate risk, should not be forgotten either because of they can affect the conduction of monetary an exchange rate policy.

Nonetheless, the Chinese economy shows some peculiarities that alleviated some of the adverse domestic consequences, or even helped to mitigate some mounting problems. This was the case with the usage, between 2003 and 2005, of part of reserves has been to strengthen the capital base of the banking system through the injection of 60 billion US $ into the three of the four major state commercial banks[8] that, by the moment, cannot be

**7.** There is a substantial gap between the reference rate on loans (1 year: 6.11%) and the current C-bills return (around 2.2%), that obviously could affect the overall profitability of commercial banks.

**8.** Thus, in December 2003, two capital injections of 22.5 billion US $ each were to the China Construction Bank and Bank of China and, in April 2005, 15 billion US $ to the Industrial Commercial Bank.

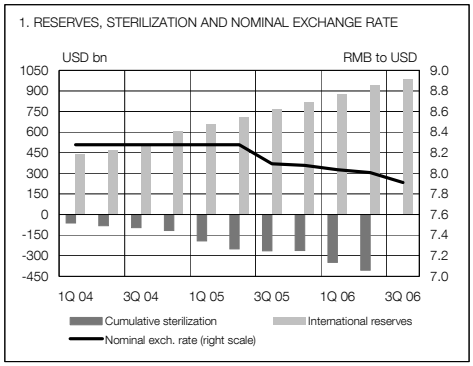
converted into RMB. Additionally, this increased the scope for further accumulation. Furthermore, the discretional use of controls on capital inflows and outflows in order to diminish the accumulation of reserves and provide some room for manoeuvre for monetary policy, such as the recently introduced Qualified Domestic Institutional Investor (QDII) scheme which softens capital outflows, although the effectiveness of capital controls inevitably erodes over time as domestic and international investors find channels to evade them. The underdeveloped financial markets has allowed the interest rates increases in the inter-bank not to move to other securities alleviating fiscal costs or crowding-out investment; also, the high degree of intervention of the public authorities in the economy through moral suasion and administrative controls has constrained credit, investment and prices in certain sectors. Nonetheless, this reliance in non-standard instruments will have to diminish as the increasing sophistication of the economy reduces their effectiveness and raises the cost of the distortions that they create.

On the other hand, China's foreign assets accumulation has also had global repercussions. The accumulation of reserves, mostly in the form of dollar-denominated assets, could have contributed to the reduction in the US long term interest rates and to finance the growing US current account and fiscal deficit. A sudden change in China's policy of accumulating reserves –which already account for roughly one-fifth of the world total– could well have an impact on global financial stability.

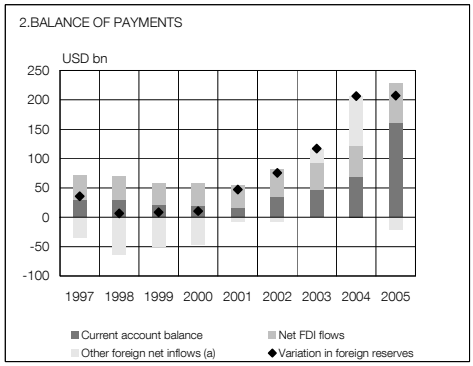
**Assessment**

The current process of reserve accumulation is not sustainable forever as its costs will overcome the benefits. To date, China has incentives to maintain artificially an undervalued renminbi to promote the export sector and, then, smooth some domestic imbalances, such as regional and wealth inequalities, and the job losses resulting from the restructuring of state-owned enterprises. Moreover, the weakness of the financial system will impede a greater flexibility of capital controls discouraged a greater flexibility of the exchange rate. Therefore, in the mid term, it is likely that the current undervaluation of the renminbi will be maintained to some extent and, consequently, the international assets accumulation. Nonetheless, the aforementioned internal and external costs of this will probably increase, feeding the already growing pressures of the international community to China so as to make him play a bigger role in the reduction of the global imbalances through a higher renminbi's flexibility. Therefore, it is likely greater exchange rate flexibility and a reduction of the reserve accumulation process, which would benefit not only to China but also the rest of the world.

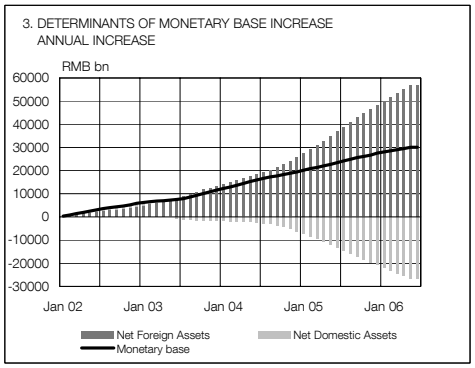
**CHINA: INTERNATIONAL RESERVES AND MONETARY EFFECTS** GRAPH A.1



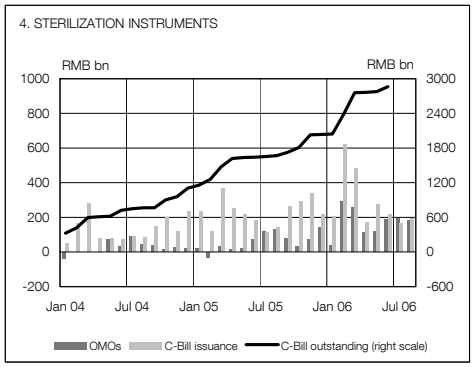

SOURCE: People's Bank of China.




SOURCE: People's Bank of China.
(a) Includes net inflows in portfolio investment, other investment and error and omissions.




SOURCE: People's Bank of China.




SOURCE: People's Bank of China.

## B. RUSSIA: Dealing with the Mixed Blessed of Oil prices

### Description of the process

Russia's international reserves were 27.9 billions of US $ in 2000 (9.5% GDP). Since then, they have risen at a fast pace, reaching 265 billions of US $ in August 2006 (23% GDP). Together to this increase in international reserves, Russia's wealth has expanded through the constitution and growth of an oil stabilization fund. The fund, kept in rubles at an account at the Central Bank, was established in 2004 and it has grown steadily reaching the equivalent of more than 66 billion US $ in August 2006. During the second quarter of 2006, nearly 20 billion US $ of the stabilization fund have been converted into foreign currency and kept in a Federal Treasury Account in the Central Bank[9].

### Drivers

The key factor in the growth of the foreign assets of the central bank has been the increase in oil prices. The price of oil was over 30 US $/bbl at the beginning of 2000, and has risen steadily since then reaching 70 US $/bbl, in the second quarter of 2006. This oil boom has generated a wide trade and current account surplus, and it has flooded the economy with foreign currency, putting upward pressure on the exchange rate. Given the commitment of the Central Bank towards maintaining a managed floating exchange rate with the US $, the

**9.** Although we are not sure about whether the foreign currency has been purchased from the central bank's international reserves or from the foreign exchange market, the idea was to implement this measure through purchases of international reserves, and we tend to think this has been the case. The following discussion builds on that assumption.

Central Bank has intervened in the foreign exchange market acquiring US $ in order to avoid the appreciation of the ruble, this way accumulating reserves[10].

The parallel build-up of the stabilization fund is also closely linked to oil prices. Although oil companies are private, the state has established different taxes on oil, among which it is worth mentioning the tax on the extraction of oil, and a progressive tax on oil revenues when the price exceeds a given threshold –established on 27 $US barrel. These fiscal revenues have been huge and a fraction of them are placed in the Stabilization Fund in order to smooth the government revenues. The taxes on oil revenues are paid in rubles so the resources of the Stabilization Fund are also held in domestic currency. To sum up, the upward trend in oil prices has contributed to the accumulation of international reserves by the central bank and to the constitution of a Stabilization Fund, increasing the wealth of Russia's public sector and reducing (if not eliminating) its vulnerability towards sudden stops of capitals.

**Monetary effects of the process**

The impact of higher reserves on the monetary base has been limited. Sterilization of the increases in liquidity through market instruments would be difficult in Russia, as local bond markets are not well developed and neither central bank paper, nor government debt can be used in large scale sterilization. Interestingly, the Stabilization Fund has become the central sterilizing device. It is a central bank liability in domestic currency and its parallel growth with reserves implies that it actually sterilises the growth in reserves, limiting the expansion of the monetary base. The volume of the Stabilization Fund at June 2006 was 1,800 billion rubles, a substantial magnitude relative to the monetary base, as panel 2 of graph shows. The strong economic growth associated to the favourable oil cycle allows to absorb the additional liquidity of the system, and so far although inflation remains high for current international standard (13% in 2005), it has been kept under control.

**Perceived problems**

The ad hoc nature of the stabilization fund and the limited potential for alternative massive sterilization is a potential problem. The large quantities of money kept idle in the Stabilization Funds have raised political pressures to use them for other purposes, either to spend or to invest. The monetary consequences of the mobilization of the resources of the fund would differ depending on the kind of use attached to the resources. Given the scale of the fund spending these resources in consumption would fuel inflationary pressures, both through its impact on demand, and through the flooding of liquidity into the economy. If, on the contrary, the resources of the Fund were invested, their impact would differ depending on whether they were invested within Russia or outside Russia. If the resources are invested domestically –either in physical capital or assets– there will be an increase in the money in circulation, and at the same time the investment may contribute to the generation of financial bubbles. Given the shallowness of the domestic financial system, it may also entail risks for financial stability. On the contrary, if the fund is invested in foreign assets –in search for profitability– *and* the foreign assets are purchased from the central bank –that is, if the government buys international reserves with the resources of the fund– the operation does not change the consolidated public sector debt, nor does have impact on inflation or the domestic financial

**10.** The central bank is also intervening on the euro/ruble exchange rate.

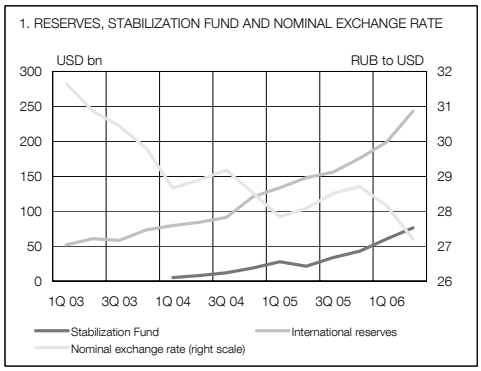
markets. As a matter of fact, it would imply a reduction in the central bank balance sheet, letting more leeway for further interventions.

The recent investment of resources from the stabilization funds in foreign investment has followed these lines, therefore overcoming the inflationary effects of the expenditure of the funds within the domestic economy. However, the political pressures entailing this situation and the discretion of the 'de facto' government in the management of the fund, implies a potential risk for the joint achievement of monetary policy and exchange rate goals. Given the paramount importance given to the exchange rate level –in order to avoid competitiveness losses in non-energy (oil and gas) sectors (Dutch disease effects), it is unlikely that the Central Bank let the exchange rate appreciate. The loss or downsizing of the stabilization fund as sterilization device has thus the potential to generate a severe inflationary problem.

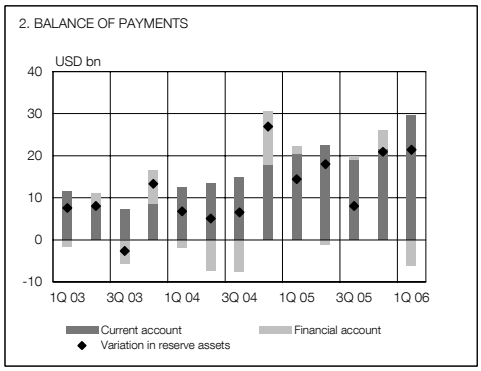
**Assessment**

The Russian case highlights the monetary management problems arising from an oil boom in a large exporter. The underdevelopment of the financial system difficults traditional sterilization devices, but an unorthodox instrument, also derived from the oil booms, helps to mitigate the problem. Since the management of this Fund is in the hands of the government, there is a clear subordination of the monetary policy management to the fiscal authority decision, putting the central bank in a weak position to achieve autonomously its monetary policy objectives.

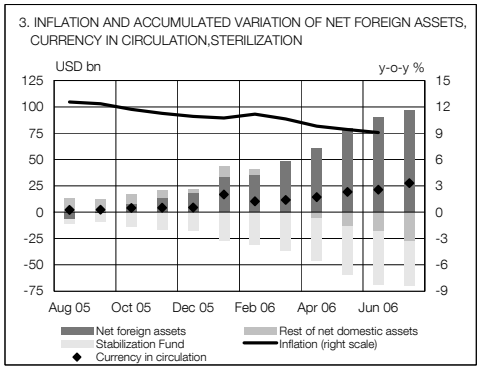
**RUSSIA: INTERNATIONAL RESERVES AND MONETARY EFFECTS** GRAPH A.2



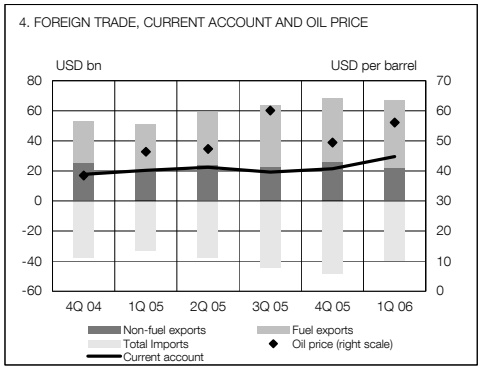

SOURCE: International Monetary Fund (International Financial Statistics) and Ministry of Finance of the Russian Federation.




SOURCE: International Monetary Fund (International Financial Statistics).




SOURCE: International Monetary Fund (International Financial Statistics), Central Bank and Ministry of Finance of the Russian Federation.




SOURCE: Central Bank of the Russian Federation.

## C. ARGENTINA: reserve accumulation and inflationary pressures

### Description of the process

During the severe crisis of 2001-2002, –which implied a sovereign default, the compulsory dedollarization of the economy, a deep banking crisis and an extreme economic depression– the international reserves of Argentina dropped to 10 billion US $, and the exchange rate experienced a substantial depreciation. Soon after, Argentina started to accumulate reserves at a rapid pace, so they reached the pre-crisis levels during the first half of 2005, and arrived to more than 28 billion dollars at the end of that year. As panel 1 in graph A.3 shows, international reserves dropped to 18 billion US $ in January after Argentina used 9.5 billion of US $ to repay the outstanding debt with the IMF, but by the end of the summer they already surpassed the holdings of the end of 2005.

### Drivers

The accumulation of foreign reserves by Argentina can be attributed to two reasons: the objective of maintaining the exchange rate at a competitive level, i.e., by offsetting the strong appreciation pressures on the peso, and the replenishment of reserve holdings after the crisis in order to the reduce financial vulnerability.

It is not easy to disentangle the importance of each reason on the interventions of the central bank. At the beginning of the process, the low level of the international reserves called for a rebuilding of the stock of reserves. The reduction of vulnerability has been achieved not only directly (by building up a buffer against sudden stops of capitals), but also indirectly, through their use to pay back external debt. The biggest of the operation took place in January of 2006, when the central bank repaid the 9.5 billion outstanding debt with the IMF. As a matter of fact, the IMF loan was deposited as reserves in the Central Bank and as a counterpart the liability side of the CB was increased by the same amount but, without a comfort level of autonomous reserves, Argentina would not have been able to implement this measure. The impact of the repayment can be seen in graph A.3. It implied a fall in reserves (panel 1) a strong reversal in the financial account (panel 2), but no impact on the net foreign assets (panel 3). Furthermore, the cost of the loan was higher than other internal credit to the government, so there was not only a reduction in external debt but also of the debt burden[11].

Notwithstanding the importance of these precautionary motives, it soon became evident that they could not explain by itself the size of the dollar purchases, and that there was a tacit policy objective of targeting the exchange rate at around 3 ARS/US $. By maintaining the nominal exchange rate undervalued with respect to the market exchange rate (and as long as inflation is relatively contained), the real exchange rate remains competitive with respect to its main trade partners. Thus, the exchange rate policy is supporting a remarkable and persistent current account surplus that, together to the financial account surplus, matches statistically the increase in reserves, as panel 2 of graph A.3 shows. The exchange rate policy is also having important fiscal effects. The trade-related tax revenues are collected in ARS pesos, so the combination of an undervalued exchange rate and high export revenues leads to important fiscal revenues. In fact, although these taxes are causing important distortions on

**11.** However, this use of reserves is not free of problems. The pay back deprives the authorities in Argentina from a discipline anchor (indeed, the desire to feel free of the IMF's surveillance is often considered the underlying motive of the operation). Moreover, the central bank dependence of the government has increased through the decree enacted to allow the operation. All together, the operation provides more room for interventions in support of the exchange rate.

the economy, their contribution to total revenues is substantial, as they accounted in 2005 to 10.1% of the total public sector revenues (2.3% of GDP), representing a 88.5% of the primary balance.

**Monetary effects**

The large purchases of dollars to maintain the nominal exchange rate are generating increasing difficulties in the management of domestic monetary policy. Panel 3 of graph A.3 shows how the increases in reserves are the main source of creation of monetary base, and, even if at the beginning of the process only a small fraction of increases of reserves were sterilized, the importance attached to preventing monetary base expansions –sterilization– has increased substantially since 2004. However, the monetary conditions, as the negative real interest rates show, are quite loose in spite of the inflationary pressures.

The central bank is partially offsetting the expansion of liquidity through different instruments, of which the issuance of central bank bonds (LEBAC and NOBAC) has been the main one (as shown in panel 4 of graph A.3). The situation of financial rebuilding of Argentina makes difficult an assessment of the impact of this large-scale issuance of this paper on interest rates, since very different developments converge nowadays (for example, change of instruments, banking sector refurbishing, large liquidity, etc). However, it seems that there is no such upward pressure on interest rates, given that the banking sector is showing an important appetite for these assets. Rather than helpful, this may be a further obstacle for the management of monetary policy, since the transmission mechanism is being quite disturbed and the monetary authorities, even when they may control liquidity, have no clear levers to influence directly on the interest rates. An often neglected problem of sterilization through bonds, which could be relevant in Argentina, is that the sterilization is only temporary. In other words, when the maturity of the sterilization bonds arrives, new bonds have to be issued to avoid the expansion of liquidity arising from the face value of the bonds and their interests. Therefore, sterilization through bonds entails a potential rollover problem that could eventually lead to an expansion of liquidity[12].

The second instrument used to drain liquidity has been the repayment of the loans (rediscount lines) given to the commercial banking system during the 2001-2002 crises, which are also displayed in graph A.3, panel 4. Through these repayments 13 billion pesos have been sterilized, and at the same time commercial banks balance sheets have been tidied up.

Moreover, in the last few months, there has been an increase in government deposits on the central bank, that, although could be withdrawn from the central bank, temporary offset the expansion of the monetary base. However, it cannot be argued that the government is purposefully sterilizing through this mechanism (as it happens in Russia with the stabilization fund).

**12.** However, this use of reserves is not free of problems. The pay back has been considered dangerous as once the requirements of the IMF are no longer in force it provides more room of manoeuvre for the government (indeed, the desire to feel free of the IMF's surveillance is often considered the underlying motive of the operation). Moreover, the central bank dependence of the government has increased through the decree enacted to allow the operation. All together, the operation provides more room for interventions in support of the exchange rate, a policy which is, as we discuss later, plenty of problems.

**Perceived problems**

Together to the problems arising from sterilization (discussed in the previous point), the process is creating a wide range of problems. The most evident is the fact that expansion of liquidity arising from the partial sterilization is feeding into inflationary pressures. Given the limitations of monetary policy both in priorities –the exchange rate controls seem to be the paramount objective–, and instruments –the transmission mechanism is much distorted and the ability to control inflationary pressures of the central bank jeopardised–, alternative tools have been in place to control the inflationary pressures. These tools consist of compulsory price controls, moral suasion and regulated prices not responding to the increase of shocks. Indeed, these unorthodox measures have temporarily stabilised inflation around 10%, a high level that, however, seems within the tolerable range. However, inflationary pressures remain latent and price controls are distorting the price assignment mechanism in different ways, this way causing substantial inefficiencies in the economy.

Looking ahead, however, the margin of manoeuvre to go on sterilizing is being reduced. The fact that the central bank cannot rely on the remaining 8.9 billion loans to the commercial banking system to sterilize, so this sterilization instrument seems a bit exhausted as the debtor banks do not seem to have the financial soundness to repay in advance. Furthermore, there is a limit on the amount that banks can accommodate central bank paper. Probably, this limit has been widened with the law which limit government paper to the banks to 40% of their assets, but in any case, the magnitudes which they already hold are huge, and the rollover problem applies. Therefore, as it has happened during the first quarter of 2006 (see graph A.3, panel 4), future sterilization will have to be done through open market operations, so it will probably become more difficult and costly.

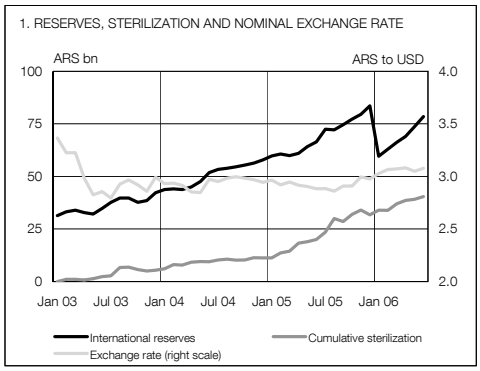
A cause of greater concern is how the interaction between central banks and government objectives affect the former's autonomy. Monetary policy is not only subordinated to the exchange rate, but the sterilization needs may eventually put pressure on the interest rates on the whole range of instruments, including government bonds. This is a potential source of conflicts between both institutions.

Finally, although it is fair to mention that, with all its drawbacks, ample liquidity conditions have allowed a gradual recomposition of the banks balance sheets and a recovery of their activity with reduced costs, the distortions on the balance sheets of banks may generate financial stability problems in the medium term.

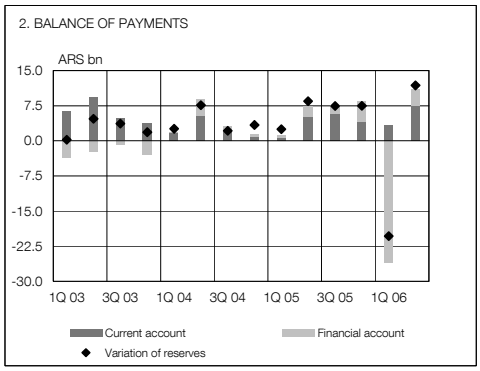
**Assessment**

To sum up, domestic monetary policy in Argentina is subordinated to the exchange rate target implicitly determined by the government. The main operational goal of the central bank now is to manage the process of reserve accumulation through sterilization to avoid feeding further into inflationary pressures. Control of inflation is being carried out mostly through administrative measures which reinforce the interventionist drive of the economy in other sector. Given the strong reliance of fiscal revenues and continued growth on a competitive exchange rate, a voluntary change of strategy –allowing a more appreciated exchange rate and a halt in the accumulation process– is not envisaged in the short run. Rather, if the inflationary pressures continue and the current monetary strategy is pushed to its limits, an strengthening of the administrative controls and a further drift towards interventionist policies is granted in the medium run.

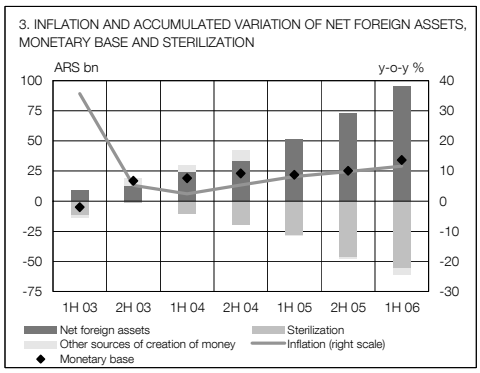
## ARGENTINA: RESERVE ACCUMULATION AND ITS CONSEQUENCES GRAPH A.3



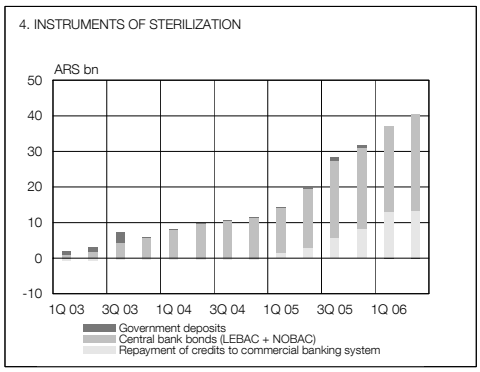

SOURCE: Central Bank of Argentina.




SOURCE: Ministry of Economy and Production of Argentina.




SOURCE: International Monetary Fund (IFS) and Central Bank of Argentina.




SOURCE: Central Bank of Argentina.

## DATA APPENDIX

### a. Sample

Our sample contains yearly observations for 29 emerging economies[13] during the period 1999-2005. We drop from the sample several observations in which there was a sudden reduction in NFA, so that we have, at the end, 166 observations.

### b. Variables

- **Net foreign assets (NFA) and Net international reserves (NIR):** foreign assets minus foreign liabilities, from the central bank balance sheet obtained from IFS-IMF.

- **Net Domestic Assets (NDA):** Data on NDA is obtained using the identity M=NDA+NFA and the data on monetary base from the central bank balance sheet, from IFS-IMF.

- **GDP:** When possible, real GDP has been obtained from IFS (line 99b). In some countries the information has been obtained from other sources. These are:

    - Brazil, Chipre, India and Venezuela: Datastream
    - China: constructed from the Asia Regional Information Center.
    - Rusia: measured in domestic currency. Obtained from Datastream for the period 2003Q1 a 2005Q4, and own estimation for 1999Q1 y 2002Q4.

- **Nominal interest rates:** When possible, we have used the overnight interest rate (IFS, line 60b). The exceptions are the following: China, one week repo (CEIC); Egypt, Hungary and Israel, Treasury interest rate; India and Peru: Datastream.

- **Inflation:** CPI y-o-y inflation, obtained from IFS (line 64). In China, we have used CPI inflation obtained from CEIC for the period 2001Q1-2005Q4, and our estimation based on the reconstruction of the index for the period 987Q1-2001Q4, using the CEIC data and the rates of interannual variation of IFS.

- **Nominal exchange rate:** Quarterly nominal exchange rate measured in US $, obtained from IFS (line AH).

- **M2:** IFS.

- **Imports:** IFS

- **Short term external debt:** Institute of International Finance database, code D203.

- **NER flexibility**: coefficient of variation of the nominal exchange rate (standard deviation of the nominal exchange rate standardized by the average nominal exchange rate), with monthly data.

- **Quasifiscal results**: using the nominal interest rates and NDA, NFA described above, quasifiscal results are defined as

$$QF_{it} = \frac{irate_{it-1} * NDA_{it-1} + ieeuu_{it-1} * NFA_{it-1}}{NDA_{it-1} + NFA_{it-1}}$$

- **RER index**: weighted RER using bilateral nominal exchange rates and trade flows, and inflation, obtained from JP Morgan database.

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**13.** These are: Algeria, Argentina, Brazil, Chile, China, Colombia, Croatia, Cyprus, Czech Republic, Egypt, Hungary, Iceland, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey, Venezuela.

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