

Spending Seigniorage: Do Central Banks Have a Governance Problem?

ALAIN IZE*

This paper reviews how central banks allocate seigniorage, based on systematic cross-country comparisons of their financial accounts. Central banks are classified as weak or strong, depending on their structural profitability. Weak central banks typically (although not exclusively) operate in smaller and less wealthy countries, lack independence from their governments, and are burdened by large nonperforming assets, compulsory transfers, and low capital. Notwithstanding their weak finances, these central banks tend to overspend with regard to their operating expenditures. Governance also appears to be a potential concern in many strong central banks, however, with operating expenditures often adjusting upward for high profitability and capital accumulation and downward for low profitability. Main policy implications are briefly reviewed. [JEL E58, G21, H11]

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Central banks' exclusive right to issue currency gives them privileged access to seigniorage, effectively making them unregulated monopolies. In the past, the siphoning off of seigniorage to governments

*Alain Ize was an Area Chief in the Monetary and Financial Systems Department of the IMF at the time this paper was written. At present he is an IMF staff member advising the Financial Systems Unit of the Financial and Private Sector Development Vice-Presidency of the World Bank. The author is indebted to Nada Oulidi for assembling a very disparate set of central bank financial statements into a homogeneous data set and conducting the statistical analysis for this paper. Comments from participants in the weekly seminar of the Monetary and Financial Systems Department of the IMF are also gratefully acknowledged.

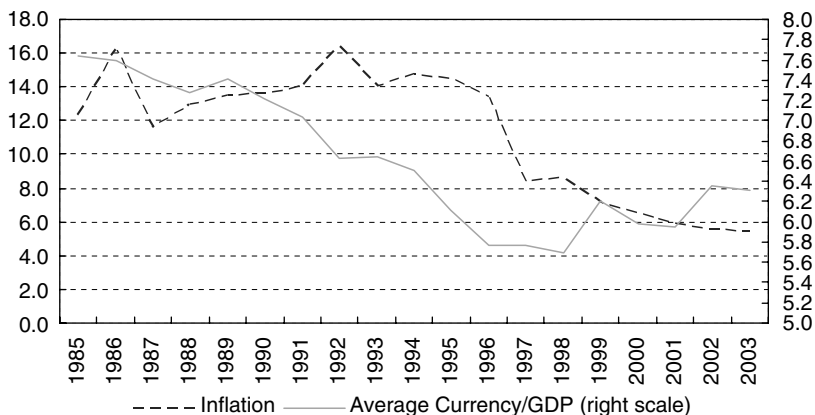
(through quasi-fiscal expenditures, profit transfers, or subsidized financing) raised familiar issues of fiscal dominance and inflationary finance. In recent years, substantial efforts have been made to weed out these linkages and enhance central banks' independence, ensuring in particular that they are well capitalized, remain financially strong, and are well protected from pressures to appropriate their resources to noncore uses, including for fiscal (or quasi-fiscal) purposes. Central banks' charters have been reformed, direct financing to governments prohibited, and quasi-fiscal expenditures eliminated. However, keeping seigniorage inside central banks (to build up their assets, cover the carrying costs of these assets, or cover operating expenses) has brought to the forefront issues of efficiency and governance. Is seigniorage spent "wisely"? Do central banks have sufficient governance standards and safeguards?

These concerns have intensified owing to the deteriorating financial position of many central banks. On the one hand, seigniorage has followed a clear downward trend, reflecting both declining inflation and a declining demand for currency (Figure 1). On the other hand, the carrying cost of foreign reserves has tended to rise, reflecting an expanded accumulation of reserves (Figure 2). Such trends have led to sustained losses and negative capital in many central banks, triggering intense technical and political debates about the need for (as well as the extent and modalities of) central bank recapitalizations (see Stella, 2005; and Ize, 2005).

This paper examines how central banks are allocating their shrinking seigniorage. Based on recent central bank financial accounts and interest rate data for a sample of 101 countries, it addresses the following issues:

- How much seigniorage is retained vs. how much is transferred? If retained, is seigniorage used to build up the central bank's balance sheet,

Figure 1. World Inflation and Currency Demand, 1985–2003
(Average of 101 countries)



Source: IMF, *International Financial Statistics*.

Figure 2. International Reserves, 1985–2004
(In percent of currency)



Source: IMF, *International Financial Statistics*.

Note: See text for the definitions of strong and weak central banks.

and, if so, which type of asset; or is it mainly used to cover its operating expenses?

- How can “poor” financial performance be explained? Is it purely a reflection of weak balance sheets or does it also reflect larger operating expenditures? If the latter, does it reflect mainly structural factors (against which central banks can do little), or does it also reflect poor governance?

The empirical literature that compares central banks’ expenditures is small but has grown rapidly, reflecting an enhanced awareness about the importance of good governance in central banks. Fry, Goodhart, and Almeida (1996) present a pioneering study, albeit limited to a relatively small sample of 42 central banks and covering only specific aspects of governance and management, such as the nature of central banks’ boards, the number and characteristics of their staff, and the functions they perform. In a more recent study McKinley and Banaian (2005) use a sample of 32 central banks to analyze the efficiency with which inputs (labor and capital) are used by central banks to produce outputs (a monetary policy quality index and some financial stability indices). Brione (2005) compares the staff costs of 28 Organization for Economic Cooperation and Development (OECD) central banks and concludes that the very large differences across banks may be

partly explained by the different functions they perform. Pedersen (2006) conducts a somewhat similar study for 21 industrial countries' central banks. On the basis of a somewhat larger sample (66 central banks), Galán Camacho and Sarmiento Paipilla (2006) analyze the evolution of central banks' staffing costs as a function of their operational functions and conclude that central banks face soft budgetary constraints.

This paper differs from the ones above in that it relies on published financial accounts and broad accounting concepts, rather than specific management parameters. This approach allows for more comprehensive coverage in terms of both countries and scope of analysis. It also allows for a more global economic analysis of central bank behavior, based on broad trends in the data. The paper builds on a framework presented by Ize (2005), which identifies structural profits as a key concept to assess the sustainability of central banks' financial performance and their need for capital. The downside of this broader approach, however, is that the scope of the paper is more limited in terms of defining and measuring central bank efficiency.

I. A Cross-Sectional Look at Central Banks' Financial Accounts

Income Statements

The first stage of analysis simply aggregates financial accounts across central banks.¹ Table 1 presents a bird's-eye view of income statements for the sample countries, expressed in terms of the sample means and (in parentheses) standard deviations. Currency is used as a scalar.² Valuation changes and all transitory revenues and expenditures are put together and classified as "transitory net income."³ Net interest income and net other (structural) income are classified as "structural income."⁴

A few important features are worth noting. As expected, the mean transitory net income is very close to zero, while its standard deviation is very large. Indeed, the high standard deviation of retained profits is explained mostly by the high volatility of valuation gains, as illustrated by a variance decomposition (Table 3). Such volatility hinders the year-to-year comparison of central bank performance, as well as its comparison across countries, particularly because many central banks do not clearly distinguish between structural and transitory income in their published accounts. The lack of a

¹The Appendix describes the data set used in this study.

²Currency (rather than GDP) is a natural scalar for central banks. Because it is the only fully market-driven source of seigniorage (unlike bank deposits at the central bank, the demand for currency is entirely voluntary), one would expect it to play a central role in central banks' accounts and be highly correlated with key accounting aggregates. Table 2 shows that this is indeed the case.

³Transitory net income includes realized and unrealized gains and losses on foreign exchange, securities, and fixed assets; net transfers to and from reserves; provisions and write-offs; and other extraordinary gains and losses.

⁴Net other structural income includes commissions and fees and other operating income.

Table 1. Adjusted Income Statement
(In percent of currency)

	Full Sample	Weak Central Banks	Strong Central Banks
Structural income	6.32	-3.26	10.64
Net interest margin	5.80	-3.35	9.92
	(13.95)	(10.42)	(13.43)
Other	0.51	0.09	0.72
	(2.39)	(2.83)	(2.16)
Transitory income	0.25	5.92	-2.30
Valuation changes	-0.14	4.02	-2.00
	(17.07)	(13.27)	(18.32)
Other	0.39	1.91	-0.29
	(4.99)	(6.39)	(4.10)
Operating expenditures	4.85	6.63	4.06
	(6.04)	(6.26)	(5.81)
Transfers	2.53	2.26	2.65
	(5.38)	(8.48)	(3.23)
Retained profits	-0.81	-6.23	1.63
	(18.35)	(17.22)	(18.45)

Source: Central bank.

Note: This table presents the sample means and, in parentheses, standard deviations of the main components of central banks' income statements, expressed in percent of currency, for the full sample and two subsamples of weak and strong central banks. Weak (strong) central banks have negative (positive) pretransfer structural profits, defined as net interest income plus other structural net income minus operating expenditures. Net other structural income includes commissions and fees and other operating income. Valuation changes include realized and unrealized gains and losses on foreign exchange, securities, and fixed assets. Other transitory income includes net transfers to and from reserves, provisions and writeoffs, and other extraordinary gains and losses.

Table 2. Pairwise Correlations

	<i>O</i>	<i>SI</i>	<i>X_F</i>	<i>X_G</i>	<i>X_B</i>
<i>C</i>	0.82	0.91	0.37	0.97	-0.29
GDP	0.84	0.91	0.45	0.84	-0.23

Sources: IMF, *International Financial Statistics*; and central banks.

Note: This table presents pairwise correlations between currency (*C*) and GDP, on the one hand, and central banks' operating expenditures (*O*), structural income (*SI*), and net claims on foreigners (*X_F*), governments (*X_G*), and banks (*X_B*), on the other hand. Net claims on the nonfinancial private sector (excluding currency) are included with net claims on banks.

uniform reporting format further contributes to the opacity of these accounts. Unless efforts are made to clarify and standardize central banks' financial reporting, the switch to international accounting standards,

Table 3. Variance Decomposition of Retained Profits

	Net Interest Margin	Net Other Structural Income	Valuation Gains and Losses	Other Transitory Net Income	Operating Expenditures	Transfers
Full sample	0.25	0.03	0.65	0.01	-0.02	0.08
Weak central banks	0.15	0.07	0.45	0.05	-0.02	0.30
Strong central banks	0.21	0.01	0.81	0.01	-0.04	0.01

Source: Central banks.

Note: This table decomposes the variance of retained profits for the full sample and two subsamples of central banks, using the income statement identity.

whereby all valuation changes will be charged against profits, could exacerbate this problem.⁵

A second important feature of Table 1 is that central banks' operating expenditures nearly exhaust net interest income. In view of substantial transfers, retained profits are, on average, negative. *Central banks, as a whole, lost capital during 2003, the base year used for this study.* To analyze whether this loss reflects a generic problem resulting from declining seigniorage, I divided the sample into a subsample of 60 strong central banks (SCBs), those with positive "structural pretransfer profits" (defined as net interest income plus other structural net income minus operating expenditures), and 27 weak central banks (WCBs), those with negative structural profits.

Clear differences between the two subsamples emerge. Unlike WCBs, SCBs accumulated capital. The poor performance of WCBs is explained mainly by their much lower net interest income (it was in fact negative). *Remarkably, however, WCBs are also afflicted by higher operating expenditures* (they spent more than 50 per cent as much as SCBs did). At first glance, the fact that WCBs spend more while earning less would suggest that weak performance may be at least partly explained by poor governance. The fact that the average country governance index (measured on the basis of the KKM index)⁶ is lower for WCB countries would be consistent with this

⁵The fact that a substantial number of central banks do not publish their income statements, or do not do so in a format that lends itself to meaningful analysis, further underlines the urgent need for greater transparency and accountability.

⁶The KKM index is calculated as the average of aggregate indicators over six dimensions of governance: voice, accountability, political stability, government effectiveness, regulatory quality, and rule of law (higher values correspond to better governance). See Kaufmann, Kraay, and Mastruzzi (2003).

Table 4. Key Economic and Social Indicators

	Full Sample (87 countries)	Weak Central Banks (27 countries)	Strong Central Banks (60 countries)
GDP per capita (US\$)	11,139.00	5,651.00	13,335.00
Population (millions)	39.00	28.00	43.00
Inflation (percent)	5.19	9.49	3.46
KKM Index	0.39	-0.01	0.54

Source: World Bank, *World Development Indicators*.

Note: This table presents key economic and social indicators for the full sample and two subsamples of central banks. The KKM index is calculated as the average of aggregate indicators over six dimensions of governance: voice, accountability, political stability, government effectiveness, regulatory quality, and rule of law (higher values correspond to better governance). See Kaufmann, Kraay, and Mastruzzi (2003).

hypothesis (Table 4). However, WCB countries are also, *on average, structurally different* from SCB countries. WCB countries are, on average, poorer and smaller (Table 4).⁷ Thus, further analysis is warranted to examine to what extent WCBs' higher operating expenditures reflect genuine structural differences, particularly those that might result from increasing returns to scale.

It is also remarkable that, notwithstanding their negative structural profits, WCBs *transferred nearly as much* as did SCBs. Moreover, unlike for SCBs, transfers by WCBs explain a sizable fraction of the variance of their retained profits (Table 3). The opposite is true for net interest income: It explains a higher share of the variance of retained profits for SCBs than for WCBs. This situation strongly suggests that WCBs, as a group, lack independence. They are being forced to transfer profits that they do not have.⁸ As a result, retained profits (what is left after the transfers) for the most part reflect the negative imprint of these transfers.

At the same time, WCBs benefited from windfall gains, in strong contrast with SCBs, which incurred valuation losses. This contrast can be explained

⁷There is, however, substantial dispersion within the two groups of central banks with regard to the economic environment in which they operate. The WCB group includes a significant number of central banks from large, wealthy countries, whereas the SCB group includes a large number of central banks from smaller, poorer countries. Table 5 illustrates this dispersion by indicating the number of central banks that are above (below) the mean of the average GDP per capita and population for the SCB (WCB) groups.

⁸Accounting practices may allow such transfers to take place in several ways. In particular, central banks often transfer unrealized valuation gains on their foreign exchange reserves without benefiting from transfers in the opposite direction when they experience valuation losses. In several of the countries in the sample, transfers from the revaluation reserve fund were made whether or not the central bank experienced gains during that particular year.

Table 5. Overlap between Weak Central Banks and Strong Central Banks

	GDP per Capita		Population	
	< US\$5,651	> US\$13,335	< 28 million	> 43 million
Weak central banks	22	4	21	5
Strong central banks	35	28	52	16

Source: World Bank, *World Development Indicators*.

Note: This table shows the extent of overlap (in numbers of central banks) between the two subsamples of central banks with regard to size (population) and income levels (GDP per capita).

largely by the fact that SCBs operate in a low-inflation environment in which the fluctuations of the U.S. dollar against other world currencies play a predominant role. During the base year of this study, most SCB currencies appreciated against the U.S. dollar, which gave rise to valuation losses. Instead, WCBs operate under a much higher inflation environment, which, by generating a devaluation bias against the dollar (the main reserve currency), enhances seigniorage through systematic valuation gains on dollar assets. Indeed, inflation in the WCB sample was nearly three times as high as that in the SCB sample (Table 4).

Finally, it is also worth noting that whereas SCBs have nearly insignificant exceptional expenditures, *WCBs report significant exceptional incomes*. Though such incomes are difficult to pin down and might be mostly circumstantial, they might reflect (at least in some cases) efforts to dress up the central banks' accounts and limit their reported losses through "creative accounting."

Balance Sheets

Table 6 presents summarized balance sheets for the aggregate sample and the two subsamples (all data are again scaled down by currency). With regard to the aggregate sample, some features are worth noticing. In particular, international reserve holdings account for the bulk of central bank assets (more than two-thirds). This fact points to the important role played by central banks in ensuring the external liquidity of their deposits, particularly those of commercial banks against which central banks have large net liabilities. As a result, only about one-third of international reserves are "financed" by unremunerated liabilities (currency and capital). The financing of the remaining two-thirds exposes central banks to a large potential carrying cost, because the interest rates on their foreign assets are generally below those of the liabilities they back, reflecting maturity, currency, or country risk premiums.

Table 6. Simplified Balance Sheet
(In percent of currency)

	Full Sample	Weak Central Banks	Strong Central Banks
Net claims	154.60	104.20	177.30
<i>On foreigners</i>	277.10	192.20	315.20
Assets	354.90	334.40	364.20
Liabilities	-77.90	-142.20	-49.00
<i>On government</i>	50.70	92.20	32.00
Assets	134.10	173.80	116.30
Liabilities	-83.40	-81.60	-84.30
<i>On banks</i>	-173.10	-180.30	-169.90
Assets	103.20	33.20	134.70
Liabilities	-276.30	-213.40	-304.60
Currency	100.00	100.00	100.00
Capital	54.70	4.20	77.40

Source: IMF, *International Financial Statistics*.

Note: This table presents the means of main balance sheet components, expressed in percent of currency. Noncurrency net claims on the nonfinancial private sector are included in net claims on banks.

In the subsamples, important differences can be spotted: WCBs have (1) much higher foreign liabilities, (2) higher net claims on government, (3) both lower claims on and lower liabilities to banks, and (4) much less capital. The overall picture that emerges is thus one in which WCBs are constrained to hold nearly as many international reserves as do SCBs but, in addition, need to provide more financing to governments. Yet they have less capital and are less profitable. Thus, they finance these higher claims mainly through foreign debt.⁹

Bivariate Statistical Analysis

A simple bivariate statistical analysis between all variables in the income and balance sheet accounts, as well as between some selected variables across these accounts, completes this preliminary review of the data. The income statement (Table 7) has several interesting features:

- Retained profits are very strongly related to transitory net income for both WCBs and SCBs. This suggests that most central banks avoid transferring their valuation gains and other transitory windfalls.¹⁰

⁹Part of this debt is with the IMF, which suggests that, through its programs, the IMF may be partly filling up the capitalization gap of WCBs.

¹⁰In the case of the WCBs, a surprisingly negative association exists between transfers and transitory income.

Table 7. Income Statement *t*-Tests for Weak and Strong Central Banks

	Operating Expenditures	Transfers	Retained Profits	Transitory Net Income	Capital
Weak central banks					
Net interest income	2.3**	-1.73	2.75**	1.88*	0.95
Operating expenditures		0.09	-0.06	0.71	1.05
Transfers			-6.79**	-3.66**	1.17
Retained profits				10.82**	-1.23
Transitory net income					-0.71
Strong central banks					
Net interest income	5.32**	0.68	2.66**	-1.44	1.65
Operating expenditures		0.23	1.28	0.39	0.47
Transfers			-0.53	2.03**	1.01
Retained profits				9.72**	1.26
Transitory net income					1.11

Sources: IMF, *International Financial Statistics*; and central banks.

Note: *90 percent significance level, **95 percent significance level. This table presents *t*-statistics for selected income statement items (plus capital) for the weak and strong central banks.

- For WCBs, there is a strong negative association between retained profits and transfers. This is consistent with the earlier finding that WCBs are (often) requested to transfer profits that they do not have.
- Operating expenditures are positively related to the net interest income in all central banks, but the link is much stronger in SCBs. Thus, whereas high interest income translates mainly into higher operating expenditures, low (or negative) income primarily translates into low (or negative) profits. This suggests that SCBs face soft budget constraints that allow the most profitable ones to raise their expenditures. On the other hand, for WCBs, the weaker link suggests that their attempt to restrain their operating expenditures is halfhearted and meets only limited success.
- Interestingly, there appears to be no strong link between capital and structural profitability, or any other key income concept (albeit the *t* statistic between the interest margin and capital is mildly significant for SCBs). This lack of a strong link could be interpreted as an indication that central banks primarily transfer or spend their profits but do not systematically retain them to increase their capital.

Table 8. Balance Sheet *t*-Tests for Weak and Strong Central Banks

	Foreign Assets	Claims on Government	Claims on Banks	Foreign Liabilities	Currency	Bank Deposits	Government Deposits	Capital
Weak central banks								
Structural profits	-1.73*	-2.09**	1.84*	-1.92*	1.79*	-0.42	-3.75**	0.48
Foreign assets		0.07	-0.41	0.12	1.91*	2.54**	3.78**	1.32
Claims on government			-0.21	10.44**	0.24	1.04	0.08	1.9*
Claims on banks				-0.53	-0.02	3.13**	-0.91	1.34
Foreign liabilities					-0.32	0.31	-0.37	1.57
Currency						0.94	-1.17	-0.19
Bank deposits							0.49	0.83
Government deposits								1.15
Strong central banks								
Structural profits	1.53	3.11**	-0.38	2.71**	-0.01	-0.05	2.45**	1.16
Foreign assets		-0.91	-1.31	-0.008	2.63**	-0.55	10.9**	8.51**
Claims on government			-0.09	10.3**	0.82	0.13	1.09	-0.15
Claims on banks				-0.05	-0.67	26.26**	-0.31	-0.45
Foreign liabilities					0.62	-0.15	0.88	0.04
Currency						-0.36	0.47	0.74
Bank deposits							0.16	-0.56
Government deposits								6.67**

Source: IMF, *International Financial Statistics*.

Note: *90 percent significance level, **95 percent significance level. This table presents *t*-statistics for selected balance sheet items (plus structural profits) for the two subsamples of weak and strong central banks.

Similar tests for the balance sheet account (Table 8) yielded the following results:

- Both WCBs and SCBs exhibit a very strong positive link between claims on government and foreign liabilities: They borrow abroad and on-lend to governments.¹¹ There is also a substantial link (mostly for SCBs) going in the opposite direction: Central banks invest abroad part of the funds they receive as government deposits. These financial activities taking place in both

¹¹When direct central financing to governments is not allowed, central banks can finance governments by acquiring government paper in the secondary market.

directions suggest that central banks play an important role as external financial intermediaries for their governments.

- The intermediation that central banks conduct with commercial banks seems to be mainly domestic. Central banks that have higher bank deposits also provide higher financing to banks. This link is particularly strong in the case of SCBs. There are two possible explanations, one of a budgetary nature and the other monetary. By imposing (unremunerated) reserve requirements on banks and reinjecting these funds through market-based instruments, central banks gain a spread that contributes to their profitability. Maintaining commercial banks short in liquidity also allows central banks to have better control on interest rates. The fact that structural profits are unrelated to bank deposits suggests that the latter explanation (enhancing monetary control) is more plausible.
- In WCBs, structural profits are negatively related to both claims on government and government deposits. In SCBs, the opposite holds. In addition, SCBs that have more government deposits also have higher capital. This suggests that being a banker to government is good business for SCBs, but bad business for WCBs. In the former case, central banks gain from the spread. In the latter case, central banks probably lose, because many of their claims on government are nonperforming. In addition, central banks that are more strongly linked to governments are more likely to be requested to assume costly quasi-fiscal responsibilities.
- More capitalized central banks have higher foreign assets. However, this is true only for SCBs.

II. Sources and Uses of Seigniorage

Analytical Framework

Following this preliminary analysis of the data, an accounting decomposition can throw further light on key differences between SCBs and WCBs with regard to sources and uses of seigniorage. Without loss of generality, a central bank's balance sheet can be expressed as

$$C + K = EX_F + X_B + X_G, \quad (1)$$

where C is currency issued; K is capital; X_F , X_B , and X_G are the net claims on the foreign sector, banks (and the private sector), and the public sector, respectively; and E is the nominal exchange rate against the U.S. dollar.¹² Alternatively, domestic claims may be expressed as

$$X_B + X_G = B - D, \quad (2)$$

where B and D are “net interest-bearing assets” (that is, performing assets minus fully remunerated deposits and central bank debt issued at market

¹²Domestic claims are assumed to be all denominated in local currency.

rates) and “net non-interest-bearing liabilities” (unremunerated deposits minus nonperforming assets), respectively.

With R and R^* , r and r^* , and π and π^* representing the domestic and U.S. nominal interest rates, real interest rates, and inflation rates, respectively, the central bank’s income statement can be written as

$$\Omega^C = \dot{K} = \left(R^* + \frac{\dot{E}}{E} \right) EX_F + RB - Z - O - T, \quad (3)$$

where Ω^C is the International Accounting Standards definition of central bank profits (inclusive of valuation gains and losses), Z is other net exceptional expenditures (such as provisions and write-offs on bad assets), O is operating expenditures, and T is transfers to the treasury.

If B in Equation (3) is replaced using Equations (1) and (2), Equation (3) can be rewritten as

$$\Omega^C = \left(R^* + \frac{\dot{E}}{E} \right) EX_F + R(C + D + K - EX_F) - Z - O - T. \quad (4)$$

Or, if Ω^C is replaced with \dot{K} and Equation (1) is differentiated, the new equation would be

$$R(C + D + K) = \Phi EX_F + (E\dot{X}_F + \dot{X}_G + \dot{X}_B - \dot{C}) + O + Z + T, \quad (5)$$

where $\Phi = R - R^*$ is the nominal interest rate premium. Using Equation (1) to correct Equation (5) for both domestic and foreign inflation (that is, expressing it in real terms) leads to

$$\begin{aligned} R(c + d + k) = & (\varphi + \pi)EX_F + E(\dot{X}_F - \pi^*X_F) + (\dot{X}_G - \pi X_G) \\ & + (\dot{X}_B - \pi X_B) - (\dot{C} - \pi C) + (o + z + t), \end{aligned} \quad (6)$$

where $\varphi = r - r^*$ and e are the real interest rate premium and the real exchange rate, respectively.

Gathering all the domestic inflation terms, and using Equation (1), Equation (6) can be written as

$$R(c + d + k) = (\varphi ex_F + \pi k) + (e\dot{x}_F + \dot{x}_G + \dot{x}_B - \dot{c}) + (o + z + t), \quad (7)$$

where the lowercase letters stand for domestic price-deflated magnitudes, in the case of domestic-currency-denominated variables, and foreign price-deflated magnitudes, in the case of foreign-currency-denominated variables. The left-hand side of Equation (7) indicates that seigniorage originates from three sources: (1) currency, (2) net nonremunerated liabilities, and (3) capital. The right-hand side defines the uses of seigniorage and can also be divided into three terms: (1) balance sheet costs (the terms in the first parentheses), namely the carrying cost of international reserves and the user cost of capital; (2) the real accumulation of capital, which can take the form of increases in real claims on foreigners (adjusted for foreign inflation) or increases in net real claims on domestic residents (adjusted for domestic inflation); and (3)

Table 9. Interest Rates and Risk Premiums

	Full Sample	Weak Central Banks	Strong Central Banks
Nominal interest rate	9.31	13.05	7.73
Inflation	5.16	9.22	3.43
Nominal risk premium	7.21	10.95	5.62
Real interest rate	3.99	3.72	4.10
Real risk premium	4.15	3.88	4.26

Source: IMF, *International Financial Statistics*.

Note: This table presents nominal and real interest rates and risk premiums for the sample and subsamples of central banks. The interest rates are obtained, when available, from yields on treasury bonds. When only rates on short-term public debt (treasury bills) are available, the bond rate is obtained by adding to the bill rate the average spread between the bond rate and the bill rate for those countries for which data are available for both.

flow expenditures, namely operating expenditures, (net) exceptional expenditures, and transfers to the shareholder.¹³

Because d is not known, the term Rd is obtained as a residual. A positive Rd implies that the seigniorage gain derived from not (fully) remunerating bank or government deposits more than offsets the seigniorage loss derived from holding assets that are not fully performing (that is, that do not earn the market rate of interest).

Interest Rates and Valuation Adjustments

Interest rates are obtained, when available, from yields on treasury bonds. In those cases in which only rates on short-term public debt (treasury bills) are available, the bond rate is obtained by adding to the bill rate the average spread between the bond rate and the bill rate for those countries for which data are available for both. Table 9 sums up the interest rate data. As would be expected, nominal interest rates and risk premiums are higher in WCB countries, reflecting higher inflation. However, there is no significant difference between SCBs and WCBs with regard to real interest rates and risk premiums. Hence, WCBs do not appear to be penalized for their worse financial conditions.¹⁴

¹³An alternative presentation considers currency as “shadow” capital (see Stella, 1997). In this case, Equation (7) becomes $R(c + d + k) + \dot{c} = (\rho ex_F + \pi k) + (e\dot{x}_F + \dot{x}_G + \dot{x}_B) + (\rho + z + t)$. Currency provides seigniorage through both the implied nominal return on its real balances and the increase in its real demand.

¹⁴This finding is somewhat surprising. Though it is true that central banks can eventually clean up their financial position through a burst of inflation, one would nonetheless expect such a threat to be reflected in a higher risk premium. The lack of premium may reflect the fact that (i) most interest rates used in this study are associated with treasury liabilities, rather than central bank liabilities; (ii) the threat of future inflation is too diffuse in time to have a significant impact on current rates; (iii) weak central banks are expected eventually to be

Table 10. Foreign Reserves Currency Weights
(In percent)

	Dollar	Euro	Yen
Euro area countries	70		30
United States		50	50
All other countries	70	25	5

Source: Author's estimates.

Note: This table presents a rough estimate of the currency composition of central banks' foreign reserves, based on expert opinions and a study by Eichengreen and Mathieson (2000).

To obtain the real changes in net foreign claims (that is, the change in foreign claims adjusted for exchange rate valuation effects and foreign inflation), assumptions about the currency composition of international reserves are needed. Because central banks do not make their foreign reserve management policies (or debt composition) public, I used weights based on a mix of expert opinion and a study by Eichengreen and Mathieson (2000) (see Table 10).

To estimate exchange rate valuation adjustments, I used the average of two opposite methods. The first method calculates price adjustments based on beginning-of-year balances and volume changes based on end-of-year balances. The second method does the opposite.¹⁵ As shown in the Appendix, both methods provide a decomposition of price and quantity effects that ensures consistency between the income statement and the balance sheet. To ensure similar consistency, I carried out price adjustments (to deflate nominal magnitudes into real magnitudes) following the same methodology.

Results

Table 11 shows the results of the seigniorage decomposition. For the sample as a whole, highlights are as follows:

- On the source side of seigniorage, it is remarkable that *unremunerated deposits at the central bank generate more seigniorage than currency does*. This finding underlines central banks' high dependence on nonmarket-based income (mostly seigniorage on required reserves).
- However, on the user side of seigniorage, *balance sheet costs, mainly the carrying cost of international reserves, are also by far the dominating*

recapitalized by their shareholder (that is, they benefit from an implicit government guarantee); or (iv) central banks' financial condition is generally not well perceived in the marketplace, perhaps in part because of the opacity of their accounts and the fact that their profitability follows rules and dynamics that are different from those of commercial banks.

¹⁵The first method assumes that interest accrues only on initial balances; the second method assumes it applies fully to final balances.

Table 11. Seigniorage Decomposition

	Full Sample	Weak Central Banks	Strong Central Banks
Seigniorage	19.97	14.66	22.36
<i>Rc</i>	8.64	12.09	7.09
<i>Rk</i>	2.3	-1.19	3.87
<i>Rd</i>	9.03	3.76	11.4
Balance sheet costs	9.4	10.74	8.79
$\varphi e x_F$	8.16	10.47	7.11
πk	1.24	0.27	1.68
Expenditure flows	6.99	6.98	7.00
<i>o</i>	4.85	6.63	4.06
<i>z</i>	-0.39	-1.91	0.29
<i>t</i>	2.53	2.26	2.65
Capital accumulation	3.58	-3.05	6.57
$e\Delta x_F$	20.58	26.84	17.77
Δx_G	4.28	-13.21	12.15
Δx_B	-14.96	-10.11	-17.14
Δc	-6.32	-6.57	-6.21

Sources: IMF, *International Financial Statistics*; and central banks.

Note: This table provides an accounting identity decomposition of seigniorage, where c is currency issued; k capital; x_F , x_B , and x_G the net claims on the foreign sector, banks (and the private sector), and the public sector, respectively; d net non-interest-bearing liabilities (unremunerated deposits minus non-performing assets); e the real exchange rate against the U.S. dollar; o operating expenditures; t transfers to the treasury; z other net exceptional expenditures; R the (home) nominal interest rate; π (home) inflation; and f the real interest rate premium.

element, accounting for nearly half of all seigniorage use. This finding suggests that the cost of the liquidity service provided by central banks through their international reserve holdings is approximately covered by the potential users of such services (the government and the financial system). Although there is no assurance that the level (and quality) of the service provided is really that demanded by the users and that the cost sharing between users is fair, the fact that on average users pay the associated cost is on the whole reassuring.

- Operating expenditures account for a substantial additional chunk of seigniorage use (about 25 percent), leaving only modest residuals available for capital accumulation (18 percent) and dividend transfers to the shareholder (12 percent).
- Remarkably, international reserve accumulation accounts for the bulk of net asset accumulation (this observation, based on flows, confirms the earlier similar observation, which was based on stocks).

The increase in foreign assets is largely offset by a reduction of net claims on banks.¹⁶

Results for the two subsamples show very marked differences:

- With reference to the bottom line, *WCBs lose (real) capital, whereas SCBs gain*, which confirms the earlier result obtained on the basis of conventional (nominal) accounting.¹⁷
- The main reason underlying the poorer financial conditions of WCBs is their *much lower capacity to produce and retain seignorage, despite the much higher inflation* (hence a much higher seignorage on currency). This surprising result follows from the fact that the higher seignorage on currency is more than offset by the lower seignorage on capital (*Rk*) and net noninterest-bearing liabilities (*Rd*).
- The lower (indeed negative) seignorage on capital is the logical outcome of negative profits leading over time to low or negative capital.
- As to the lower *Rd*, it can reflect either a higher proportion of remunerated deposits or a higher proportion of nonperforming assets. The latter seems more logical; *WCBs' weaker finances are more likely to reflect their inability to obtain interest income on their assets than their inability to limit their interest payments on their deposits*. Indeed, assuming that none of the deposits is remunerated would lead to the conclusion that only 10 per cent of WCB domestic assets are fully remunerated, compared with 66 per cent for SCBs. As a result, WCBs' seignorage income is effectively being siphoned off by nonperforming assets.
- Notwithstanding equivalent real risk premiums and lower net foreign assets, WCBs face higher carrying costs of foreign reserves than do SCBs. This surprising result derives from the fact that *risk premiums and net foreign assets are positively correlated for WCBs and negatively correlated for SCBs*. For the latter, the negative correlation could reflect the fact that countries with higher international reserves are more stable and thus have lower funding costs. For the former, the causality could flow the other way; countries that are less stable (and thus pay higher premiums) increase their reserves in an attempt to increase their stability and reduce their funding costs. This interpretation is consistent with the fact that, as was already apparent in Figure 2, *WCBs accumulate foreign assets at a much higher rate than do SCBs*.

¹⁶Although this increase in foreign assets could be viewed as an indication that central banks channel abroad much of the liquidity they obtain from banks, the bivariate tests conducted earlier do not seem to support this view.

¹⁷This rather bleak conclusion holds, however, only under a strict definition of capital. If currency is counted as "shadow capital," WCBs still accumulated, as a group, some capital. Such an accumulation, which might be sufficient to stave off a downward spiral into debt unsustainability, would be consistent with the earlier finding that WCBs do not seem to face substantial penalties with regard to interest rate premiums. However, counting currency as capital implicitly assumes that it will continue to be demanded. In view of rapidly evolving payment technologies, this assumption is clearly debatable.

- Finally, it is also noteworthy that WCBs are able to accumulate international reserves despite their weak financial condition, owing to a high accumulation of liabilities with government.¹⁸ This reserve accumulation capacity supports the hypothesis that WCBs are highly dependent on their governments and “bank” for them rather than for their commercial banks.

III. Central Banks' Operating Expenditures

Demand vs. Supply Factors

Central banks' operating expenditures should reflect the volume of services they provide and the price of these services. Central bank services can be classified into two broad categories: those directly related to monetary management (price and output stability) and those related to financial system stability and development (supervision and payments). When central banks face a soft revenue constraint (which should be the case for SCBs), one would expect the provision of central bank services to be determined strictly from the demand side (*supply accommodating demand*). Demand should rise with country size (possibly with increasing returns), per capita GDP (assuming central bank services are not inferior goods), the size of the financial sector, and the scope of central banks' responsibilities (in particular, whether they are responsible for financial supervision).

When central banks face a harder revenue constraint (presumably the case of WCBs), one would expect supply factors to dominate (*demand accommodating supply*). Relevant supply factors should include variables that determine the availability of seigniorage (such as inflation, currency in circulation, or currency growth) or the cost of central bank services (mostly the wage level of central bank staff). Variables that determine how wisely the seigniorage may be used (such as governance indices) could also affect the outcome.

The very high (82 per cent) correlation between currency issued and central banks' operating expenditures would suggest, at first sight, that supply-side effects might dominate. To test whether this is indeed the case and whether some central banks may be affected by “hard” revenue constraints, the following two non-nested models are compared: On the demand side, regressors include population, per capita GDP, broad money (M2) over GDP (all variables in logs), and a multiplicative dummy for central banks that are responsible for banking supervision. On the supply side, regressors include (the log of) currency in circulation, the KKM governance index, and the average inflation rate over the past 10 years.

¹⁸This flow observation confirms the observation made earlier based on the bivariate statistical analysis of stocks.

Results are reported in Table 12. Neither the financial depth variable in the demand model nor the wage level or inflation variables in the supply model were significant (and hence are not shown in the table). Both models give otherwise satisfactory results, with all variables having the appropriate signs. In the demand model, there are very clear size and wealth effects. However, there are also clear increasing returns: A 10 percent increase in country size or per capita income is reflected in only a 7.5 or 5.8 percent increase, respectively, in operating expenditures. This confirms the earlier finding that central banks in the smaller and poorer countries are more likely to struggle financially than are those in large, wealthier countries, reflecting the fixed costs of central banking. Similar increasing returns are present in the supply model, with a 10 percent increase in currency issued translating into only a 7 percent increase in operating expenditures.

It is also noteworthy that the provision of supervisory services, though significant, has only a modest impact on central banks' operating expenditures, increasing them by less than 2 percent. Similarly, the governance variable has a significant but modest impact, with an improvement in the KKM index from the worst to the best country in the sample reducing central banks' operating expenditures by slightly more than 1 percent.

To test whether there is a substantial difference between the two groups of central banks, I estimated the two models for each subsample. Though financial depth has a significant impact on the operating expenditures of WCBs but not on those of SCBs, other effects are very similar.

The results of the model comparison for the aggregate sample, using the Davidson and Mackinnon's (1981) J-statistics for non-nested models, appear in Table 13.¹⁹ They indicate that the demand model dominates the supply model, which is consistent with the numerical dominance of the SCBs in the overall sample. This finding therefore suggests that central banks' operating expenditures are driven, overall, by a *soft budget constraint*.

A reduced-form equilibrium model that combines and retains all significant demand and supply factors is shown in Table 12. On the basis of the residuals of the equilibrium model, an index of relative performance, p_i , for central bank i is then derived as

$$p_i = 100(e^{\delta_i} - 1), \quad (8)$$

where δ_i is the residual of the reduced-form regression. Thus, p_i is the percentage of over- or underspending of central bank i compared with its peers.

The performance index, which is shown in Figure 3, indicates that differences in performance are very large. The best performer spends more

¹⁹This test compares the relative significance of the predicted values of each model when introduced as a regressor in the other model. See Davidson and MacKinnon (1981).

Table 12. Central Banks' Operating Expenditures

Variables	Full Sample			Strong Central Banks			Weak Central Banks		
	Demand	Supply	Reduced form	Demand	Supply	Reduced form	Demand	Supply	Reduced form
Log (population)	0.76		0.61	0.74		0.55	0.86		0.86
	-22.2**		-7.24**	-20.45**		-5.43**	-12.19**		-3.3**
Log (GDP/Per Capita)	0.62	0.068	0.58	0.61		0.51	0.57		0.75
	-14.93**	-0.71	-5.67**	-12.94**		-3.88**	-7.4**		-3.12**
Bank supervision	0.01		0.01	0.008		0.007	0.03		0.03
	-2.26*		-1.93*	-1.05		-0.95	-1.83*		-1.41
Log (M2/GDP)	-0.005			0.0004			0.78		
	(-0.16)			-0.01			-3.3**		
Log (currency)		0.67	0.15		0.67	0.19		0.7	-0.05
		-19.52**	(1.98)*		-18.23**	-2.07*		-7.12**	(-0.21)
KKM		-0.41	-0.22		-0.09	-0.16		-0.41	-0.012
		(-2.96)**	-1.34		(-0.46)	(-0.95)		(-1.23)	(-0.05)
Adjusted R-squared	0.54	0.83	0.88	0.89	0.85	0.9	0.91	0.81	0.87
Standard error of regression	0.54	0.63	0.53	0.51	0.59	0.49	0.46	0.69	0.58
Sum of squared residuals	26.91	36.95	25.32	16.4	22.39	15.06	4.87	10.9	7.03
Log likelihood	-75.46	-90.39	-72.24	-48.33	-59.07	-45.39	-15.24	-26.07	-20.14
Durbin Watson	2	1.92	2.03	2.28	2	2.21	2.31	2.24	2.22
F-statistic	171.08	156.67	142.49	141.05	134.12	122.09	72.23	37.67	34.32

Source: IMF, *International Financial Statistics*; World Bank, *World Development Indicators*; and central banks.

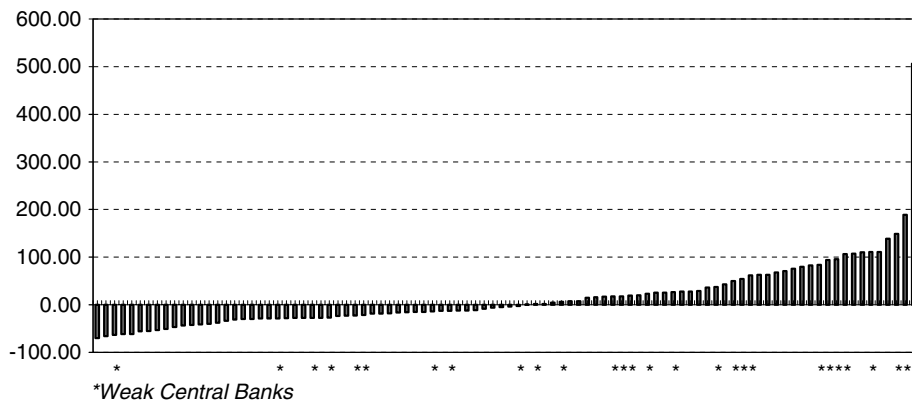
Note: *90 percent significance level. **95 percent significance level. This table presents non-nested supply and demand models of central banks' operating expenditures. On the demand side, regressors include population, per capita GDP, M2 over GDP (all variables in logs), and a multiplicative dummy for central banks that are responsible for banking supervision. On the supply side, regressors include (the log of) currency in circulation, and the KKM governance index. A reduced-form equilibrium model that combines and retains all significant demand and supply factors is also shown.

Table 13. Operating Expenditures: Model Comparison

Variables	Model 1 (Demand)	Model 2 (Supply)
Log (population)	0.59 (6.07)**	
Log (GDP per capita)	0.48 (5.75)**	
Bank supervision	0.02 (2.03)**	
Log (o) (Model 2)	0.25 (1.90)*	
Log (currency)		0.16 (1.90)*
KKM		-0.09 (1.30)
Log (o) (Model 1)		0.79 (6.42)**
Constant	-0.09 (0.13)	0.26 (0.35)
Adjusted <i>R</i> -squared	0.88	0.88
Standard error of regression	0.53	0.53
Log likelihood	-73.10	-72.80
Durbin Watson	1.97	2.01

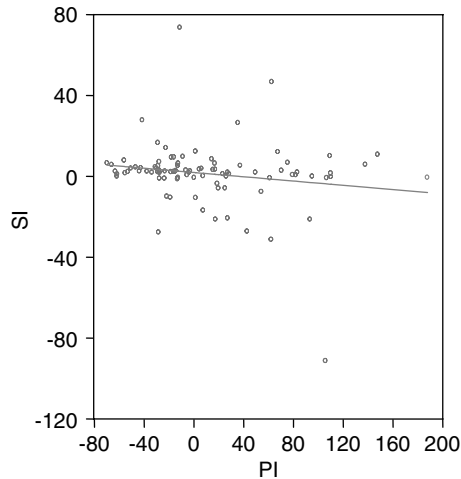
Source: IMF, *International Financial Statistics*; World Bank, *World Development Indicators*; and central banks.

Note: *90 percent significance level. **95 percent significance level. This table presents the results of a model comparison for the aggregate sample, using Davidson and MacKinnon's (1981) J-statistic for non-nested models. Results indicate that the demand model dominates the supply model.

Figure 3. Countries' Ranking by Performance Index
(In percent)

Source: Central banks.

Figure 4. Structural Income (SI) and Performance Index (PI)
(in percent)



than *three times* less than the group average, whereas the worst performer spends more than *five times* more than the average. By itself, this finding is already a clear indication that some central banks face soft budget constraints and governance issues.

This conclusion is further supported by the fact that WCBs tend to have lower expenditure performance indices. This can be seen in Figure 3, where WCBs are grouped on the right-hand side of the chart. It is similarly apparent from a scatter diagram between the expenditure performance index and the ratio of structural profitability to currency (Figure 4) that *the central banks with the highest level of spending tend to be the least profitable*. This finding clearly points in the direction of weak governance. With strong governance, financially weaker central banks should spend less (rather than more), reflecting efforts to restrain their operating expenditures.

IV. Conclusions

The above results tell two somewhat distinct, yet partly overlapping, stories. The typical WCB story is that of central banks in smaller and poorer economies that have not been able yet to distance themselves from their governments or that are still living the aftermath of past dependencies. Faced with weak or volatile public budgets, these central banks exhibit *limited independence*. They are still used as sources of cheap or last-resort financing. They “bank” mostly for their government and are burdened with large nonperforming assets (possibly acquired as a result of quasi-fiscal activities or supports to failing banks) and compulsory transfers that deeply undermine their profitability. Though WCBs make up, in part, for their financial

difficulties by following looser monetary policies, the bulk of the adjustment takes place through their capital account, which shrinks over time.

Remarkably, the typical WCB also has higher operating expenses than does the typical SCB. Though these higher expenses are not the main reason for their poor financial health, the fact that WCBs' weak finances do not seem to lead to efforts to limit them clearly raises questions as to their *governance*. The fact that WCBs typically operate in countries with lower governance standards suggests that their weak governance and limited financial independence may be reflections of the same underlying weaknesses in the institutional environment.

In contrast, the typical SCB operates in larger and wealthier economies with lower inflation and better governance. Their finances are sound and their operating expenses substantially below those of the typical WCB. Nonetheless, the fact that SCBs' operating expenses are strongly related to their profitability (unlike dividend transfers) and vary widely across central banks operating under similar environments suggests that many SCBs do not feel compelled to squeeze out every penny for their shareholders. Thus, governance concerns do not seem to be limited to WCBs.

This being said, it is also remarkable that operating expenses are more closely linked to demand factors than to supply factors. By itself, this finding supports a more benign interpretation of central bank behavior, based on a *limited perspective of public welfare rather than an outright lack of governance*. Most SCBs try to fulfill their stability mandate as best they can, without questioning whether the marginal dollar used in this quest would be better used elsewhere in the public sector.

The fact that several WCBs operate in large, wealthy countries but SCBs include a large number of central banks from smaller, poorer countries is a warning against overgeneralizing the WCB-SCB stories depicted above, however. The variety of experiences suggests instead that good central bank governance is neither an automatic result of the environment in which central banks operate nor outside the reach of those central banks that operate in more difficult environments. This underlines the importance of putting in place good governance arrangements.

A number of preliminary policy implications may be inferred:

- This study does not undermine the need for promoting central bank independence. Instead, the fact that central banks with more governance problems also seem to be the least independent, whereas more independent central banks seem, overall, to have better governance, *strengthens the case for independence*. At least in countries with sufficient governance standards, this fact should reduce concerns that giving central banks more independence will lead to a free-for-all increase in central banks' expenditures. Indeed, allowing central banks to freely manage their budget and set their wage scale is particularly essential at a time when many of them need to evolve toward a modern concept of central banking, with *fewer, but more highly skilled, staff*.

- Independence goes hand in hand with accountability, however. *An essential prerequisite for accountability is transparency.*²⁰ As already noted, for many of those central banks that do publish their financial accounts, there is much room for improvement in making them more easily accessible and understandable. In particular, income statements need to clearly distinguish between transitory and permanent (structural) components. For those central banks that do not yet make their income statement public, it is, of course, high time to do so.
- *Periodic reviews of central bank expenditures by governments* (including with regard to the cost of reserve accumulation) might be a healthy practice to ensure that criteria for comparing the provision of public goods are sufficiently uniform across the public sector. As discussed in Ize (2005), central bank recapitalizations may provide good opportunities for such broad policy debates. Arrangements such as the one introduced recently in New Zealand (whereby seigniorage income on currency belongs to the state, but a share of it, negotiated with the treasury every five years, is retained by the central bank for its own funding) offer interesting examples of more systematic stock-taking opportunities that other central banks may wish to follow.
- In view of its implications for a healthy financial intermediation, central banks' high dependence on seigniorage income arising from unremunerated deposits, including bank deposits, is a source of concern looking ahead. The fact that carrying international reserves on the balance sheet is costly for many central banks provides, at least in principle, a justification for not paying the full market interest rate (that is, not paying the risk premium) on funds deposited at the central bank (which should benefit from the liquidity associated with high international reserves). However, questions remain as to what is a socially desirable level of international reserves and whether bank users or taxpayers in general should pay for their carrying cost.
- The role played by central banks as external financial intermediaries of governments, mostly in lower-income countries, needs to be better analyzed and its potential benefits and pitfalls better assessed. Though there are clear dangers for central banks' financial health and independence, increased access to external finance may also yield social benefits.

The conclusions above are subject to important caveats that reflect the limitations of this study. In particular, the fact that the study rests on data from a single year (2003) and its conclusions are based purely on cross-sectional evidence raises issues of causality and hinders the distinction between stable patterns and merely circumstantial occurrences. This problem

²⁰One of the main merits of transparency is to allow for systematic peer comparisons. By facilitating studies such as this one, transparency provides the necessary benchmarking for central banks to have a clearer idea of where they stand and take appropriate action.

is amplified by the fact that some of the conclusions in this paper are based on simple averages. Though the aggregate sample was divided into two more homogeneous subsamples and care was taken to eliminate clear outliers, the large standard deviations of many variables across the two subsamples indicate that considerable heterogeneity remains. Thus, the risk remains that some of the results may be dominated by large deviations in a few of the countries in the sample.²¹

In addition, assessing central bank output is inherently difficult, given the lack of counterfactual evidence for what economic performance would look like in the absence of a central bank. This problem is amplified here by the fact that this study does not make any specific inferences about central bank efficiency in the traditional sense—that is, how much output is obtained for a given input. Measuring the quality of central bank services is a particularly difficult task. The performance index in this paper should thus be interpreted with caution. Clearly, more analysis is needed to firm up the main conclusions of the paper.

APPENDIX

Sample Countries

Information on income statements for 2003 (the base year for this study) was drawn from central banks' websites. Balance sheet information for 2002 and 2003 and all macroeconomic indicators were drawn from International Financial Statistics (IFS). Other items net were consolidated with capital. From the full universe of 184 IMF member countries, a first selection was made to exclude those countries whose income accounts were not published or were published in a language not easily accessible. Doing so reduced the sample to 101 countries (Table A.1). The sample was reduced to 87 countries for the seigniorage study, after the elimination of those countries that (1) did not have sufficiently detailed income statements (that would allow in particular to identify net interest margins), (2) for which no interest rate data could be obtained, or (3) for which the flows derived from the beginning-of-period and end-of-period balance sheet information did not seem to be easily reconcilable with the income statement.

Valuation Adjustments

Consider the general balance sheet form

$$K_t = E_t X_t^* + X_t, \quad (\text{A.1})$$

where X_t^* and X_t stand for net foreign-currency-denominated assets and net local-currency-denominated assets at time t , respectively; K_t is the central bank's capital; and E_t is the exchange rate. If valuation adjustments are applied to beginning-of-period stocks,

²¹Overcoming these problems and identifying proper dynamics and causality patterns would require a panel analysis over a sufficiently long period (and, therefore, a much larger investment in the preparation of the data).

Table A.1. Sample Countries

Argentina	Denmark	Kuwait	Qatar*
Armenia	El Salvador	Kyrgyz Republic	Romania
Australia	Estonia	Latvia	Russia
Austria	Fiji	Lebanon	Saudi Arabia*
Azerbaijan	Finland	Lesotho*	Serbia*
The Bahamas	France	Lithuania	Sierra Leone
Bahrain	Georgia	Luxembourg	Singapore
Bangladesh	Germany	Macedonia, FYR	Slovak Republic
Barbados	Greece	Madagascar	Slovenia
Belarus	Guatemala	Malta*	South Africa
Belgium	Haiti	Mauritius	Spain
Belize	Honduras	Moldova	Sweden
Bermuda	Hungary	Mongolia	Switzerland
Bolivia	Iceland	Mozambique	Tanzania
Bosnia and Herzegovina	India	Namibia*	Thailand
Botswana*	Indonesia	Netherlands	Tunisia
Brazil	Iran, I.R. of	New Zealand	Turkey
Bulgaria	Ireland	Nicaragua	Ukraine
Canada	Israel	Nigeria	United Arab Emirates*
Cayman Islands*	Italy	Norway	United Kingdom
Chile	Jamaica	Oman	United States
Colombia	Japan	Pakistan	Uruguay
Costa Rica	Jordan	Paraguay	
Croatia	Kazakhstan	Peru	
Cyprus	Kenya	Poland	
Czech Republic	Korea	Portugal	

*Countries excluded from the seigniorage study.

profits can be expressed from the income statement as

$$\Delta K_t = \left(R_t^* + \frac{E_t - E_{t-1}}{E_{t-1}} \right) E_{t-1} X_{t-1}^* + \left(r_t + \frac{P_t - P_{t-1}}{P_{t-1}} \right) X_{t-1}, \quad (\text{A.2})$$

where R_t^* and r_t are the nominal foreign interest rate and the real domestic interest rate, respectively, and P_t is the domestic price level. But taking the first differences of Equation (A.1) leads to

$$\Delta K_t = (E_t X_t^* - E_{t-1} X_{t-1}^*) + (X_t - X_{t-1}), \quad (\text{A.3})$$

which can also be decomposed into price and volume effects as

$$\begin{aligned} \Delta K_t = & E_t (X_t^* - X_{t-1}^*) + \frac{E_t - E_{t-1}}{E_{t-1}} E_{t-1} X_{t-1}^* \\ & + P_t \left(\frac{X_t}{P_t} - \frac{X_{t-1}}{P_{t-1}} \right) + \frac{P_t - P_{t-1}}{P_{t-1}} X_{t-1}. \end{aligned} \quad (\text{A.4})$$

If Equations (A.2) and (A.4) are compared, it can immediately be seen that the valuation adjustments are the same, making the income and balance sheet statements, expressed in real terms, fully consistent.

A similar decomposition can be carried out for the income statement, based on end-of-period stocks:

$$\Delta K_t = \left(R_t^* + \frac{E_t - E_{t-1}}{E_t} \right) E_t X_t^* + \left(r_t + \frac{P_t - P_{t-1}}{P_t} \right) X_t. \quad (\text{A.5})$$

And the first differences of Equation (A.1) can also be decomposed as

$$\begin{aligned} \Delta K_t = & E_{t-1}(X_t^* - X_{t-1}^*) + \frac{E_t - E_{t-1}}{E_t} E_t X_t^* \\ & + \left(\frac{P_{t-1}}{P_t} X_t - X_{t-1} \right) + \frac{P_t - P_{t-1}}{P_t} X_t. \end{aligned} \quad (\text{A.6})$$

It can again be checked that Equations (A.5) and (A.6) are mutually consistent.

REFERENCES

- Brione, P., 2005, "Central Bank Staff Costs," *Central Banking Journal*, Vol. 16, No. 2, pp. 69–74.
- Davidson, R., and J. MacKinnon, 1981, "Several Tests for Model Specification in the Presence of Alternative Hypotheses," *Econometrica*, Vol. 49 (May), pp. 781–93.
- Eichengreen, B., and D.J. Mathieson, 2000, "The Currency Composition of Foreign Exchange Reserves: Retrospect and Prospect," IMF Working Paper 00/131 (Washington, International Monetary Fund).
- Fry, M., C. Goodhart, and A. Almeida, 1996, *Central Banking in Developing Countries: Objectives, Activities and Independence* (New York, Routledge).
- Galán Camacho, J.E., and M. Sarmiento Paipilla, 2006, *Staff, Functions, and Staff Costs at Central Banks: An International Comparison with a Labor-Demand Model*, Borradores de Economía (Bogotá, Banco de la Republica).
- Ize, A., 2005, "Capitalizing Central Banks: A Net Worth Approach," *IMF Staff Papers*, Vol. 52 (September), pp. 289–310.
- Kaufmann, D., A. Kraay, and M. Mastruzzi, 2003, "Governance Matters III: Governance Indicators for 1996–2002," Policy Research Working Paper No. 3106 (Washington, World Bank).
- McKinley, V., and K. Banaian, 2005, "Central Bank Operational Efficiency: Meaning and Measurement," in *Central Bank Modernisation*, ed. by Peter Nicholl and Neil Courtis (London, Central Banking Publications).
- Pedersen, E.H., 2006, "Danmarks Nationalbank's Operating Costs and Number of Employees in an International Comparison," Working Paper No. 35 (Copenhagen, Danmarks Nationalbank).
- Stella, P., 1997, "Do Central Banks Need Capital?" IMF Working Paper 97/83 (Washington, International Monetary Fund).
- , 2005, "Central Bank Financial Strength, Transparency, and Policy Credibility," *IMF Staff Papers*, Vol. 52 (September), pp. 335–65.