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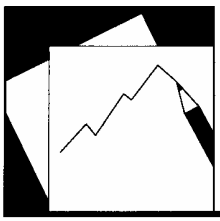

IMF Working Paper

Capitalizing Central Banks: A Net Worth Approach

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IMF Working Paper

Monetary and Financial Systems Department

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Abstract

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The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

This paper provides a simple, quantitative, net worth-based, approach to assessing the need for central bank capital. It derives a concept of "core capital" (a function of the central bank's operating expenditures and the carrying cost of its international reserves) as the minimum capital needed by a central bank to ensure the credibility of its inflation target. The approach is illustrated with the published accounts of three loss-making central banks and selected accounting entries for a broader sample of central banks. Policy implications are explored. In particular, the paper argues that central bank capitalizations cannot be automatic and require instead a broad policy debate.

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I. INTRODUCTION

The decline in world inflation and interest rates in recent years has brought with it a string of losses in many central banks, leading policymakers to plan for their recapitalization. This has typically led to protracted and often convoluted negotiations between central banks and national treasuries. In part, the difficulty reflects the need for explaining to the legislature why the central bank lost its capital in the first place. In many cases, this implies bringing to light past quasi-fiscal operations buried deep in the central bank's balance sheet that may have unsettling political or legal consequences. In addition, before subscribing to a recapitalization —which typically implies a fiscal effort to replace debt financing by tax financing—treasury officials generally question two key items in the central bank's accounts, its level of international reserves and its operating expenditures, neither of which central banks feel at ease to discuss, much less negotiate upon.

Last but not least, the discussions bring back the familiar issue of determining an appropriate level of central bank capital. As stressed by Stella (1997 and 2002), while central bank capital matters, the norms conventionally applied to commercial banks as regards capital requirements clearly do not apply, as such, to central banks. Unlike commercial banks, central banks benefit from monopoly rights on currency emission and a quasi-fiscal inflationary taxation capacity on their monetary liabilities (including on required reserves and other captive deposits), which gives them large quasi rents not properly reflected in their balance sheets. Thus, many central banks may function well without capital or with a negative capital. At the same time, however, the costs faced by central banks, which are specific to their operations, can also be very high. Thus, to give them the income they need to match those expenditures, other central banks may need a level of capitalization far in excess of commercial banks. Whether central bank capitalization requirements exceed or fall short of those for commercial banks, it is clear that simple rules of thumb based on analogies with commercial banking, such as a 10 percent capital assets ratio, are not helpful.

This paper provides a simple yet formal quantitative framework to assess the need for central bank capital in a fully deterministic world in which all key policy and macroeconomic variables are known with certainty.[2] The minimum capital requirement ("core" capital) needed to ensure the credibility of the central bank's inflation target can be expressed as a simple function of its operating expenditures and the carrying cost of the international reserves held in excess of currency. Based on the published accounts of three loss-making central banks and data on operating expenditures and international reserve holdings for a

[2] The paper only briefly refers to the stochastic case in which central banks, as commercial banks, need additional "buffer" capital (i.e., a suitable "distance to default") to shield their creditors against risk. Other recent papers dealing with the determination of central bank capital include Ernhagen, Vesterlund, and Viotti (2002), Ueda (2003), Hawkins (2004), and Martinez-Resano (2004).

broader sample of central banks, the paper shows that core capital is likely to be substantially positive in many low and middle income countries.

The paper then discusses some policy implications. In particular, it examines the sources of the underlying tensions between central banks, national treasuries, and legislatures that generally accompany and often delay the process of central bank capitalization. The paper concludes that while these difficulties may be avoided through legislation that allows for automatic recapitalizations, such arrangements may not necessarily be conducive to optimal outcomes. Because a positive core capital implies *fiscalizing* some of the central bank's future expenditures, ensuring that opportunity costs are adequately internalized is likely to require instead a broad national consensus between the monetary authorities, the fiscal authorities, and the legislature.[3] More transparency in central bank accounting and reporting should enhance the quality of the decision making process and, more generally, facilitate the ongoing monitoring of central bank activities.

Section II presents the framework. Section III illustrates. Section IV discusses policy and reporting implications. Section V concludes.

II. THE FRAMEWORK

A. Basic Accounting Definitions

Let π be the (target) inflation rate, r the real domestic interest rate on public securities (adjusted for domestic inflation), r^* the real interest rate on public securities in the reserve currency country (deflated by inflation in that country, π^*), E and e the nominal and real exchange rates, respectively, o the central bank's operating expenditures, b the central bank (net) interest bearing liabilities, x the net international reserves, and k the central bank's capital. As currency issue provides the main, non distortionary, source of revenue, it is natural to use it as scaling variable and express all quantities as ratios to currency. Expressed in this fashion, the two variables that drive the capital accumulation dynamics, o and x, are initially assumed to remain constant, i.e., both operating expenditures and international reserve holdings are assumed to grow at the same rate as currency; this assumption will be later relaxed.

For normative reasons, core capital is calculated such that central banks are assumed not to rely on the distortionary taxation of their deposits. At the same time, all domestic assets (including any public securities) are assumed to be marked-to-market and all nonperforming assets to be fully provisioned for and written off. Thus, all central bank liabilities (except currency) and all central bank domestic assets are assumed to be remunerated at market rates of interest and are therefore included in b. The central bank's balance sheet may thus be

[3] The paper does not otherwise deal with issues related to the transfer of profits between central banks and national treasuries.

expressed as:

$$k = ex - b - 1 = u - b, \tag{1}$$

where $u = ex - 1$ is a key policy variable, defined as the central bank's "excess international reserves" (in excess of currency).[4]

Several definitions of profits will be used. First, conventional accounting profits may be defined, following international best practices, as:[5]

$$\Omega^{IAS} = (r^* + \pi^* + \frac{\dot{E}}{E})ex - (r + \pi)b - o, \tag{2}$$

"Real" profits, corrected for nominal currency growth (the sum of inflation and real currency growth, g) and assuming away dividend payments, are defined as:

$$\Omega^R = \Omega^{IAS} - (\pi + g)k = \dot{k}. \tag{3}$$

Using (1) and (2), regrouping terms and assuming that relative purchasing power parity holds on average over long periods, $\pi^* + \frac{\dot{E}}{E} = \pi$, (3) may be expressed in "structural" form, i.e., unencumbered by short-term valuation adjustments, as:

$$\Omega^S = r^* ex - rb - o + \pi - gk = \Omega^R - \frac{\dot{E}}{E} ex + (\pi - \pi^*)ex. \tag{4}$$

Notice that structural profits differ from real profits in that they do not incorporate short-term valuation adjustments on the stock of international reserves; however, they do include the systematic, longer term component of these valuation adjustments, i.e., the seignorage gains resulting from systematic depreciations when domestic inflation is higher than world inflation.

Let us define $\varphi = r - r^*$ as the interest rate premium on domestic securities. With a constant real exchange rate, i.e., ruling out systematic changes in the real exchange rate, φ is a structural variable that reflects risk (country risk and currency risk), as well as any liquidity

[4] The use of the term "excess reserves" does not carry a normative connotation. It may be optimal to have u >> 0 leading to capital shortfalls.

[5] See Sullivan (2003).

premium resulting from a potential mismatch between the (longer) maturity of central bank debt and that (shorter) of central bank reserves. Using the definitions of φ and u and substituting b using (1), and rearranging terms, (4) may be rewritten as:

$$\Omega^S = r^* + \pi - \varphi u - o + (r^* + \varphi - g)k. \tag{5}$$

Finally, define "core profits," Ω^C, as structural profits expressed for $k = 0$:

$$\Omega^C = r^* + \pi - \varphi u - o. \tag{6}$$

As we will see below, this variable plays a fundamental role in driving capital dynamics and, hence, determining core capital requirements.

With (6), (5) may be expressed as:

$$\Omega^S = \Omega^C + r_n k, \tag{7}$$

where, r_n, is the growth-adjusted domestic interest rate:

$$r_n = r^* + \varphi - g. \tag{8}$$

Since capital replaces interest bearing debt (which pays $r^* + \varphi$), r_n is the opportunity cost of capital net of the reinvestment rate needed to allow it to grow at par with currency. Thus, the equation above indicates that for the structural return on equity of a central bank, Ω^S / k, to be capital invariant and market determined (as would be the case for commercial banks), core profits should equal zero. Indeed, the existence of large core profits or losses is what sets aside central banks from commercial banks. While market competition rapidly drives core profits and losses to zero for commercial banks (through adjustments in intermediation margins and changes in market participation), such adjustments do not necessarily take place for central banks.[6] Instead, a central bank can indefinitely maintain positive core profits without attracting competitors, and remain profitable even when its capital is negative. Inversely, a central bank can indefinitely sustain core losses provided its owner (the government) is willing to *fiscalize* those losses by capitalizing the central bank with sufficient core capital to generate an income stream which offsets the core losses, notwithstanding the fact that the expected return on equity is below the market rate

[6] Notice that zero "core" profits does not imply zero profits. Instead, it only implies no "excess" profits (the rate of return on equity equals in this case the market rate, r_n).

($\Omega^S / k < r_n$).

B. Core Capital

In view of the asymmetry of profits transfers (excess profits are automatically transferred to the treasury but the treasury does not automatically make up for a loss), the central bank should meet its intertemporal budget constraint. While failure to do so may not necessarily undermine the market value of its debt (investors may continue to acquire the debt under the expectation that the central bank will be able to generate in the future the necessary inflationary income to pay off its obligations), it can undermine the credibility of its inflation target. Thus, to be able to maintain its inflation credibility (which is particularly important under an inflation targeting regime), the present value of the central bank's (real) profits (i.e., its net worth) should be non negative. Given that Ω^S is expressed as a ratio to currency (which grows at the rate g), this may be expressed as:

$$\int_0^{+\infty} \Omega^S e^{-r_n t} dt \geq 0. \tag{9}$$

With (7), Ω^S can be written as:

$$\Omega^S = \dot{k} = r_n (k - k^C), \tag{10}$$

where:

$$k^C = \frac{\varphi u + o - (r^* + \pi)}{r_n} = \frac{-\Omega^C}{r_n}. \tag{11}$$

From (10), it is clear that the capital dynamics depend on the sign of the growth-adjusted rate of interest, r_n. When the latter is positive, the capital dynamics are unstable (k diverges to plus or minus infinity unless it is initially equal to k^C) and for any $k > k^C$ ($k < k^C$), Ω^S remains positive (negative). Thus, $k = k^C$ is the lower threshold value of k that satisfies (9).

Inversely, for $r_n < 0$, the capital dynamics are stable (k always converges to k^C) and $k = k^C$ is the higher threshold value of k that satisfies (9).[7] In what follows, the analysis will be restricted to the "normal" case in which the average net return on capital is positive.[8]

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[7] In this case, having more capital makes the central bank "worse off" because the more capital it has, the more resources it needs to set aside to allow capital to grow at the rate g.

[8] Given that currency growth is likely to be lower than output growth, the condition $r_n = r - g \geq 0$ should be satisfied when the (real) rate of interest is not lower than the rate of output growth, which is the familiar dynamic efficiency condition of the growth literature.

(continued)

C. Central Bank Independence

The first thing to notice from (11) is that core capital is directly related to core profits. With a positive Ω^C, a central bank does not need core capital. In fact, a central bank that has large positive core profits can have a large negative capital position. This would be the case of countries that do not hold large excess international reserves, that are financially well integrated (φ close to zero), or where central banks' operating expenditures are low. Inversely, countries which are highly exposed to macroeconomic volatility (hence that need to hold large excess reserves when country and currency risk are high), and where the central bank's operating expenditures are high, would need to hold large amounts of central bank core capital if they wish to target low levels of inflation. Such central banks would need to back most of their excess reserves with capital, rather than debt.

The second thing to notice is that higher operating expenditures or higher excess reserves, unsurprisingly, raise capital requirements. Similarly, the lower the target rate of inflation, the higher the capital needed to support it. Let us define the "core rate of inflation," π^C, as the threshold rate of inflation that ensures zero core profitability. It is a function of the foreign reserves holding policy and the central bank's operating expenditures, such that:

$$\pi^C = \varphi u + o - r^* . \tag{12}$$

Thus, core losses will directly result from targeting a rate of inflation below the core rate:

$$\Omega^C = \pi - \pi^C . \tag{13}$$

Unless the central bank has enough core capital to support a negative inflation gap ($\pi < \pi^C$), it will eventually run into financial difficulties that will require relaxing its inflation target. Lack of capital can thus directly interfere with monetary independence.

Somewhat counter-intuitively, however, a higher rate of currency growth or higher interest rates (whether international or domestic) may increase or decrease capital requirements. To understand what drives these results, let us take each of these variables in turn. As regards currency growth, a higher g leads to a higher k^C when $k^C / r_n > 0$. With a positive growth-

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This condition is also consistent with the transversally condition of intertemporal models. It implies that a borrower cannot indefinitely service its debt (at the rate r) by increasing its borrowing (at the rate g). It is thus equivalent to the familiar no-Ponzi game solution of growth models.

adjusted rate of interest, this condition reduces to $k^C > 0$. A positive core capital implies that assets are higher than (non capital) liabilities. As all assets and liabilities are assumed to grow at the same rate, the higher g, the higher the profits (hence capital) required to accumulate the excess of assets over liabilities (or, equivalently, the higher the profits required to allow capital to grow at the rate g). Thus, the higher the rate of growth of currency, the faster the central bank needs to accumulate international reserves, and hence the more capital it needs to generate the necessary cash flow. However, a central bank may not necessarily wish to maintain a constant international reserves ratio to GDP. This illustrates the limitations of the uniform growth assumption and the need to explore alternative assumptions (see below).

Take now the case of φ. The k^C schedule can have either of the two shapes shown on Figure 1, depending on the sign of the expression: $(r^* + \pi) - o + u(r^* - g)$. When this expression is positive, Figure 1-A applies: $k^C < u$, which, with (1), implies that net debt is positive ($b > 0$). Thus, an increase in φ raises expenditures, requiring higher capital. Inversely, when the expression above is negative, Figure 1B applies. High capital requirements ($k^C > u$) induce the central bank to hold positive net domestic assets instead of debt ($b < 0$). In this case, an increase in domestic interest rates clearly improves the central bank's profitability and, hence, reduces capital requirements.

A similar tale applies to world interest rates. An increase in r^* raises both the central bank's interest income on its foreign reserves and the interest expenditure on its debt. Depending on relative sizes (i.e., the amount of capital), one effect dominates the other. Assuming again $r_n > 0$, the k^C schedule can have either of the two shapes shown on Figure 2, depending on whether $1 + k_c = ex - b \gtrless 0$. In Figure 2A, low capital requirements lead to excess debt relative to foreign reserves. Hence, an increase in world interest rates worsens profitability and raises capital requirements. In Figure 2B, it is the other way around.

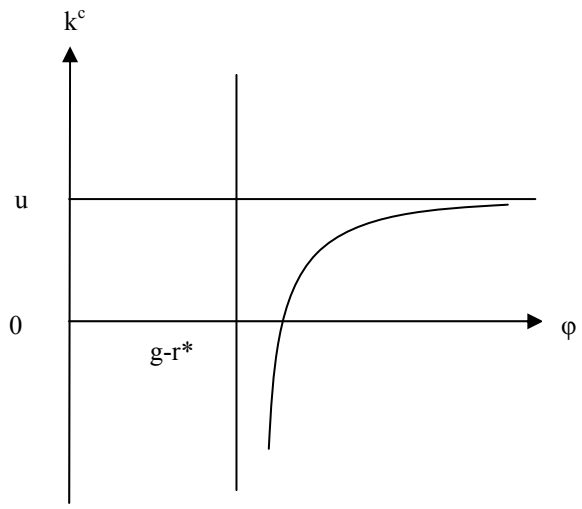
D. Dealing with Changing Balance Sheets

The methodology presented above assumes that in the steady state all items in the central bank's balance sheet grow at the same rate (hence the balance sheet structure remains invariant), which may not always be the case. For example, the income elasticity of the demand for currency could be substantially less than one (indeed, as electronic means of payment become increasingly available, the demand for cash has tended to decline). Yet, the central bank could wish to maintain a constant ratio of international reserves to GDP. Inversely, central banks that have accumulated very large international reserves during periods of heavily administered exchange rates with pressures towards currency appreciation are likely to accumulate less reserves as they shift to cleaner floats or gradually jettison some of their reserves to reduce their carrying cost.

To account for differential growth rates, let g_u and g_o be the rates of growth of excess reserves and operating expenditures, respectively, and define $\Delta g_u = g - g_u$ and $\Delta g_o = g - g_o$

Figure 1. Core Capital and Interest Rate Premium

1.A. Low Capital



1.B. Low Seignorage

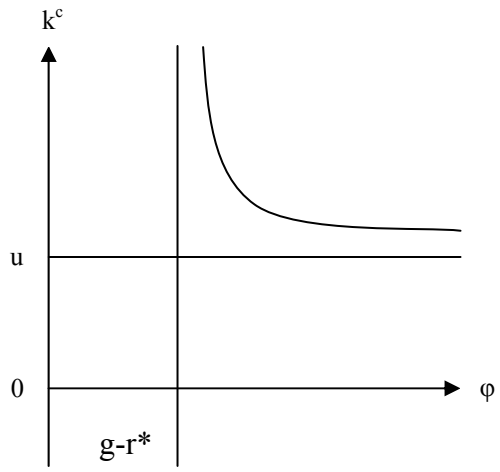
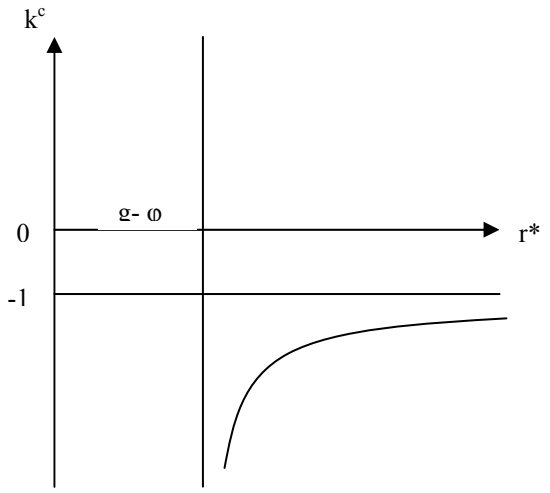
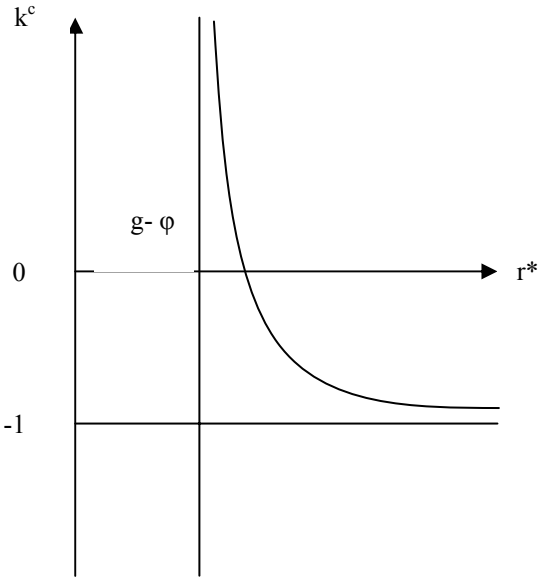


Figure 2. Core Capital and World Interest Rates

2.A. Low Capital



2.B. High Capital



as the growth differentials with respect to currency.[9] An expression of k that satisfies (7) must be of the type: $k = Ae^{r_n t} + Be^{-\Delta g_u t} + Ce^{-\Delta g_o t} + D$, where the coefficients A, B, C and D can be obtained from differentiating k and substituting in (7), under the initial condition $k^C = A + B + C + D$. In turn, substituting k in the net worth condition (9) leads to the following expression for the adjusted core capital, $\widehat{k}^C$:

$$\widehat{k}^C = k^C - \frac{\Delta g_o}{r_n + \Delta g_o}\frac{o}{r_n} - \frac{\Delta g_u}{r_n + \Delta g_u}\frac{\varphi u}{r_n}, \tag{14}$$

where k^C is the core capital for uniform growth rates (as defined above). Adjusted core inflation and core profits can similarly be derived as those levels of inflation and (structural) profits for which $\widehat{k}^C = 0$:

$$\widehat{\pi}^C = \pi^C - \frac{\Delta g_o}{r_n + \Delta g_o} o - \frac{\Delta g_u}{r_n + \Delta g_u}\varphi u, \tag{15}$$

and:

$$\widehat{\Omega}^C = \Omega^C + \frac{\Delta g_u}{r_n + \Delta g_u}\varphi u + \frac{\Delta g_o}{r_n + \Delta g_o} o. \tag{16}$$

Notice from these expressions that, for *small values of* r_n, core capital (as well as core inflation and core profits) becomes quite sensitive to the differential growth assumption. Indeed, in the limiting case where r_n is very small, $\frac{\Delta g}{r_n + \Delta g} \to 1$, and the expenditures terms drop out altogether from the expression of core capital. If both operating expenditures and interest expenditures grow less rapidly than currency, $\widehat{k}^C$ becomes extremely negative. Thus, even a slightly lower expected rate of growth of central bank expenditures over the expected rate of growth of currency can dramatically reduce (or obviate, altogether) the need for central bank capital.

E. The Case of a Stochastic Environment

Let us now briefly outline how these results would need to be altered to fit a stochastic environment. Minimum capital requirements would generally exceed the deterministic threshold, k^C, as additional "buffer" capital, k^B, is likely to be needed to: i) allow the central

[9] $g_u = 0$ corresponds to the case of a marginal currency board-type arrangement such that international reserves increase at par with currency.

bank to absorb adverse macroeconomic volatility (affecting g, φ, e, or r^*); and ii) give it a sufficient margin to increase its (excess) international reserves or operating expenditures, or follow a more ambitious monetary policy (i.e., reduce its inflation target). A value-at-risk (VAR) methodology, as proposed by Blejer and Schumacher (1999), could be used to determine such buffer capital.[10] Based on the projected distributions and correlations of the main stochastic variables, and reasonable bounds for the policy variables, a probability distribution can be inferred for k^C using (11); k^B can then be determined at the upper tail of this distribution, with a suitable tolerance level.

III. SOME ILLUSTRATIONS

A. Methodology

The following numerical illustrations are based on the latest published accounts of three central banks that have reported losses in recent years and/or negative capital positions, Costa Rica, Chile, and Mozambique. In all three cases, the story is fairly similar. The weak balance sheets in part reflect poorly performing domestic assets, resulting from large credits to government or failing banks. They also reflect costly domestic liabilities, resulting from central bank attempts to sterilize capital inflows and limit exchange rate appreciations. The latter led to large excess international reserve holdings in a context of high interest rate premia on central bank paper. Large operating expenditures (relative to currency) are an aggravating factor in some of these cases.

Determining capitalization needs would require estimating, in addition to core capital, the current capital, k, and buffer capital, k_B. However, the former requires determining the net worth of assets which may be partially performing or have an uncertain recovery value, as well as the net worth of unremunerated non-monetary liabilities (such as unremunerated reserve requirements), or contingent liabilities. This is inherently a difficult exercise that requires more information than that which is generally published. On the other hand, estimating buffer capital requires a full, forward-looking stochastic analysis of risks and volatilities (also a complex exercise). For simplicity, this exercise is therefore limited to determining core capital. It is an assessment of minimum capital requirements rather than potential capital shortfalls.

Table 1 presents the main parameter values for the three case countries. The estimates of r^* and r (hence φ) are derived from ten-year historical averages. The estimate of r^* is based on the real interest rate on two-year U.S. T-bills (two years being a reasonable average duration for an international reserve portfolio). Similarly, the estimate of r is derived from

[10] Notice, however, that the past volatilities of macro variables such as the interest rate or the exchange rate do not always provide a good basis to project their future volatilities, due to regime changes and potential "peso problems."

Table 1. Basic Parameters for the Case Study Countries

	η	g	r*[1]	r	φ	r_n	Π_{avg}	Π
Chile	0.88	4.25	2.45	5.41[2]	2.98	1.16	5.43	3.00
Costa Rica	0.92	4.32	2.45	7.46[3]	5.03	3.14	12.94	3.00
Mozambique	0.60	4.67	2.45	9.60[4]	7.17	4.93	9.39	3.00

[1/] 2-year U.S. Treasury bill rate.
[2/] 3-month Central bank of Chile bill rate.
[3/] Tasa básica pasiva (weighted average of commercial bank and central bank funding rates).
[4/] 3-month treasury bill rate.

the average interest rate on the local currency instruments that account for the bulk of the domestic marketable debt of the central bank. The real rate of growth of currency, g, is obtained from deriving the income elasticity, η, of the demand for real currency balances by regressing (the log of) real currency holdings over (the log of) real GDP. Expected currency growth is then obtained by extrapolating expected real GDP growth from the average growth over the last ten years. The target rate of inflation, π, is uniformly taken as 3 percent (which coincides with the publicly announced target in Chile), and is contrasted with the historic average inflation over the last ten years.

The parameters u and o are extracted from the latest available central bank accounts. For illustrative purposes, these values are compared to some international averages for a sample of 9 high income countries, 14 middle income countries, and 11 low income countries for which data on both balance sheets and income statements are available (Table 2).[11]

Table 2. Excess International Reserves and Central Bank Operating Expenditures as Ratios to Currency, (2002–2003)[1]

	u	o
Chile	3.95	1.14
Costa Rica	1.17	5.59
Mozambique	3.92	16.77
Average low Income countries[2]	1.54	11.79
Average middle income countries[3]	3.21	3.75
Average high income countries[4]	-0.11	1.16

[1/] IFS and Central bank financial statements.
[2/] Low income countries: Bolivia, Paraguay, Guatemala, Indonesia, Malawi, Mozambique, Kenya, Honduras, Azerbaijan, Nicaragua ,and Haiti.
[3/] Middle income countries: Brazil, Argentina, Peru, Colombia, Korea, Thailand Trinidad, South Africa, Chile, Costa Rica, Poland, Israel, Uruguay, and Russia.
[4/] High income countries: United States, Canada, France, Italy, Germany, United Kingdom, Australia, New Zealand, and Austria.

[11] Cross-country comparisons of central bank operating expenses need to be interpreted with care. Unless adjusted for scale economies and the range of services provided, it is not possible to assess efficiency from such simple comparisons.

A broad range of estimates is obtained for core profits, core inflation and core capital, using as upper and lower bounds the following two limiting cases: (i) excess international reserves and operating expenditures grow at the same rate as currency; and (ii) excess international reserves and operating expenditures stop growing.[12] The static case where all variables (including currency) are expected to remain constant is used as a middle of the range estimate.

B. Costa Rica

The Central Bank of Costa Rica reported, at end 2003, a negative capital position of some US$1.3 billion, equivalent to 8 percent of GDP and over three times currency in circulation (Table 3). As a result, it has reported large quasi-fiscal losses (1.5 percent of GDP on average during the last five years). Its weak financial situation resulted in part from an accumulation of large liabilities during the 1980s, as it issued debt to offset the monetary implications of subsidized sales of foreign exchange and subsidized credit to the central government and private sector. In addition, it accumulated non-earning assets during the 1990s, derived from trade credits and the liquidation of a state-owned bank. In recent years, the central bank's position was also affected by a substantial accumulation of foreign reserves and a sharp reduction of non-remunerated reserve requirements. A 1996 law prohibited additional central bank credit to the government and the provision of subsidized credit. It also called for a gradual recapitalization, as a result of which some important contributions were made by the treasury to strengthen the central bank's accounts (6 percent of GDP in 1999 and 2.5 percent in 2001).

Table 3. Costa Rica: Summary of Central Bank Balance Sheet
(As a ratio to currency in circulation), 2003

Liabilities		Assets	
Currency	1.0	International reserves	2.2
Market Debt	3.9		
Net other liabilities	0.7		
Capital	-3.4		
Total liabilities	**2.2**	**Total assets**	**2.2**

Reflecting in part its monetary policy and exchange rate regime (a crawling peg that does not directly target inflation), the cost of issuing medium term domestic currency debt has been quite high. Real interest rates on central bank instruments exceeded the U.S. real interest rate (of around 2 percent) by about 500 basis points (Table 1). Together with relatively high operating expenditures ($o = 5.6$, compared with a mean of 3.7 for the sample of middle

[12] As indicated above, this assumes that increases in international reserves accommodate, one for one, increases in currency, as in a currency board arrangement.

income economies)[13] and notwithstanding moderate excess reserves ($u = 1.2$, compared to a mean of 3.2 for the same sample), this has given rise to substantial core losses ($\Omega^C = -6.1$) and a core rate of inflation (about nine percent) that closely approximates current and average historic inflation (10 percent and 13 percent, respectively; see Tables 1 and 4). Indeed, the central bank has been unwilling to lower its target rate of inflation in recent years out of concern for the sustainability of its balance sheet.

Table 4. Core Capital, Core profits, and Core Inflation

	Ω^c	k^c	Π^c
Costa Rica			
Uniform Growth	-6.06	1.93	9.06
Asymmetric Growth	0.59	-0.19	2.41
Zero Growth	-6.06	0.81	9.06
Chile			
Uniform Growth	-7.48	6.48	10.48
Asymmetric Growth	2.67	-2.31	0.33
Zero Growth	-7.48	1.38	10.48
Mozambique			
Uniform Growth	-39.42	8.00	42.42
Asymmetric Growth	-17.59	3.57	20.59
Zero Growth	-39.42	4.11	42.42

Thus, allowing the central bank to lower its inflation target to three percent while continuing to increase its international reserves and operating expenditures at par with currency (and output) growth would require raising its core capital to around twice its stock of currency. With constant reserves and operating expenditures, on the other hand, core capital would be around zero. However, given their moderate level, the scope for reducing international reserves may be limited. Thus, actual recapitalization needs may be closer to the upper bound of the range than to its lower bound, suggesting that a large capitalization (and the associated fiscal effort) are key requirements for allowing the central bank to stabilize inflation, thereby gaining credibility and reducing the cost of its debt.

C. Chile

The balance sheet of the Central Bank of Chile is dominated by very large external reserves, equivalent to nearly 5 times currency in circulation at end-2003 (Table 5). These were accumulated for the most part during the 1990s as the central bank intervened repeatedly in the foreign exchange market to limit the appreciation of the exchange rate under its crawling

[13] The relatively high central bank operating expenditures are likely to reflect economies of scale, as the size of Costa Rica's economy is substantially below that of most other middle income countries in the sample.

Table 5. Chile: Summary of Central Bank Balance Sheet
(As a ratio to currency in circulation), 2003

Liabilities		Assets	
Currency	1.0	International reserves	4.9
Market Debt	6.8	Net other assets	2.6
Capital	-0.3		
Total liabilities	**7.5**	**Total assets**	**7.5**

band regime (the band was eliminated and a full fledged inflation targeting regime adopted in 1999).[14] The other noteworthy component of the balance sheet is a large stock of domestic securities issued by the central bank. These were issued partly as a counterpart to the accumulation of foreign reserves, and partly as counterpart to the large liquidity and solvency support provided to banks in difficulty during the 1982 banking crisis. While the central bank eventually received dollar bonds from the government to support these operations, the interest rate on the bonds has not fully matched the interest cost of its debt.

The carrying costs of the public bonds and the large excess international reserves ($u = 4.0$, compared to a mean of 3.2 for our sample of middle-income countries) have contributed to generate persistent losses in recent years, of between 1 and 2 percent of GDP per year, despite the central bank's very low operating expenditures ($o = 1.1$) and relatively moderate interest rate premia (about 300 basis points; Table 1).[15] Indeed, core losses (under a uniform growth assumption) are very high ($\Omega^C = -7.5$) and core inflation ($\pi^C = 10.5$ percent) is substantially above both targeted and historic inflation (Tables 1 and 4).

However, given the relatively large size of international reserves, results are extremely sensitive to growth assumptions. They change dramatically if one assumes that excess international reserves only grow to accommodate increases in currency (perhaps not an unreasonable assumption in this case). Core losses turn into profits, core capital becomes negative, and core inflation falls below target.[16] Thus, one of the main questions Chile's

[14] Notwithstanding substantial pressures in the foreign exchange market during the 1998-2002 period of high capital market turbulence that followed the Russian, Brazilian, and Argentinean crises, foreign reserves were kept high as the central bank issued dollar indexed liabilities to help meet the excess demand for dollar hedges.

[15] Interest rate premia have recently declined, partly accompanying the decline in Chile's sovereign risk (which currently fluctuates around 100 basis points). This paper uses a longer historical average to ensure a steadier benchmark and facilitate cross-country comparisons.

[16] However, unless the central bank is recapitalized, it will continue in the short term to incur structural losses. As discussed below, avoiding a recapitalization on the grounds that expected future profits will offset immediate losses may be problematic.

central bank faces is whether it will continue to need a large systemic liquidity buffer in the future and, if so, whether there are ways to reduce its carrying cost.

D. Mozambique

As in the case of Chile, Mozambique's central bank holds very sizable international reserves (about 5 times its stock of currency in circulation, compared to a mean of 1.9 for the sample of low income countries), accumulated mostly as a result of large external loans and grants given to the government (and the central bank), as well as, in recent years, some sterilization of capital inflows (Table 6). However, the interest rate premium on its domestic debt (700 basis points) and its operating expenditures are both way higher than in Chile ($o = 16.8$; see Table 2). The former reflects, in addition to a high currency and country risk, a very undeveloped bond market. The latter reflects in large part the substantial fixed cost of operating a full-fledged central bank in a small, low income economy (the average operating expenditures of central banks in low income countries is 11.8, somewhat below Mozambique but yet much above average levels in higher income countries).

Reflecting the very substantial carrying costs of international reserves and equally high operating expenditures, core capital is very high, even if one assumes that both international reserves and operating expenditures will stop rising. Core inflation is similarly high. In practice, however, minimum capital requirements are lowered very substantially by the fact that market debt accounts for less than one fourth of the central bank's liabilities (other than currency and capital). The cost of the nonmarket debt, which is composed mostly of debt to multilateral organizations (at preferential rates) and unremunerated (or only partially remunerated) bank reserves and public sector deposits, is much lower than that of market debt. One of the key question Mozambique thereby faces is whether it will be able in the future to continue financing its international reserve accumulation through non-market debt, and if so, whether the resulting burden imposed on the financial system could become excessive.

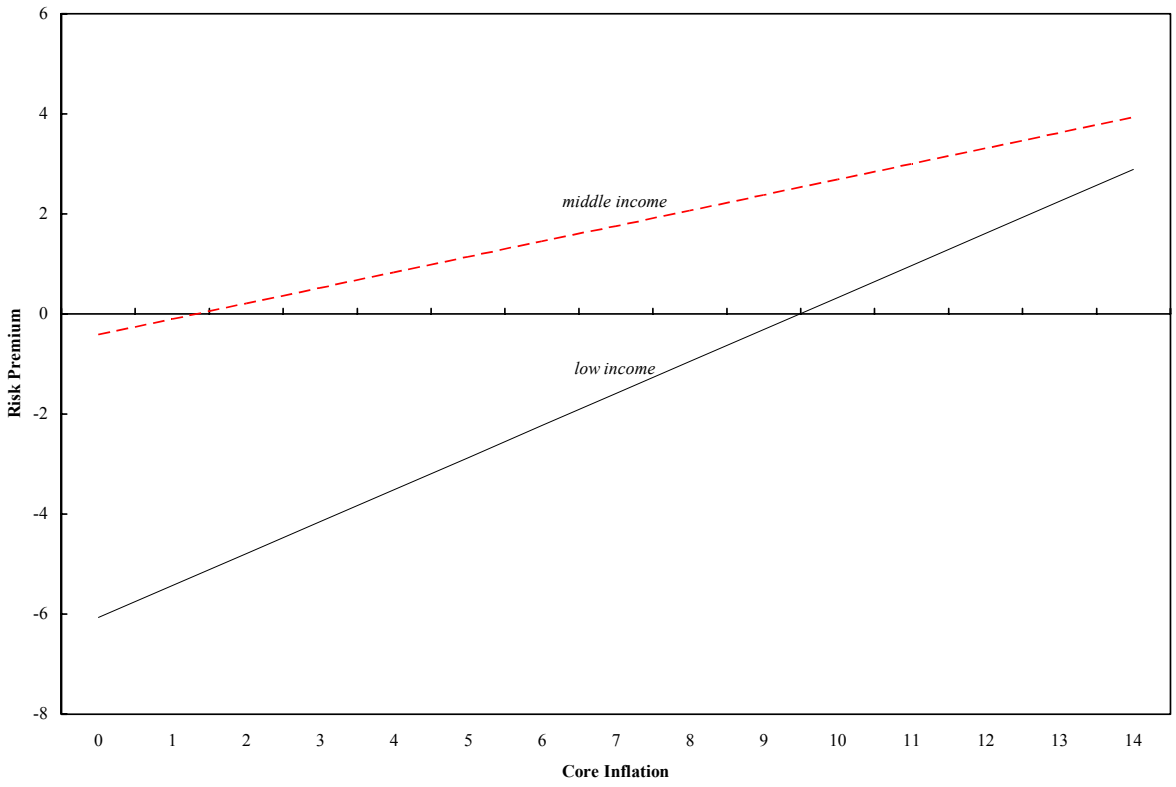
Table 6. Mozambique: Summary of Central Bank Balance Sheet
(As a ratio to currency in circulation), 2002

Liabilities		Assets	
Currency	1.0	International reserves	4.9
Market Debt	0.7		
Net other liabilities	3.1		
Capital	0.1		
Total liabilities	**4.9**	**Total assets**	**4.9**

E. How Widespread Is the Need for Core Capital?

Before turning to policy issues, the extent of the underlying need for core capital (as derived from (11), i.e., for the case of uniform growth) can be quickly assessed, based on the average excess reserves and operating expenditures shown in Table 2 for the high, middle and low income countries. A quick glance at the data shows that the average high income country does not need core capital under any positive inflation rate or risk premium. Instead, middle and low income countries need core capital for a wide range of risk premia and inflation rates, as shown in Figure 3. In the absence of core capital, for the middle income country to be able to target a low inflation rate of 3 percent, its risk premium should be no higher than 57 basis points. Few, if any, middle income countries can match that figure. In the case of the representative low income country, the lower rate of inflation it could target, even without paying any premium on its public debt, is 10 percent. That rate of inflation is likely to be too high to firmly secure the value of the currency, hence to maintain a low risk premium on the local currency debt. Absent distortionary taxation (more on this below), a positive core capital is therefore likely to be needed in many of these countries.

Figure 3. Core Inflation and Risk Premium for the Sample Averages of Low and Middle Income Countries



IV. Policy and Reporting Implications

A. Should Central Bank Recapitalizations Be Automatic or Negotiated?

To the extent that central banks have been used in the past as convenient channels to carry out quasi-fiscal expenditures (including support to troubled financial entities), central bank recapitalizations bring into the open issues which politicians would rather keep buried.[17] Even when this is not the case, central bank capitalizations can still trigger lengthy and sometimes acrimonious debates as they involve the use of scarce public funds for activities that are for the most part out of the public eye and whose benefit is often difficult to grasp. In particular, capitalization debates may bog down as they home in on the size of the central bank's interest expenditures (hence excess international reserves) and on its operating expenditures. The scarcity of comparable benchmarks (particularly as regards central bank operating expenditures) and the lack of a clear consensus as regards optimal levels of international reserves makes these discussions inherently complex.[18]

To avoid these debates and speed up the capitalization, some central bank charters include an obligation for national treasuries to automatically recapitalize central banks. However, the fact that there are relatively few such charters is perhaps not too surprising as they amount to giving central banks nearly unconstrained power in setting their expenditures. Because central bank objectives (achieving price and financial stability) are strictly monetary and financial in nature, their boards are likely to be less preoccupied with costs than fiscal authorities which are responsible for financing all public expenditures. Indeed, the large quasi rents obtained by central banks from the issue of high power money can generate, by themselves, a bias towards an excess provision of monetary and financial stability services relative to other public goods. Certainly, this would be the case when the socially optimum level of central bank expenditures is below the income generated by seignorage at the socially optimum rate of inflation (i.e., when seignorage income is not binding). When central banks are automatically recapitalized, the risk of *over-provisioning* extends even to the case in which the socially optimal level of central bank spending exceeds seignorage. Thus, the relative scarcity of legislations that allow for automatic capitalizations should come as no surprise.

The extreme opposite alternative would consist in taxing away all seignorage revenue and financing central bank expenditures through regular budgetary appropriations (i.e., turning

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[17] On quasi-fiscal expenditures, see Stella (1996).

[18] A rapidly growing literature has emerged in the last few years that re-examines the role of international reserves in the context of open capital accounts and floating exchange rates. See Flood and Marion (2001), Wijnholds and Kapteyn (2001), Aizenman and Marion (2003), and Garcia and Soto (2004).

central banks into government agencies). Unless proper arrangements are found that protect central banks' independence, this could of course undermine their capacity to achieve an optimal rate of inflation. In addition, it is likely to result in an *under-provisioning* of monetary and financial stability services. Because the constituency for macro-financial stability is broadly diffused and the marginal benefits of macro-financial stability expenditures are hard to grasp, the latter are likely to lose their ground when compared to more immediately pressing expenditures promoted by well identified interest groups with clearly measurable benefits. While less extreme, solutions that shift the ownership of international reserves to national treasuries but allow central banks to retain seignorage revenue (as in many Anglo Saxon countries) are likely to face similar difficulties.

Middle ground, negotiated, solutions that allow central banks to retain seignorage but require legislative approval for central bank capitalizations, while still clearly imperfect, are thus likely to be unavoidable. Requiring that the three main parties involved in the capitalization (the monetary authorities, the fiscal authorities, and the legislature) reach an agreement may be the only way to limit the scope for glaringly inefficient levels of central bank spending.

At the same time, a clear distinction needs to be made between quasi-fiscal expenditures (such as those resulting from central bank supports to failing banks) and macro-financial stability expenditures. The former clearly need to be automatically picked up by the national treasury.[19] Hence, central bank recapitalizations whose only purpose is to "repay" the central bank for *past* quasi-fiscal expenditures should be uncontroversial and a matter of routine. Instead, those capitalizations that aim at *fiscalizing* part of the central bank's *future* expenditures on monetary and financial objectives are of course likely to be more controversial and to generate ample debates, as they should.

B. Some Options to Limit the Need for Core Capital

Reaching a consensus is likely to require doing some sensitivity analysis and exploring the scope for policy changes aimed at limiting the need for core capital. In particular, policy makers may wish to trade off at the margin some inflation against the provision of central bank services. As is apparent from (11), each one percentage point in additional inflation can finance an additional accumulation in foreign reserves of one time currency under a 100 basis points risk spread.[20]

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[19] Notice, however, that it is generally preferable for a central bank to limit its exposure by maintaining senior claims on the banks it lends to. This shifts the potential costs of bank support operations to the deposit insurance agency (whose claims on the liquidated bank become junior relative to those of the central bank), or to the national treasury if the deposit insurance agency needs to be supported by the fiscal authorities.

[20] This assumes that the demand for currency is invariant to the rate of inflation. A more refined calculation should correct for the inflation elasticity of currency demand.

Indeed, in some cases the legislature (or the fiscal authorities) may become deadlocked and indefinitely delay reaching an agreement on the central bank's capitalization, or refuse altogether to consider appropriating tax income for covering central bank expenditures such as the cost of holding foreign reserves. In part, such an attitude may result from the inherent technical difficulty in assessing the benefits of such expenditures and comparing them with other expenditures with more obvious returns. In such cases, central banks are bound to perform a constrained optimization exercise in which they must compare the stability benefits of holding additional reserves with the inflationary costs of financing those reserves.

In conducting this analysis, the ratio of international reserves to currency is a key variable that policy makers need to look at. Indeed, reserve accumulation objectives are most often set in regards to variables such as imports, banking system liabilities, or short-term external debt, i.e., in relation to variables that measure *benefits*. It is equally important, however, to integrate to the analysis variables that measure *costs*, including the ratio of reserves to currency, and the risk premium.

The debate may spill over into a discussion of the exchange rate regime. By economizing on reserves, a floating rate regime may be viewed as more affordable than a fixed rate regime. At the same time, a more transparent, inflation-anchored, regime may reduce the risk premium on the local currency debt, favoring inflation targeting regimes. Central bank recapitalizations can also provide a good opportunity to review public debt management and financial development policies. By allowing treasury instruments to substitute central bank instruments, a recapitalization can help rationalize and deepen the market for public securities, thereby reducing their cost and promoting financial deepening.

Limiting the future accumulation of foreign reserves can also drastically reduce the need for central bank capital. In particular, countries that have accumulated reserves as a result of heavy interventions aimed at limiting exchange rate appreciations, rather than as a goal in itself (i.e., to constitute a systemic liquidity buffer), may need to find ways to dispose of these reserves over time, at least in relative terms (in relation to currency), if not in absolute terms.[21] However, central banks that choose to slow down their reserve accumulation (rather than selling off at once some of their current reserves) may face credibility issues if they justify lower capital requirements based on trading off central bank losses in the near term against central bank profits in the longer term (that will start to arise once international reserves have declined sufficiently in relative terms).

Should the capitalization of the central bank become bogged down by the fact that the authorities (monetary or fiscal) are unsure how many international reserves they might need in the future, a possible way out is to transfer at least part of the cost of further accumulations

[21] For example, countries that wish to continue accumulating international reserves may consider adopting the currency board-type accumulation rule, $g_u = 0$.

to the national treasury. This can be done by allowing the central bank to issue domestic debt on account of the treasury and depositing the proceeds in a frozen and unremunerated (or only partially remunerated) government account on the liability side of its balance sheet.[22] However, the already flagged caveat applies. To ensure that the central bank does not deviate excessively over time from the social optimum, it will need to engage in periodic reviews of its international reserves accumulation objectives with the national treasury.

C. Addressing the Issue of Central Bank Operating Expenditures

Central bank capitalizations should also provide good opportunities to generate a long overdue debate about the adequacy of the central bank's operating expenditures. Coming at the end of an era of moderately high inflation, that typically generated substantial seignorage revenues (potentially allowing for some slippage of expenditures), the shift to lower inflation targets, and the uncertainty as regards the future of central bank money in an electronic world, call for efforts to rationalize central bank expenditures and enhance central bank governance and accountability.

While this concern also applies to the smaller and lower income countries, it should nonetheless be recognized that there are substantial fixed costs and scale economies in operating a full fledged central bank. Clearly, the operating expenditures of central banks in small, low income countries cannot be expected to match, as a ratio to currency, those of the larger and higher income countries. For some countries, this could be viewed as an argument in favor of simpler, less resource intensive, monetary and exchange rate arrangements. For others, this may point towards the need to share, at least temporarily (until operating expenditures decline in relative terms and bond market development and enhanced credibility bring domestic interest rates down), the burden of sustaining the central bank's finances with financial intermediaries (through unremunerated required reserves deposited at the central bank). In either case (but particularly in the latter), a careful cost-benefit analysis is clearly called for.

D. Some Reporting Issues

Enhanced transparency should facilitate the above discussions. Firstly, central banks should systematically report their detailed income statements, in a manner that facilitates cross-country comparisons and benchmarkings. While this seems obvious, many central banks do not as yet comply with this practice.

Some key, central bank-specific, accounting concepts appear to be worth computing and reporting on a systematic basis. First, in view of the importance of inflation in the central

[22] This solution would be particularly attractive in cases where the required rate of accumulation of international reserves approximates the rate of interest, pushing core capital to impractically large levels.

bank accounts, systematically adjusting profits for inflation is clearly called for. While some central banks already do such adjustments, this is far from being a generalized practice.[23] It would also seem important to calculate and report structural profits, obtained by removing temporary valuation gains and losses (including those derived from interest rate changes, as well as exchange rate changes) from the calculation of conventional profits. Such calculation would provide a less volatile, hence more transparent and meaningful, measure of underlying profitability.[24]

The next logical step is to derive core profits as structural profits expressed at zero capital. Structural losses provide an immediate (and easy to calculate) warning that the central bank balance sheet is not sustainable in the absence of core capital. Unless the central bank is properly capitalized, it will need to tax its depositors (banks or public entities), or else adjust its policies (i.e., reduce its excess international reserves, limit its operating expenditures, or raise its target rate of inflation). In this context, reporting the implicit taxation of central bank deposits (i.e., their remuneration at less than market rates) or subsidization of central bank operations by the government (through bonds at above market rate) would also enhance the transparency of central bank accounts.

V. CONCLUSIONS

This paper proposed a simple methodology to assess the need for central bank capital, based on a forward looking projection of profits, that is, on expected net worth. It suggested some analytically relevant, central bank-specific, accounting concepts that could usefully be reported by central banks. In particular, it proposed a concept of structural central bank profits, net of temporary valuation gains and losses, as a less volatile and potentially more revealing alternative for economic analysis than conventional profits. It also derived a concept of core capital as the minimum capital needed by the central bank to support a credible inflation target. Core capital was shown to be a simple function of the international reserves held in excess of currency, the central bank's operating expenditures, the interest rate premium on central bank debt, the targeted inflation rate, and the projected rates of growth of currency, international reserves, and operating expenditures. Core profits and core inflation were defined, respectively, as the profits a central bank would obtain, and the minimum rate of inflation it would need to target, in the absence of capital.

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[23] While profits could also, in principle, be adjusted for real balance sheet growth, the fact that the balance sheet may not grow uniformly over time adds complexity and limits the transparency and usefulness of such adjustments. Notice also that adjusting profits for inflation does not imply removing the inflation tax from profits. It only corrects for the inflationary erosion of capital.

[24] The suggestion is to complement (certainly not replace) conventional, fair value-based, measures of profits which clearly should continue to constitute the primary source of accounting information.

The methodology was illustrated with the detailed accounts of three loss-making central banks and the average excess international reserves and operating expenditures for a broader sample of central banks. The country averages suggest that core capital is likely to be positive in many of the low and middle income countries. Some of the specific country examples reviewed in this paper indeed confirmed that a substantial capitalization was needed to allow the central bank to credibly target a low rate of inflation. In other cases, however, the need for (and extent of) core capital was less clear-cut and very much dependent on the expected growth rate of international reserves.

Because capitalizations aimed at building up a positive core capital amount to fiscalizing future central bank expenditures, they are likely to trigger lengthy debates between the monetary authorities, the fiscal authorities, and the legislature as to what constitute socially desirable levels of spending on monetary and financial stability services. The paper argued that such debates are largely unavoidable and should be beneficial to help approximate central bank expenditures to their socially optimal levels. In cases where negotiations stall, central banks may have to optimize under constraints and target a rate of inflation that is consistent with their desired delivery of macrofinancial stability services.

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