Should a Central Bank Transfer its Profits to the Treasury?*

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Abstract

In this paper we show how two seemingly irrelevant accounting principles for central banks –the choice of the unit of account for its balance sheet and the method of inventory valuation of foreign currency reserves– can overstate or understate profits transferred to the treasury and how this can threaten the ability of central banks to control inflation. We show the first point through Monte Carlo experiments calibrated for the Venezuelan economy and the second point in an infinitely lived representative agent model that illustrates the problem of the joint determination of the level of central bank assets and the size of profits transferred to the treasury when the objective of the central bank is to eliminate the possibility of a hyperinflation.

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1 Introduction

There is a growing body of literature that explores the relationship between the financial strength of central banks and their ability to attain price stability. That this link exists is not obvious: since central banks have the monopoly to issue base money at virtually no cost and benefit from seignorage revenues, in theory, their profitability, net worth and financial strength should not affect the ability of central banks to attain their monetary policy objectives (Stella (2005)). Recent evidence, however, suggests that this may not be the case. Ize (2005) shows that there is a threshold level of capital for central banks consistent with a credible inflation target, which depends, among other things, on the level of international reserves, operating expenditures and the inflation target. Ize (2007) shows that central banks with negative structural profits tend to be associated with higher inflation rates to a greater extent than central banks with positive structural profits that accumulate capital. Despite their negative structural profits, financially weaker banks transfer as much as central banks with positive structural profits. Using data for 15 Latin American and Caribbean countries, Kluh and Stella (2008) provide econometric evidence indicative of a negative correlation between inflation and central bank financial strength. Adler et al. (2012) find that central bank financial strength can explain large interest rate deviations from the optimal rule, thus affecting monetary policy effectiveness, using data from a sample of 41 economies. Benecka et al. (2012) also find a statistically significant and potentially non-linear negative relationship between several measures of central bank financial strength and inflation, although the link appears weaker and less robust when compared to other studies.

There are a number of reasons why the balance sheet of a central bank may deteriorate, such as the absorption of problem assets from the banking sector to deal with systemic crises, the need to collect the excess liquidity issued to address the systemic crisis through costly debt securities, quasi-fiscal losses related to fiscal dominance and, in recent years, deficient reserves accumulation. Excessive transfers of profits to the Treasury because of improper accounting practices may also be an important reason.

Ize (2007) stresses that governance matters are relevant since financially weaker central banks may be transferring profits they don't even have, a circumstance made possible by accounting practices that allow transfers of unrealized valuation gains on their international

reserves, without benefiting from transfers in the opposite direction.[1] Schwarz et al. (2014) simulate the financial results for the European central bank (ECB) under alternative accounting, profit distribution and loss coverage rules; the Eurosystem accounting framework and the International Financial Reporting Standards (IFRS). They find that, under IFRS, profits and profit distribution would have been higher and more volatile, and the financial buffers substantially lower. This is largely due to the treatment of unrealized gains and losses and the build-up of risk provision funds under the ECB framework.[2]

In this paper we address two related issues. The first one is how the choice of the unit of account for central bank accounting purposes (the numeraire) and of the method of inventory valuation can affect the computed profits for Central Banks. The second one is whether these profits should be transferred to the Treasury and, strongly linked to this, what level of real assets (mostly held in the form of foreign currency reserves) should a central bank hold in order to keep inflation under control.

Two questions naturally arise when considering the matter of numeraire choice in a macroeconomic model. The first one is whether model predictions depend on the choice of the numeraire. Economic theory suggests that, in the presence of market imperfections, results may not be neutral to the choice of the numeraire. For example, Gabszewicz and Vial (1972) find that alternative choices for numeraire entail large differences in real effects in models with imperfect competition.[3] Likewise, in the presence of uncertainty and incomplete markets, the equilibrium allocation may also depend on the numeraire choice.[4] The second one is whether the choice of the numeraire has quantitative implications that affect policy design. For instance, it matters for computing GDP growth.[5] It is also important in cost-

[1] The situation is different for financially stronger central banks, where valuation gains and losses account for 0.81 of the variance of retained profits, compared to 0.45 for financially weaker central banks.

[2] Under the Eurosystem accounting framework the treatment of unrealized results is asymmetric. Unrealized gains are transferred to a revaluation account, while unrealized losses affect the profit and loss account if they surpass revaluation account balances. Moreover, unrealized gains are not protected from distribution under the IFRS.

[3] Along these lines, Srinivasan and Kletzer (1994) argue that the predictions of the Dixit-Stiglitz model of international trade are sensitive to issues regarding numeraire choice. This is so because while "changing the numeraire has no effect on Walrasian equilibria -since the objective function for profit-maximization firms is unaffected if all prices are taken as given- changing price normalization typically lead price-setting firms to choose different production plans."

[4] See Flemming et al. (1977) and Eichberger and Harper (1997)

[5] To wit: "between the periods 2013-15 Eurozone GDP dropped 14% in US dollar terms but rose 2.7% in euro terms". See Obstfeld et al. (2015).

benefit analysis as suggested in Brekke (1997)[6] or when testing hypothesis like the PPP, the Law of Demand, or the Weak Axiom, as found in Papell and Theodoridis (2001), Zambrano and Vogelsang (2000) and Nachbar (2002), respectively.

This literature then suggests that a seemingly irrelevant issue, the choice of numeraire, may be crucial for the design of adequate profit transfer rules for central banks. Large positive profits under a certain numeraire may actually be zero or negative with a different one. Interestingly, this issue has not received much attention in the literature, so our paper is a contribution in this regard. In particular, we compare profit calculations when using local currency as numeraire, the standard approach, to those when using CPI baskets, arguably the *proper* numeraire. The analysis is carried out for the three well-known inventory valuation methods namely: first in first out (FIFO), last in first out (LIFO) and, the weighed average method. The analysis is based on Monte Carlo simulations calibrated to fit the Venezuelan economy to highlight the large differences stemming from different choices of numeraire and inventory valuation methods on the computation of central bank profits. We find that the improper choice of numeraire and inventory methods may lead to large profit transfers and a critical deterioration of the bank's net worth.

We then connect the issue of a central bank's net worth and its capacity to attain its inflation goals. To that end, we extend an infinitely-lived representative agent model developed by Sims (2005)) and show that there is a minimum level of initial real reserves in excess to real money holdings that allows the central bank to avoid an explosive price dynamic. The larger the profit transfers to the treasury, the less likely the central bank is to attain positive net worth and credibly avoid price instability. Our analysis suggests that overestimation of profits of the size found in the Monte Carlo simulations would require a very large increase in the required level of real reserves.

An important lesson that can be drawn from the analysis is that the magnitude of profit transfers and the level of real reserves should be jointly determined. In particular, there is a *critical* level of real reserves that eliminates the technical feasibility of a hyperinflationary crisis. When foreign currency sales, or the sale of other assets, drive real reserves below such critical level, central bank profits should not be transferred because they are necessary to avoid an erosion of the net worth of the central bank that could impede attaining price

[6]The author argues that when valuing public goods, the choice of money as numeraire is systematically favorable to those who value money the least, relative to alternative numeraires.

stability. On the other hand, when reserves are above the critical level, central bank profits can safely be transferred to the treasury without undermining price stability.

The rest of the paper is organized as follows. The next section discusses accounting frameworks used by central banks internationally. The third section presents a discussion of the impact of the numeraire choice and inventory valuation methods on the computation of central bank profits. We illustrate this with Monte Carlo experiments calibrated for the Venezuelan economy. In section 4 we develop a model to examine the connections between price stability, transfer of profits to the treasury and the desired level of real reserves. We present our conclusions in section 5.

2 Accounting principles and central banking

We present next a brief summary of central banks' accounting practices worldwide, with emphasis on Latin American countries. Our main goal here is to identify valuation changes practices–whether such changes are recognized as income or not, the size of transfers to the treasury, loss coverage procedures, and foreign reserves related practices. We take advantage of some recent surveys. In particular, we use the European central bank survey (ECB),[7] the KPMG survey,[8] and, to provide the Latin American perspective, the CEMLA survey.[9]

One must begin with a clarification: there is not such a thing as an accounting standard for central banks. In fact, there is a vast heterogeneity in terms of the accounting principles they employ. In general, central banks tend to apply a combination of principles which usually comes from four types of sources: (1) International Financial Report Standards (IFRS), (2) nationally Generally Accepted Account Principles (GAAP), (3) central bank specific rules and, (4) the Eurosystem in central banks of the European Union. As reported in the CEMLA survey, central banks in Latin America seem to partially follow either International

[7]To the best of our knowledge it is one of the most comprehensive surveys covering 57 central banks worldwide. The survey includes 8 central banks form Latin America: Brazil, Chile, Costa Rica, Dominican Republic, Guatemala, Mexico, Peru and Uruguay. See Bunea et al. (2016) for a more detailed analysis of this survey.

[8]This survey covers 18 central banks, including Australia, Brazil, Bulgaria, Canada, Chile, England, France, Germany, Israel, Kenya, Mauritius, New Zealand, Russia, South Africa, Swiss and the Federal Reserve Bank of the United States. See KPMG (2012).

[9]This survey was carried out between February and April of 2012. The central banks providing information were from: Argentina, Bolivia, Brazil, Costa Rica, Chile, Colombia, EL Salvador, Spain, Guatemala, Honduras, Mexico, Peru, Dominican Republic and Uruguay. See CEMLA (2012).

Financial Reporting Standard (IFRS) or local Financial Reporting Standards (GAAP) together with either internally defined central-bank-specific principles, or as determined by the financial sector supervising authority. Despite this variability/flexibility, the use of IFRS is extensive: 12 out of 16 surveyed banks report to partially follow it. Similar results are found in the KPMG survey, where more than half of banks adopt IFRS or a financial reporting framework based on IFRS, while the remaining reported the use of local GAAP or their own specific legislation. Finally, the ECB survey reports that 21% of banks fully adopt IFRS while 25% partially adopt it; 40% follow the euro-system (given the large sample of European banks), 10% adopt GAAP, and 5% use their own regulation.

Regarding the valuation of assets and liabilities and the treatment of valuation gains and losses, there are three approaches (See Archer and Moser-Boehm (2013)). One approach is to measure assets and liabilities at "fair value" and to recognize valuation changes as revenues as reflected in the Profit and Loss (P&L) statement. In other words, under this "income approach" realized and unrealized valuation gains are incorporated in the (P&L) statement. Alternatively, assets and liabilities may be measured at fair value, but only accrued and realized gains and losses are included in the P&L statement. Under this second approach, unrealized valuation changes are recorded either (i) directly in a revaluation account (balance sheet items that effectively constitutes part of equity), or (ii) as "other comprehensive income," which goes into the reporting entity's equity. Finally, in the third approach, assets and liabilities are instead recorded at their face value with no recognition whatsoever of revenues from changes in market values.

In regards to the specific treatment foreign currency reserves receive, the CEMLA survey reports that 100% of central banks in Latin America use the market value for the exchange rate when converting to local currency those items denominated in foreign currency. The CEMLA survey also finds that 14 central banks (out of 16) include realized profits in their P&L statement, while the remaining four reflect them as change in their equity. Regarding unrealized profits due to monetary items, ten central banks reflect them in the P&L statement, while seven reflect them as a change in equity.[10] Moreover, CEMLA surveys document that 81% of banks transfers realized profits and that 31% of them transfer unrealized profits as well. Transfers are typically made in single payments (81%) during the first quarter of each year. Similar results are found in the KPMG survey: 11 banks out of 18 (i.e. 61%) adopt

[10]One bank partially reflects them in the P&L and partially as change in equity.

the so called "income approach" for foreign reserves revaluation. On the contrary, according to the ECB survey, for the majority of banks (42 out of 56), unrealized gains from assets are not distributable profits, possibly due to the stricter Euro-system rules in that sample. Only ten of the banks in the sample distributed unrealized foreign exchange valuation gains, 13 distributed unrealized security price valuation gains, and ten unrealized gold valuation gains. There is a relatively important fraction of central banks transferring unrealized gains, even though this is not considered a good practice (Bunea et al. (2016)). Possibly, this is an outcome of following IFRS, where revaluation must be considered profits/losses and reflected in P&L (KPMG (2012)).

Regarding the size of transfers, the ECB survey reports that for the selected period (2007-2013), transfers were, on average, 56% of reported profits, excluding banks with negative profits. There is some variability though. For instance, in 2013, 23 out of 56 banks did not transfer profits to the treasury–mainly due to losses, ten distributed between 50% and 75% of their profits, 16 banks transferred between 75 and 100% of their profits and two transferred more than their reported profits (see Bunea et. al 2016). It is worth mentioning that eight central banks made transfers in years when they experienced losses.

There are five ways to treat losses (See Bunea et al. (2016)). These strategies are typically adopted in a sequential manner, depleting one source before moving to the next. First, losses can be covered using specific buffers (defined for specific purposes). The ECB survey finds that 31 central banks incorporate this strategy. A typical second step is to cover losses from general reserves. In the ECB survey, 43 central banks adopt this strategy. A third strategy is to carry the loss forward against future profits; 28 central banks in the ECB survey adopt this practice. Central banks can also have claims on governments with no effect on equity. In the ECB survey, nine central banks adopt this strategy. Finally, there is the option of direct capitalization. This is the case for 20 central banks in ECB survey. Likewise, in the CEMLA survey around half of the central banks reported that they cover their losses with reserves while the other half reported that the government covers the losses either in cash or (more commonly) in claims.

Up to this point, we have discussed the *de jure* strategies. In practice though, the treatment of net losses is generally not as transparent. For instance, in the KPMG Survey only four banks clearly disclosed what happens in the event of a net loss. Moreover, central banks recognize a *distribution asymmetry*, in the sense that net profits are usually distributed

whereas net losses are normally not compensated (see Bunea et al. (2016) and Archer and Moser-Boehm (2013)). Furthermore, the possibility for central banks to draw from external resources to cover losses seems even less likely in the presence of fiscal dominance.

An issue absent from these surveys is the inventory valuation method for foreign currency assets. As we discuss next, this has important implications for the size of profits. In principle, there should be a tendency to move away from LIFO on the basis of what is prescribed by IFRS. However, central banks do not necessarily follow this prescription. One reference, from the scant literature on the matter, suggests that "most central banks use a form of modified weighted average for determining the cost of their currency sales...."(Sullivan (2016)). Only the central bank of Venezuela explicitly mentions the use of FIFO as the valuation method for realized exchange rate valuation changes.[11]

A final aspect in this section is how profits should be computed. In particular, we want to address the issue of the numeraire. For accounting purposes the universal practice is to use the local currency.[12] There is virtually no discussion as to whether this is appropriate and, if not, what are the consequences. In the next section we address this issue.

3 The computation of central banks profits

A central bank typically keeps a stock of assets (e.g foreign currency and other liquid foreign and domestic assets) that produce real returns (such as interest paid by bonds and the like) and may generate profits when sold, or when they appreciate in value. Profits due to sales arise when the central bank sells the asset at a price higher than the one it takes to replace it (the opportunity cost). Profits due to asset appreciation arise when the price at which one may replace the asset exceeds the price one paid for the asset. Finally, the profits due to the intrinsic return of the asset are self-explanatory.

There is an ample debate among central bank economists about the proper size of the profits due to foreign assets valuation.[13] One view is that, because the worth of a unit of hard

[11] See BCV resolution of 06/30/2004 at http://www.bcv.org.ve/c4/comunicados.asp.

[12] However, for reserve management decisions others numeraires may be used. Borio et al. (2008) recognize that the local currency is invariably the numeraire for accounting purposes. But for reserve management around one third of central banks used the domestic currency, one fifth a basket of currencies and the remaining set a single foreign currency. This information comes from a BIS survey of central banks representing 80% of global foreign exchange reserves at the end of 2006.

[13] See, e.g., the discussion in Baltensperger and Jordan (1998).

currency is, in its own terms, always equal to one, profits from foreign asset appreciation are viewed as purely accounting profits and, in consequence, should not be transferred to the treasury. This point of view is unwarranted. The implicit assumption here is that what matters for the public is the net worth measured in units of hard currency. But there are other plausible options for the unit of account and they all yield different values for the change in central bank net worth as prices fluctuate. Real exchange depreciations (resp. appreciations), for example, produce no change in the net worth of a portfolio of foreign assets when measuring it in units of foreign goods but produce a positive (resp. negative) change in the same net worth when calculated in units of domestic goods. The example, simple as it is, clearly illustrates that the sign and magnitude of certain comparative static exercises may critically depend on the numeraire choice.[14] What is, then, the proper numeraire? A consideration of the opportunity cost of the resources given to a central bank provides an answer to this question: even when profits are a residual of central bank operations, what is relevant for society is the amount of overall consumption sacrificed to keep the central bank in operation. *The proper numeraire is therefore the basket of goods that the typical member of society consumes.* In the next sub-section we show the discrepancies that may arise from using other numeraires; in particular, the local currency, which is virtually the universal practice.

3.1 The cost of an improper computation of central bank profits

In this section we assess the quantitative importance of the choice of the numeraire and inventory valuation methods for central bank accounting outcomes. To that end, we perform Monte Carlo experiments. The parameters of the data generating process of the variables are calibrated for the Venezuelan economy. In particular, based on our simulations we compute (1) profits from buying and selling reserves, hereafter *realized foreign profits*, (2) the differences between income and expenditures from domestic operations, hereafter *realized domestic profits* and, (3) the variation in the value of the stock of remaining reserves, hereafter *unrealized foreign profits*. Realized (both domestic and foreign) and unrealized profits are measured using two numeraires: local currency (Bolívares) and CPI baskets; in addition, the

[14] See, e.g., McCauley (2008) for an evaluation of this principle in the context of management foreign reserves and Mas-Colell (1991), Grodal and Dierker (1999), Zambrano and Vogelsang (2000) and Nachbar (2002) for applications of the same principle.

computations of profits from foreign assets (realized and unrealized) are calculated for three well-known inventory valuation methods: LIFO, FIFO and weighted average. The details are presented in the Appendix.

The estimation delivers an average inflation rate of 17.8% and a average depreciation of 16% for the nominal exchange rate. As expected, both series are positive correlated, with a correlation coefficient of 0.47. Likewise, inflation is quite persistent: the correlation coefficient of inflation and its first lag is 0.54. Regarding domestic operations, income is about 0.1% of the level of foreign reserves while expenditure is about 2.5%.

Taking the estimated parametrization as a benchmark, we introduce some counterfactual perturbations in the data generating process in order to understand the role of some key parameters. Hence, the insights from these exercises are relevant beyond the case of Venezuela. In Table 1 we present summary statistics corresponding to the simulations of one-period realized (top) and unrealized profits (bottom). Values are expressed as percentages of foreign reserves.

The lessons derived from the simulations can be summarized as follows:

1. Regardless of the numeraire, the choice of the inventory valuation methods does not affect **the sum** of realized and unrealized profits from foreign operations. Therefore, transfers to the treasury—linked to foreign profits— will depend on the inventory method, as long as there are differences in the propensity to transfer realized and unrealized profits. In the case that reserve valuation gains are not considered profits, FIFO would imply larger transfers to the treasury.

2. Regardless of the inventory valuation method, realized and unrealized foreign profits will be overestimated when the numeraire is the local currency. Inflation is the cause. In our benchmark simulation, the overestimation is quite large for foreign reserves operations. For instance, total foreign profits overestimation (realized plus unrealized) —relative to the CPI numeraire case— is about 78% of foreign reserves, while the overestimation when focusing on realized profits (under the weighted average valuation method) is about 32.5% of foreign reserves.

3. When the numeraire is the local currency, the inventory valuation method is of great importance. FIFO maximizes the reported size of the realized foreign profits while

Realized profits (from reserves sales and domestic operations)								
	Foreign operations						Domestic operations	
	Numeraire: Bolívar			Numeraire: CPI basket			Bolívar	CPI basket
	FIFO	LIFO	Weight. Avg.	FIFO	LIFO	Weight. Avg.		
Mean	47,8	3,8	24,9	-14,5	-0,1	-7,7	-2,3	-1,9
St. Dev.	52,8	10,9	30,4	39,4	7,6	21,6	1,9	1,5
Prob(variable <= 0)	12,9	58,4	15,2	69,2	76,6	70,7	88,8	88,8
Percentile 5%	-13,2	-2,9	-8,1	-76,9	-10,0	-41,0	-5,4	-4,3
Percentile 95%	150,2	23,2	84,5	48,4	9,7	27,6	0,8	0,7
Unrealized profits (from reserves revalorization)								
Mean	10,2	54,2	33,1	-5,4	-19,8	-12,2		
St. Dev.	20,8	57,8	36,1	16,7	44,8	28,2		
Prob(variable <= 0)	32,5	14,7	15,0	68,8	71,2	70,9		
Percentile 5%	-11,6	-20,1	-12,7	-36,1	-88,4	-56,7		
Percentile 95%	48,1	162,9	100,3	16,4	56,4	34,1		

Table 1: Profits under Benchmark parametrization (as percent of foreign reserves).

LIFO minimizes them. The dispersion of realized foreign profits is also higher under FIFO. The opposite occurs with unrealized foreign profits, with LIFO maximizing their reported value and dispersion. The fact that the nominal exchange rate has a positive trend is responsible for this patter. The differences are sizable. For example, the estimated expected value of central bank realized foreign profits measured in local currency is more than twelve times higher when using FIFO relative to LIFO. The results regarding the weighted average method are somewhere in between, as expected.

4. When the numeraire is the basket of goods represented in the CPI, in the majority of the simulations we observe losses rather than profits. Real exchange rate appreciation is responsible for this result. Inventory valuation methods only affect the magnitude of the loss. For example, the estimated expected realized losses are much larger under FIFO than under LIFO (more than 14 percentage points).

5. On average, the net profits from domestic monetary policy is negative, around 2% of the value of foreign reserves. Only in around 12% of the realizations profits from domestic operations are non negative. The absolute value of profits from domestic operations is around 20% smaller when using the CPI basket as numeraire. Regarding the size of profits from domestic vs foreign operations; as expected, when the local currency is used as numeraire, the latter dominates. For instance, taking as example the weighted average inventory method, the absolute value of net profits from domestic operation is less than 10% of realized foreign profits and less than 4% of total foreign profits.[15] When using the domestic baskets as unit of account, realized profits from local and foreign operations are closer (and both are negative) but they are larger in magnitude for the foreign related operations.

We now discuss the role of certain parameters in the simulations. First, suppressing the dynamic structure of the data generating process does not have a significant impact (see section 6.1.1 of the appendix). Reducing the high correlation between contemporaneous inflation and nominal exchange rate depreciation does not alter our main conclusions either,

[15]Based on information from Argentina (2000-2014), Chile (2000-2015), Colombia (2005-201, Costa Rica (2008-2013), Mexico (2013-2015), Peru (2008-2015), Dominican Republic (2004-2015), Uruguay (2004-2015) and Venezuela (2000-2014); we found that foreign reserves represent more than 70% of total assets, likewise, gains from foreign reserve appreciation represents almost 90% of total income.

although the variance of profits increases (see section 6.1.2 of the appendix). The main driver of our simulation results is the fact that inflation is positive, and higher than nominal depreciation.

In section 6.1.3 of the appendix we study the role of nominal depreciation. When there is no depreciation, and when local currency is the numeraire, profits from foreign reserve operations are naturally zero for all inventory methods, while profits from domestic operation are still negative and around -2%. Depreciation makes $FIFO > Average > LIFO$ when computing realized foreign profits and $LIFO < Average < FIFO$ when computing unrealized foreign profits. This exercise also illustrates that when the numeraire is the CPI basket, real appreciation implies negative profits for the three inventory methods, while real depreciation implies positive profits. Nominal depreciation does not affect significantly the size of the loss from domestic operation regardless of the unit of account.

Finally, in section 6.1.4 of the appendix, we evaluate the role of inflation. Clearly, the inflation rate determines the degree of overvaluation due to the *improper* choice of numeraire. No inflation means that both numeraires produce equal size profits, while positive inflation yields an overestimation of foreign profits when using local currency as the numeraire. The higher the inflation, the higher the overestimation. This is true even with no exchange rate appreciation (as Table 6 in section 6.1.4 of the appendix shows). The magnitude of domestic profits is also smaller as inflation grows and the same is true about the profit discrepancies across numeraires.

Central banks routinely measure the changes in their net worth in terms of domestic currency. The simulations reveal that in an inflationary environment this implies overestimation of profits and, in the case they are transferred to the treasury, excessive transfers. Employing the LIFO inventory valuation method reduces the size of *realized* profits but not enough to compensate the overestimation associated to the choice of an improper numeraire. Moreover, the valuation method choice is completely irrelevant when unrealized profits may also be subject to transfers. Hence, LIFO (or any other method) does not really protect the net worth of the central bank in an inflationary environment when the numeraire is the domestic currency.

The discussion above reveals that different methods for estimating central bank profits have substantial consequences on their sign and magnitude. In section 4 below we examine the macroeconomic implications of excessive transfers that arise from using improper

methods to compute central bank profits.

4 Macroeconomic implications: required foreign reserve levels, central bank profit transfer rules, and price stability

In the previous section we show that in an inflationary context, the typical numeraire for computing profits (local currency) implies a significant overestimation of real profits and, in consequence, excessive transfers from the central bank to the treasury. The direct implication of this is a tendency towards low equity, which may compromise the ability of the central bank to attain its price stabilization goal.

In this section we provide some perspective on the problems that could arise from improper profit transfers from the central bank to the treasury. We extend a model by Sims (2005), where the balance sheet of the treasury and of the central bank are not consolidated. We use the model to study the effect of alternative central bank profit transfer rules on several macroeconomic variables. The model allows a better understanding of the appropriateness of transferring central bank profits to the treasury in a country with weak fiscal institutions.

4.1 The Model

The economy is composed of infinitely lived agents who face the problem:

$$\max \int e^{\beta t} log C(t) dt \tag{1}$$

By choice of C, F_p, B and M subject to:

$$C(1+\psi(v)) + \dot{F}_p + \frac{\dot{M} + \dot{B}_p}{P} = \rho F_p + r\frac{B_p}{P} + \tau \tag{2}$$

The interpretation is as follows: at every instant the representative agent must choose how much to consume (C), how much to save in domestic bonds (B_p), how much to save in real assets (F_p), and how much wealth to keep under the form of money (M).

At every instant the sources of funds are equal to the sum of the agents' real income (Y), the return on the agent's real investments (ρF_p, where ρ is the real interest rate), the return

on domestic bond holdings (rB_p/P, where r is the nominal interest rate and P is the price level) and the government transfers (τ).

Each agent uses his real resources in accumulating real assets ($\dot{F}_p$), domestic bonds ($\frac{\dot{B}_p}{P}$), real money balances ($\frac{\dot{M}}{P}$), in consuming, and in "facilitating consumption". The meaning of 'facilitating consumption' is as follows: if the agent wishes to consume an amount C of goods, it must purchase an amount equal to $C(1+\psi(v))$ of goods. The expression $\psi(v)$ captures the cost of making transactions in the economy and it is an increasing function of the velocity of money (v), defined here as $v = \frac{PC}{M}$. Hence, the higher the agent's money holdings, the lower the transaction costs incurred for by the agent given a certain level of desired consumption.

The solution to this problem can be summarized in the following expressions:

$$r = \rho + \frac{\dot{P}}{P} \tag{3}$$

$$r = \psi' v^2. \tag{4}$$

$$\rho - \beta = \frac{\dot{C}}{C} + \frac{(2\psi' + \psi'' v)\dot{v}}{1 + \psi + \psi' v}. \tag{5}$$

In this economy the central bank uses an interest rate rule given by

$$\dot{r} = \theta_0 + \theta_1 \frac{\dot{P}}{P} - \theta_2 r \tag{6}$$

Assume for simplicity that the real assets of the government are being held by the central bank. Then the central bank's budget constraint is given by:

$$\dot{F}_G + \frac{\dot{B}_G}{P} = \rho F_G + r\frac{B_G}{P} + \frac{\dot{M}}{P} - \tau_B \tag{7}$$

The interpretation is as follows: The central bank obtains real resources through base money issuance, $\frac{\dot{M}}{P}$, and through the return obtained from its asset holdings ($\rho F_G + r\frac{B_G}{P}$). Those resources are used to accumulate more assets ($\dot{F}_G + \frac{\dot{B}_G}{P}$), and to transfer profits to the Treasury (τ_B). The sum $F_G + \frac{B_G}{P}$ thus constitutes the stock of real reserves held by the central bank.

The specific contribution of this section is that we use this model to explore the macroeconomic implications of three profit transfer rules: A "zero transfer" rule, a rule by which only the real return of the reserves $\rho(F_G + \frac{B_G}{P})$ is transferred to the Treasury, and a rule in which, in addition, the central bank transfers the amount $\frac{\dot{P}}{P}(F_G + \frac{B_G}{P})$, that is, the amount of goods corresponding to the nominal appreciation of $F_G + \frac{B_G}{P}$. This is the size of central bank profits under the "domestic currency" numeraire and constitutes the case of "improper" transfer that we study in this Section. As in Sims (2005), we assume that the transfer becomes zero when seignorage revenue is negative.

4.2 Analysis

This economy has two equilibria: one with stable inflation and one with an explosive inflation path (given by an arbitrarily high velocity of money and real money balances equal to zero). This has the following interpretation: even in an environment of price stability there are shocks to the economy that could trigger the economy to move from the stable equilibrium into the unstable equilibrium. The crux of the analysis is that this could not occur if there was a way to make it impossible for the explosive inflation situation to be an equilibrium. Sims (2005) suggests that such can be the case if the central bank is prepared to redeem the entire stock of money at a given upper bound P^* for the price level. Such promise is credible only if the central bank has enough real reserves $F_G + \frac{B_G}{P^*}$ so that $\frac{M}{P^*} < F_G + \frac{B_G}{P^*}$, which would prevent agents from demonetizing the economy, leading to hyperinflation. Notice that $\frac{M}{P^*} < F_G + \frac{B_G}{P^*}$ if and only if $P^*F_G + B_G - M > 0$, that is, if the central bank has positive net worth at the critical price level.

This means that price stability indeed requires a minimal real reserve level, which can be computed in such a way to ensure a positive net worth at the critical price level. This minimal reserve level depends not only on the size of shock the economy is subject to but also, on the transfers size which as discuss depends on accounting principles and in particular on the unit of measure.

Below we show a parametrization of the model that clearly illustrates this. The parametrization follows Sims (2005).

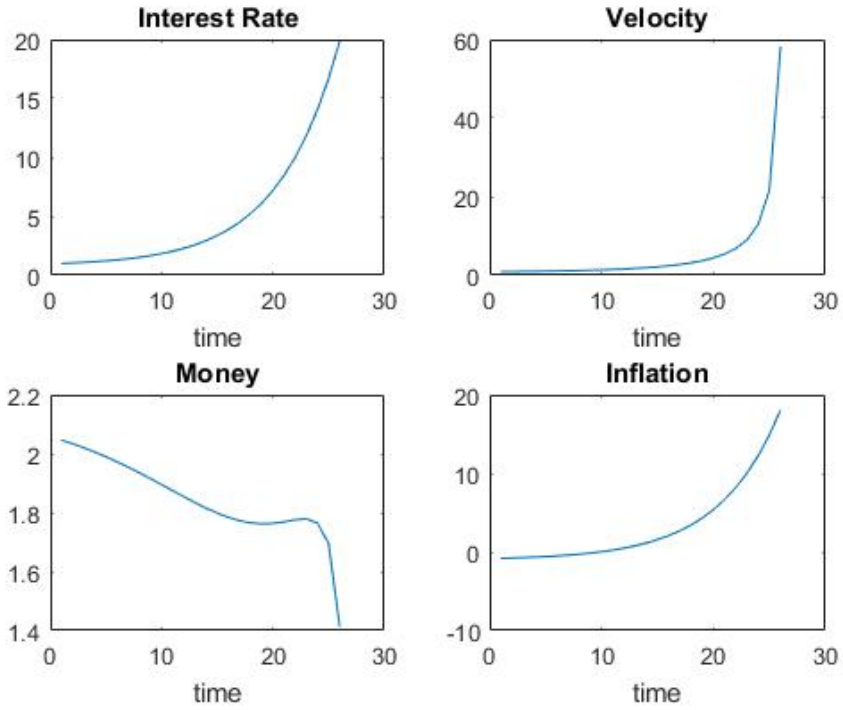
Consider the case where transaction costs are given by

$$\psi(v) = \frac{\gamma v}{1 + \phi v},$$

and the economy is initially at a steady state with zero inflation and real interest rate equal to 2%. We use this scenario to study the effect of varying the profit transfer rule on the minimal reserve level that is required to eliminate the explosive inflation equilibrium. The policy rule for this experiment is defined by $\theta_0 = 0.02$, $\theta_1 = 1.2$ and $\theta_2 = 1$. The transactions technology is defined by $\gamma = 0.02$ and $\phi = 0.3$.

Consider an unexpected drop in the real interest rate to 1.8%. The new stable equilibrium would require a drop in the nominal interest rates to a new level equal to 0.8%. Imagine, however, that, following the drop in the real interest rates, the nominal interest rate adjustment is incomplete as it falls only to 1%. In this case the resulting price level is above the price level consistent with the stable equilibrium. This leads to policy actions that steadily drive the interest rate upwards. Figure 1 shows the evolution of interest rates, velocity of money, the log of money holdings and inflation in this economy.

Figure 1: Dynamics with insufficient response of r to a drop in ρ

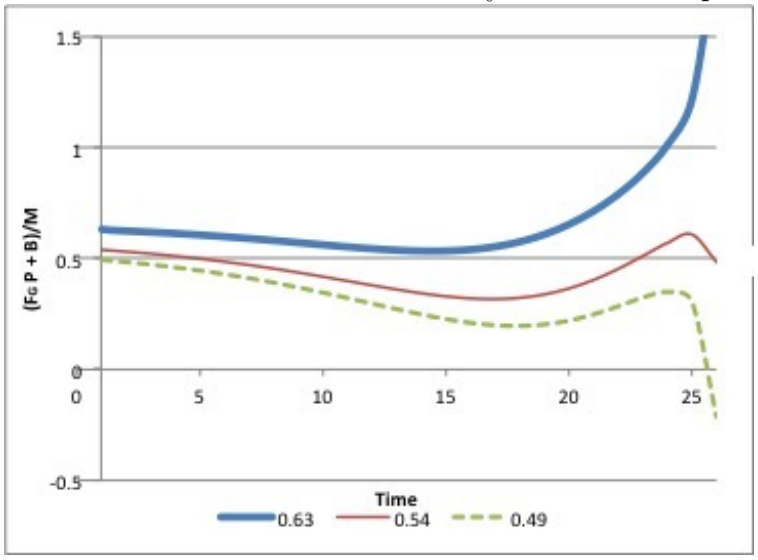


Whether the central bank can avoid this explosive price path to materialize depends on its initial net worth and its profit transfer rules. Figure 2 shows the ratio of reserves to real

money balances for the case where the central bank transfers zero profits to the treasury for different initial levels of $\frac{F_G P+B_G}{M}$ (This ratio is above one for a positive net worth for the central bank).

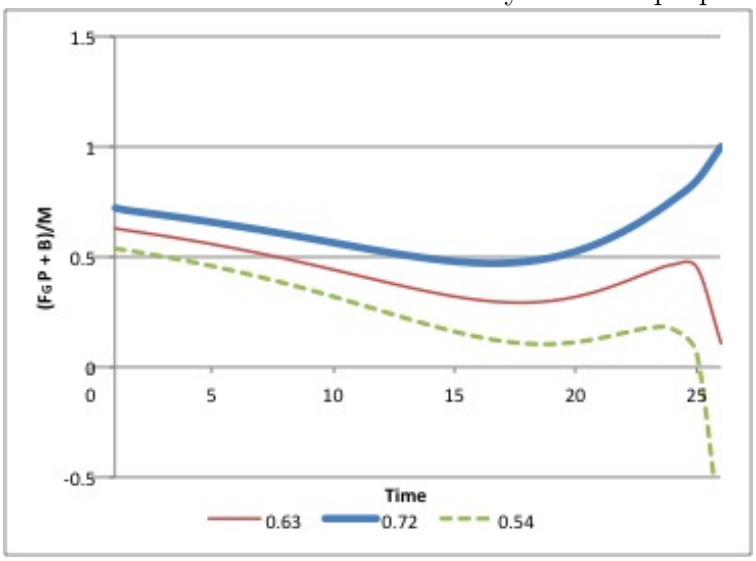
Figure 2 shows that there is an initial level of $\frac{F_G P+B_G}{M}$ such that, even if the central bank initially has negative net worth, it is only a matter of time before the accumulation of profits drives net worth to the point where the central bank can cut inflation by announcing that it can redeem the entire stock of money at the current price level. When the reserves to real money balances ratio is not high enough, positive net worth can never be achieved, which would make it a matter of time before the central bank runs out of assets. This, in turn, would make it impossible for the Bank to perform open market operations. In this example, the initial reserve level cannot be below 63% of real money balances to guarantee price stability.

Figure 2: Ratio of real reserves to real money. Case 1: zero profit transfer



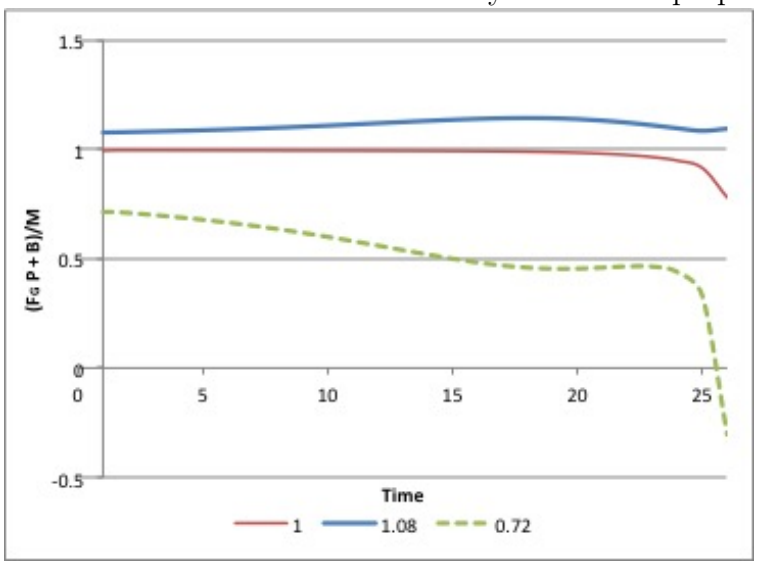
When the profit transfer rule is that of giving the government the real returns yielded by the real reserves (our case of proper transfers), the initial reserve level necessary to avoid the explosive inflation equilibrium increases. Figure 3 shows that an initial reserve to real money holdings ratio of 63% is no longer sufficient to avoid the explosive inflation equilibrium. In this example the initial reserve level cannot be below 72% of real money holdings if the explosive equilibrium is to be avoided.

Figure 3: Ratio of real reserves to real money. Case 2: proper transfers



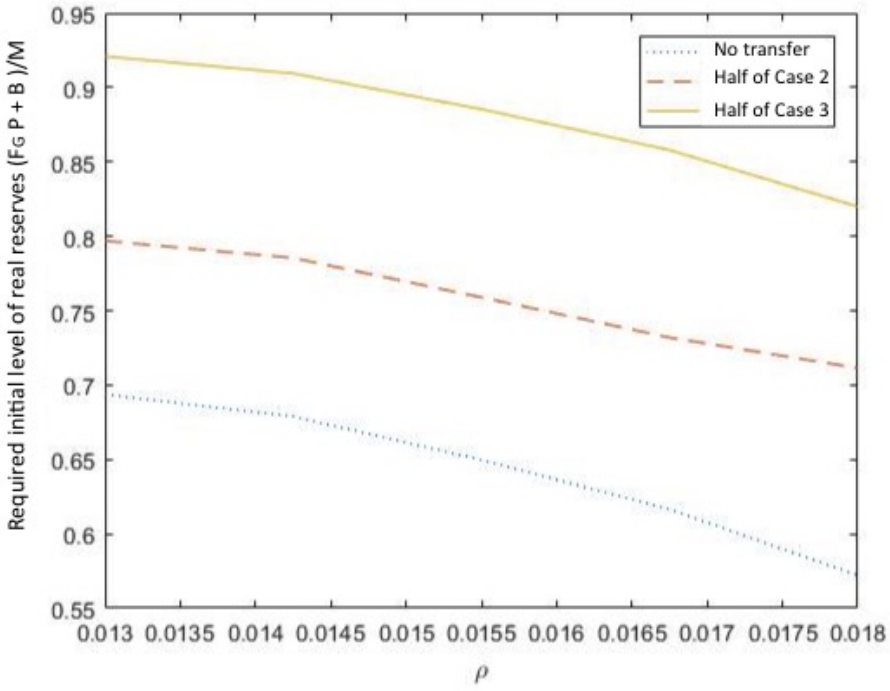
Consider now the case where the central bank also transfers the nominal appreciation of the stock of real reserves (our case of improper transfer). This case is interesting because reaching a ratio of real reserves to real money holdings equal to 1 is no longer enough to avoid the explosive inflation equilibrium. In this case, the ratio must be at least equal to 108%(leading to a seemingly excessive central bank capitalization) for the central bank to avoid the explosive inflation equilibrium, as Figure 4 shows.

Figure 4: Ratio of real reserves to real money. Case 3: improper transfers



The analysis above indicates that there exist a connection between the transfer scheme and the minimum level of real reserves required in excess of real money holdings to avoid a hyperinflation. Obviously, the size of the shocks the economy is exposed to also plays a role. The connection between these three factors is clearly shown in Figure 5. The figure shows the minimum level of real reserves required to avoid a hyperinflation for different values of the real interest rate for three different transfer schemes namely, case 1 (zero-transfer schemes), as well as 50% of the computed profits according to the case 2 rule and according to the case 3 rule. It assumes incomplete adjustment in nominal interest rate at the same level $r_o = 1\%$ just as before.

Figure 5: Minimum required levels, shocks sizes and transfers



The larger the shock (i.e. the farther away ρ is from its initial level of 2%) the higher the initial real reserves required to avoid an unstable path for prices. Likewise, given the shock (a fixed level of ρ), the more lax the accounting framework is in terms of maximizing profits to distribute, the higher the required initial level of real reserves.

Let us summarize the lessons that can be extracted from the discussion above: First, reserves are not really necessary in the stable equilibrium. Second, to avoid the explosive inflation equilibrium it is necessary for the central bank to hold a minimum level of real reserves so that profit accumulation eventually leads to positive net worth. So the reserves are, in the end, a form of contingent backing of the stock of money in circulation in a country with weak fiscal institutions. Third, routine transfers of central bank profits increases the

minimum level of reserves required to avoid the explosive inflation equilibrium. Fourth, larger shocks require higher level of initial reserves or, alternatively, more conservative accounting methods in terms of the size/distribution of profits. Fifth, excessive central bank profit transfers (such as the ones implied by an improper choice of numeraire) require that the central bank keeps a higher net worth and hence a fairly high level of real reserves to avoid the explosive inflation. In short: there exists a direct relationship between the minimum reserve level, shocks size and the profit transfer rule. The more aggressive the profit transfer rule is, the more reserves, domestic and foreign, it is necessary to hold to avoid the explosive inflation.

Finally, the analysis allows us to derive a clear criteria to follow regarding central bank profit transfers to the Treasury: given the critical/target level of real reserves, asset sales should trigger profit transfers to the treasury only when real reserves, net of sales, are above the critical level. When real reserves, net of sales, are below the target real reserve level, central bank profits should not be transferred, as those profits are necessary to attain a net worth consistent with a credible strategy to avoid hyperinflation. The level and sign of these transfers would be irrelevant if the treasury were committed to assist the central bank, through additional taxation, to avoid a balance sheet crisis, shall one become imminent. But the presence of fiscal dominance and weak fiscal institutions do not lend credibility to this possibility (Sims (2013); Reis (2013)).

We close our analysis with an exercise that combines the insights obtained from the Monte Carlo simulations of central bank profits with those obtained from the macroeconomic model just discussed. Specifically, we wish to evaluate—in the context of our very simple model—the economic costs of the profit miscalculations in the Monte Carlo simulations from section 3. Our measure of economic cost is the excess of minimum initial reserves $(F_G P + B_G)/M$ needed to avoid a hyperinflation, following a shock of real interest rate (as before a drop in ρ to 1.8%) with incomplete adjustment in nominal interest rate. Recall from section 3 that when focusing on the weighed average inventory method, the simulation suggests an overestimation of realized profits in the order of 16% of foreign reserves and of total profits in the order of 38% of foreign reserves. In scenario 1 we set profits as the 'proper' profits $\rho(F_G + \frac{B_G}{P})$ plus $0.16(F_G + \frac{B_G}{P})$, while in scenario 2 we set profits as the proper level plus $0.38(F_G + \frac{B_G}{P})$. Transfers to the treasury are defined as a fraction δ of distributable profits. As before, we assume partial adjustment in the nominal interest rate. Results for different

values of δ are presented in Table 2.

Table 2: excess of relative equity due to miscalculation of profits

delta	Scenario 1	Scenario 2
0	1.0000	1.0000
0.0600	1.0245	1.0599
0.1200	1.0501	1.1268
0.1800	1.0767	1.2019
0.2400	1.1050	1.2862
0.3000	1.1344	1.3265
0.3600	1.1654	1.3613
0.4200	1.1975	1.3983
0.4800	1.2318	1.4375
0.5400	1.2677	1.4783

Clearly if $\delta = 0$ the size of profits is irrelevant. Lets us consider the case where central banks transfer 54% of their profits (close to the value of 56% discussed in section 2). The exercise suggests that consistently overestimating profits by 16% of reserves level (scenario 1) implies maintaining a ratio of real reserves to real money holdings $(F_G P + B_G)/M$ that would be 27% higher than absent that overestimation of profits. This is a considerable amount.

5 Conclusions

In this article we show the importance of the numeraire choice and inventory valuation methods for the proper computation and distribution of central bank profits. We also study the relation between the desired level of profit transfers to the treasury and the desired level of real reserves. We show that an improper numeraire choice can dramatically alter the sign and magnitude of central bank profits. We also show that there is a tradeoff between profit transfers and real reserve levels if the central bank wishes to avoid a hyperinflation. Because real reserve levels can serve as "contingent backing" for the stock of money in circulation, an improper choice of numeraire can lead to excessive profit transfers, low central bank capitalization levels, and this can become a serious threat to the prospect of price stability if the treasury is not committed to helping the central bank solve any eventual balance sheet problems. Such are the subtle implications of numeraire choice for monetary policy.

6 Appendix: Monte Carlo experiments on the size of central bank profits for the Venezuelan economy

The simulations were carried out as follows. We first define a vector

$$x \equiv (v_t, c_t, \hat{e}_{t-4}, \hat{e}_{t-3}, \hat{e}_{t-2}, \hat{e}_{t-1}, \hat{e}_t, \pi_{t-4}, \pi_{t-3}, \pi_{t-2}, \pi_{t-1}, \pi_t, Y_d, X_d)$$

where $v_t, c_t, \hat{e}_i, \pi_i, X_d, Y_d$ represent, respectively, central banks' sales and purchases of foreign currency for the current period, t, the (gross) depreciation and the inflation rate for period i, and income and expenditure from central bank domestic operations.[16]

We set the time period to be a semester, assume that x follows a multivariate normal distribution with mean μ_x and variance-covariance matrix Ω_x, and estimate the parameters (μ_x, Ω_x) using data from 1990 to 2003.[17] Due to data availability we are able to assess the role of inventory valuation methods only for foreign reserves related accounting items and not for the stock of domestic assets; however we also consider in our simulation incomes and expenditures from central bank domestic operations under their actual accounting principles. Incomes are measured as net gains from repos and repurchase operations of bonds denominated in domestic currency. Expenditures include the interests paid for legal and excedentary reserves of financial institutions at central bank, losses related to open market operations, and interest rate paid for titles issued by the Central Bank. Based on this data, we get values for the means, the standard deviations and the correlations of the relevant variables. These statistics are shown in table 3.

We normalized to one the nominal exchange rate and the price level at $t-5$. In addition, we also set to 1 the level of reserves (at time t). We assume that this stock comes entirely from the four previous semesters, according to the distribution $\Theta = \{\theta_{t-4}, \theta_{t-3}, \theta_{t-2}, \theta_{t-1}\}$ with θ_i being the fraction of the reserves inventory purchased at period i. Clearly $\sum_i \theta_i = 1$. To simulate Θ, we take four realizations of a random variable, c, coming from a normal distribution with mean 0.6677 and standard deviation 0.123 and then compute $\theta_i = \frac{c_i}{c_1+c_2+c_3+c_4}$.[18] This stock, together with reserves purchased at t, c_t, represents the inventory available to be sold.

[16] Variables c_t, v_t, X_d, Y_d are measured in terms of the value of foreign reserves.

[17] Data after that date is not suitable because of the exchange rate controls established by the Venezuelan government since 2003. For the variables (X_d, Y_d) we have information from the second semester of 1992.

[18] Notice these are precisely the mean and standard deviation of the purchases of foreign currency reserves over the time horizon under analysis.

	c_t	v_t	$\hat{e}_t$	$\hat{e}_{t-1}$	$\hat{e}_{t-2}$	$\hat{e}_{t-3}$	$\hat{e}_{t-4}$	π_t	π_{t-1}	π_{t-2}	π_{t-3}	π_{t-4}	Y_d	X_d
c_t	1,00													
v_t	0,60	1,00												
$\hat{e}_t$	0,27	0,57	1,00											
$\hat{e}_{t-1}$	0,11	-0,17	-0,01	1,00										
$\hat{e}_{t-2}$	-0,22	-0,22	-0,28	-0,02	1,00									
$\hat{e}_{t-3}$	-0,06	0,14	0,09	-0,28	-0,02	1,00								
$\hat{e}_{t-4}$	0,03	0,10	0,20	0,16	-0,30	0,02	1,00							
π_t	0,11	0,21	0,47	0,59	0,05	-0,05	0,59	1,00						
π_{t-1}	-0,10	-0,06	0,00	0,46	0,59	0,05	0,01	0,54	1,00					
π_{t-2}	-0,19	-0,03	-0,02	-0,01	0,46	0,59	0,07	0,31	0,55	1,00				
π_{t-3}	0,21	0,01	-0,03	-0,04	-0,01	0,28	0,58	0,35	0,23	0,42	1,00			
π_{t-4}	-0,10	-0,04	-0,05	-0,04	-0,04	-0,03	0,37	0,20	0,34	0,22	0,40	1,00		
Y_d	0,16	0,25	0,20	-0,10	0,58	-0,06	-0,05	0,14	0,15	0,02	-0,08	-0,25	1,00	
X_d	-0,13	0,18	0,01	0,25	0,17	0,16	0,24	0,48	0,52	0,50	0,43	0,39	0,07	1,00
Mean	0,667	0,687	1,160	1,165	1,165	1,161	1,141	1,178	1,179	1,179	1,195	1,200	0,001	0,025
Std. Dev.	0,123	0,258	0,253	0,251	0,251	0,254	0,228	0,114	0,113	0,113	0,137	0,137	0,002	0,019

Table 3: Correlation matrix, means, and standard deviations

Our experiment has ten thousand realizations of (x, Θ); and for each of them, we calculate period t central bank profits from reserve sales (realized foreign profits) as well as the change in valuation of the remaining stock of foreign reserves (unrealized foreign profits). We also compute the realized domestic profits $Y_d - X_d$. We carry out such calculations for two numeraires: the local currency and the CPI basket. For foreign reserves related operations, we compute profits using three well-known methods of inventory valuation: FIFO, LIFO and weighted average. Table 1 of section 3.1 shows the summary statistics.

6.1 Counterfactuals

To explore the role of certain parameters, we carry out some simulations for alternative values of μ_x and Ω_x.

6.1.1 Role of the dynamic structure

In this experiment we impose the following structure for Ω_x: $cov(\pi_{t-j}, x_t) = cov(\hat{e}_{t-j}, x_t) = 0$ for all $(j, x) \in \{1, 2, 3, 4\} \times \{c, v, \pi, \hat{e}\}$. This essentially implies taking away the dynamic structure of the process. The remaining elements of Ω_x are just like in the benchmark parametrization. In Table 4 we show the summary statistics for the simulation. There are not significant changes and all of our main conclusions hold.

Realized profits (from reserves sales and domestic operations)								
	Foreign operations						Domestic operations	
	Numeraire: Bolivar			Numeraire: CPI basket			Bolivar	CPI basket
	FIFO	LIFO	Weight. Avg.	FIFO	LIFO	Weight. Avg.		
Mean	50,3	3,4	26,4	-14,6	-1,3	-8,0	-2,4	-2,0
St. Dev.	60,8	11,9	34,9	52,3	9,6	28,9	1,9	1,5
Prob(variable <= 0)	16,0	60,1	17,0	66,6	79,1	67,0	89,3	89,3
Percentile 5%	-18,2	-3,9	-10,2	-94,7	-14,9	-52,6	-5,5	-4,4
Percentile 95%	166,5	21,7	91,9	73,5	7,2	39,1	0,7	0,7
Unrealized profits (from reserves revalorization)								
Mean	11,2	58,1	35,1	-3,9	-17,2	-10,5		
St. Dev.	22,0	65,2	40,3	18,0	57,5	35,1		
Prob(variable <= 0)	32,9	16,2	16,6	67,2	67,0	67,2		
Percentile 5%	-10,8	-23,8	-15,0	-34,5	-101,6	-61,9		
Percentile 95%	52,5	180,9	110,3	21,4	84,2	51,1		

Table 4: Taking out dynamic structure; variables are only correlated contemporaneously

6.1.2 Role of the contemporaneous correlation between π_t and $\hat{e}_t$

As expected, the contemporaneous inflation rate and the nominal exchange rate depreciation are highly correlated. To evaluate the role of this fact, in this simulation we further set $\rho(\pi_{t-j}, \hat{e}_{t-j}) = 0$ for all $j \in \{0, 1, 2, 3, 4\}$.[19]

In table 5 we show the summary statistics for this simulation. The most significant change is an increase in the dispersion of profits when using the CPI basket numeraire. However, our main conclusions still hold.

[19] In addition, like in the previous exercise, we set $cov(\pi_{t-j}, x_t) = cov(\hat{e}_{t-j}, x_t) = 0$ for all $(j, x) \in \{1, 2, 3, 4\} \times \{c, v, \pi, \hat{e}\}$.

Realized profits (from reserves sales and domestic operations)								
	Foreign operations						Domestic operations	
	Numeraire: Bolivar			Numeraire: CPI basket			Bolivar	CPI basket
	FIFO	LIFO	Weight. Avg.	FIFO	LIFO	Weight. Avg.		
Mean	49,4	3,4	26,0	-14,6	-1,2	-8,0	-2,3	-1,9
St. Dev.	60,7	11,0	34,5	61,7	10,5	33,9	1,9	1,5
Prob(variable <= 0)	16,2	60,1	17,4	63,8	78,1	64,4	89,4	89,4
Percentile 5%	-19,6	-3,8	-10,7	-110,6	-16,9	-60,9	-5,4	-4,4
Percentile 95%	168,0	21,9	93,4	90,0	10,0	48,6	0,7	0,7
Unrealized profits (from reserves revalorization)								
Mean	11,6	57,5	35,0	-4,4	-17,7	-11,0		
St. Dev.	22,4	65,3	40,3	21,8	68,5	41,9		
Prob(variable <= 0)	32,7	16,7	17,0	66,0	64,5	64,5		
Percentile 5%	-10,8	-24,7	-15,2	-40,3	-119,0	-72,7		
Percentile 95%	54,9	181,0	111,7	27,0	103,4	62,9		

Table 5: Taking out remaining contemporaneous correlations between inflation and exchange rate depreciation

6.1.3 Role of nominal exchange depreciation

We now allow $\hat{e}_t$ to vary from 1 to 1.35. In all cases we set $\sigma_{\hat{e}} = 0$. Profits are displayed in Figure 6

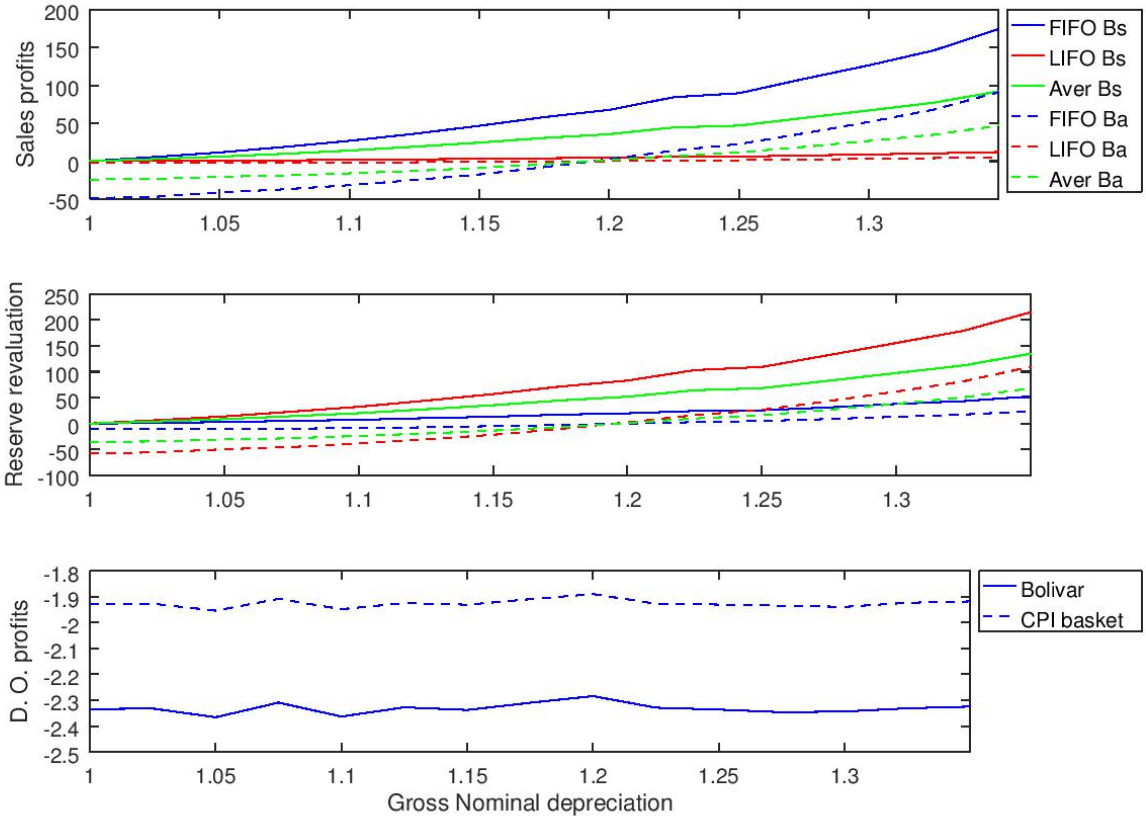


Figure 6: Depreciation ($\hat{e}_t$) and profits

With no depreciation ($\hat{e}_t = 1$) and when local currency is used as numeraire, foreign profits equals zero for the three inventory methods. Depreciation makes $FIFO > Average > LIFO$ when computing realized profits and $LIFO < Average < FIFO$ when computing unrealized profits. When the numeraire is the CPI basket, real appreciation $\hat{e}_t < \pi_t = 1.183$ implies negative foreign profits for the three inventory methods while real depreciation implies positive profits.

6.1.4 Role of Inflation

We now allow π_t to vary from 1 to 1.35. In all cases we set $\sigma_\pi = 0$. Profits are displayed in Figure 7

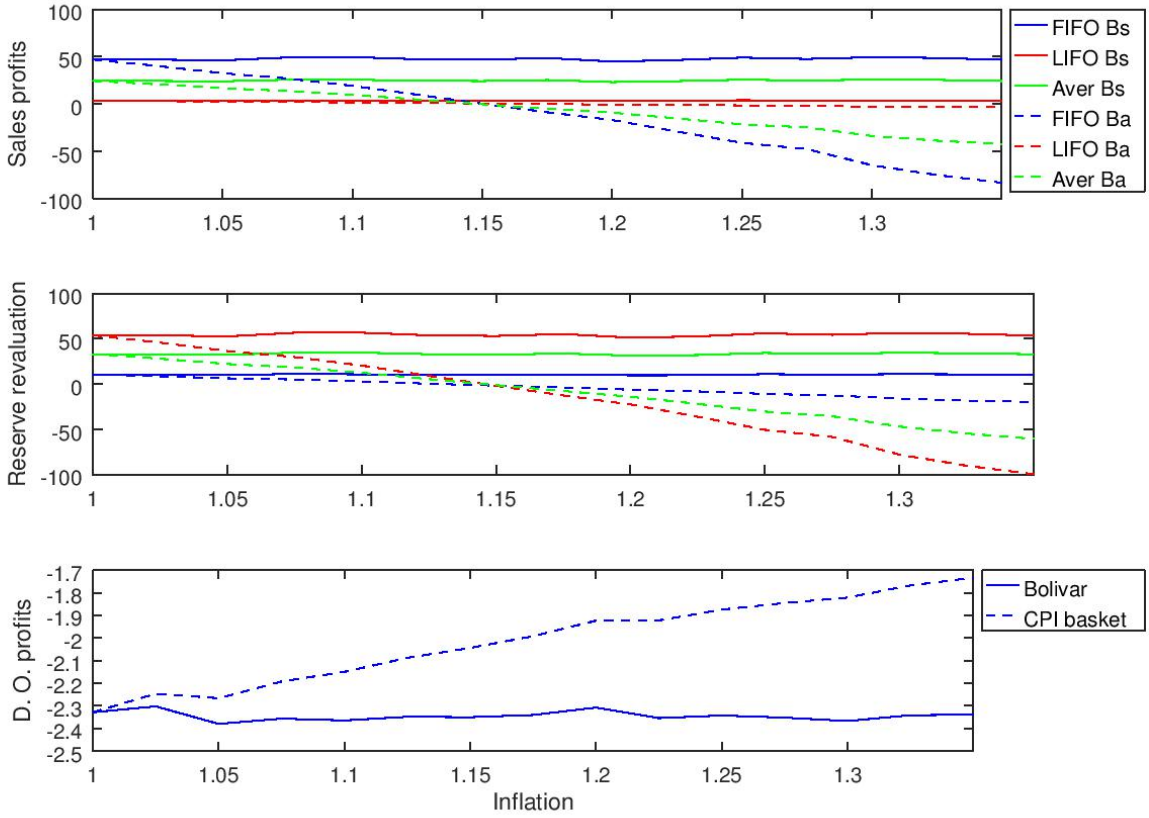


Figure 7: Inflation (π_t) and profits

Clearly, π_t determines the degree of overvaluation due to the improper choice of numeraire. The higher π_t, the higher the overestimation.

We further stress that overestimation of foreign profits does not arise because of real exchange rate appreciation, but because of inflation, as seen is a final exercise in which we set $\pi_t = \hat{e}_t$ and move them from 1 to 1.35 (see Table 6). Notice that this implies no tendency toward appreciation or depreciation. [20] No changes in the real exchange rate implies no

[20] To guarantee that real exchange rate does not vary across simulations we further set $\sigma_\pi = \sigma_{\hat{e}} = 0$. The

real foreign profits (i.e measured in CPI basket) but the higher π, and $\hat{e}$ the higher the overvaluation due to the improper choice of numeraire.

rest of the parameters of Ω_x are as in the benchmark parametrization.

Realized profits (from reserves sales and domestic operations)								
	Foreign operations						Domestic operations	
	Numeraire: Bolivar			Numeraire: CPI basket			Bolivar	CPI basket
$\Delta\pi_t = \hat{e}_t$	FIFO	LIFO	Weight. Avg.	FIFO	LIFO	Weight. Avg.		
1	0,0	0,0	0,0	0,0	0,0	0,0	-2,3	-2,3
1,07	17,6	1,0	9,1	0,0	0,0	0,0	-2,4	-2,2
1,14	41,3	2,6	21,5	0,0	0,0	0,0	-2,3	-2,0
1,21	73,6	4,7	38,5	0,0	0,0	0,0	-2,3	-1,9
1,28	118,5	7,7	62,0	0,0	0,0	0,0	-2,4	-1,8
1,35	172,0	12,2	91,4	0,0	0,0	0,0	-2,3	-1,7
Unrealized profits (from reserves revalorization)								
1	0,0	0,0	0,0	0,0	0,0	0,0		
1,07	4,5	21,1	13,1	0,0	0,0	0,0		
1,14	11,7	50,4	31,5	0,0	0,0	0,0		
1,21	20,8	89,7	55,9	0,0	0,0	0,0		
1,28	33,9	144,8	90,5	0,0	0,0	0,0		
1,35	52,4	212,1	133,0	0,0	0,0	0,0		

Table 6: Moving depreciation and inflation at the same rate

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