

Development Discussion Papers

Seignorage in Highly Indebted Developing Countries

Malcolm F. McPherson

Development Discussion Paper No. 696
April 1999

© Copyright 1999 Malcolm F. McPherson
and President and Fellows of Harvard College

Harvard Institute for
International Development

HARVARD UNIVERSITY



Seignorage in Highly Indebted Developing Countries

Malcolm F. McPherson*

Abstract

Seignorage is the capital gain generated by the creation of reserve money. The literature on seignorage shows that countries with highly developed and deep financial systems generate few resources relative to national income (or government revenue) from seignorage. By contrast, countries with shallow financial systems and profligate governments appear to gain access to large amounts of real resources when they create reserve money. Results obtained in this paper suggest there is no anomaly. Highly indebted developing countries resorting to money creation to finance their activities do not generate large amounts of seignorage, particularly on a sustained basis. In fact, when *all* of the consequences of rapid reserve money growth are considered --- including the increased local currency cost of servicing and amortizing external debt due to exchange rate depreciation --- these countries incur a net loss from reserve money creation.

JEL Codes: E, E5, H, H6, H63

Keywords: Seignorage, Debt Management, Exchange Rates, Inflation, Reserve Money

Malcolm McPherson is a Fellow of the Harvard Institute for International Development. He is presently Principal Investigator for the EAGER/Public Strategies for Growth with Equity study "Restarting and Sustaining Growth and Development in Africa". A multi-country study, it seeks to understand how African governments can be induced to revive *and* sustain economic reform.

* I am grateful to Professor James Duesenberry and Dr. Clive Gray for helpful comments. I also thank Tzvetana Rakovski for assistance with the data analysis. This paper was written with funding from the U.S. Agency for International Development, Division of Strategic Analysis, Office of Sustainable Development, Bureau for Africa, Activity No. 698-0546, Equity and Growth Through Economic Research project, Restarting and Sustaining Growth and Development in Africa. The usual disclaimers apply.

Seignorage in Highly Indebted Developing Countries

Malcolm F. McPherson

Table of Contents

	Page
1. Introduction	1
2. Background	2
a. Some History	2
b. Measuring Seignorage	3
3. Empirical Estimates of Seignorage	5
a. Conventional Estimates	5
b. Broadening the Analysis	9
c. Transition Dynamics	13
4. Benefits and Costs of Seignorage	14
a. Benefits	14
b. Costs	15
c. Overview	17
5. Concluding Comments	18
References	20
Annex A: "Sustainable" Deficits and "Sustainable" Borrowing	26
Annex B: "Seignorage and Political Instability": A Critique	29
Annex C: Seignorage Gains and Capital Losses on External Debt	32
Endnotes	34

List of Tables

Table 1: Annual Rates of Seignorage for Selected Countries	7
Table 2: Seignorage and Its Components (percent of GDP)	12

Seignorage in Highly Indebted Developing Countries

Malcolm F. McPherson

"Brazil's budget deficit soared to 14 per cent of gross domestic product in the year to the end of February as a result of the currency devaluation in January. The figure reflects the impact of the devaluation on Brazil's dollar-linked debt at a time when the currency was weakening sharply" *Financial Times* 14th April 1999, p.6

1. Introduction

A common definition of seignorage is the "...net revenue derived by any money-issuing authority".¹ Economists regularly refer to seignorage as "revenue" that is "collected".² The actual transfer of resources, however, occurs as a capital gain or loss. For example, the "inflation tax", a component of seignorage, takes the form of a variable capital levy on outstanding money balances.³

There is a large literature on seignorage (and the inflation tax)⁴ and many estimates of the "revenue" from both have been derived.⁵ The estimates, ranging from small fractions of GDP and government revenue to amounts that exceed GDP, have a peculiar feature. The most efficiently managed economies with the deepest financial systems appear to gain the least from seignorage and the inflation tax. Economies with profligate governments and shallow financial systems appear to gain the most.⁶

Yet, appearances deceive. For almost all developing countries, the conventional estimates of seignorage are over-stated. For countries with large external debts, the estimates are fundamentally wrong. Excluded from the calculation is the increased local currency cost of servicing the foreign debt of public entities due to exchange rate depreciation, itself the result of the money creation that generated the seignorage. This cost (which is reflected as a capital loss in local currency terms) largely offsets any apparent first-round seignorage "gain". Indeed, for highly indebted developing countries, the capital loss on foreign debt can exceed the capital gain from seignorage.

This paper discusses how that occurs. Section 2 has a brief historical sketch of seignorage and how it is measured in the literature. Section 3 reports some estimates of seignorage from the literature and offers an alternative interpretation. It also highlights the transition costs of seignorage away from the "steady state". These transition costs help explain why Russia recently declared a stand-still on its debt service. Section 4 discusses some additional benefits and costs of seignorage and section 5 concludes. Three annexes expand on points in the text. Annex A examines the concept of "sustainable deficits" and (implicitly) "sustainable" seignorage.⁷ Annex B examines a study that purports to link the generation of seignorage to political instability. Annex C develops the conditions under which the gain from seignorage exceeds the capital loss on foreign debt associated with exchange rate depreciation.

2. Background

a. Some History

Drawing on the Oxford English Dictionary, McKinnon (1979:283) defined seignorage as:

...a duty levied on the coining of money for the purpose of covering the expenses of minting, and as a source of revenue to the crown, claimed by the sovereign by virtue of his prerogative.⁸

Black (1998:287) noted that seignorage was the "...excess of the face value over the costs of production of the currency..."⁹ That is, "the coining of money" yielded a "rent" accruing to the *seigneur*.¹⁰

As a means of gaining additional rents, some rulers "clipped" or debased the currency. This practice had adverse consequences and the history of monetary economics has many examples.¹¹

Such practices, however, were not universal. Long periods of stable prices (lasting centuries) indicate that most rulers were restrained in the degree to which they "raised the coin".¹² An obvious example is provided by the English currency "sterling". Due to its stable value over long periods of time, the word "sterling" also came to mean "conforming to the highest standard".¹³

While full-bodied coin was the customary medium of exchange, the principal gain from seignorage was the "commission" or "premium" charged when coins were first struck. After its issue, however, full-bodied coin was costly to maintain. Storage and transport costs were high and the coins themselves lost weight through wear and tear. Under such a system, inflation (defined as the sustained rise in the general price level) could only occur if there were rapid increases in the supply of the commodities (such as gold and silver) from which the coins were made. One of the most frequently cited historical examples is the Spanish experience when prices rose sharply as silver and gold flowed in from the New World in the first part of the 16th Century.

While some inflation could occur as the supplies of gold and silver rose or the currency was "clipped", economic systems that used commodity money could not explode into bouts of hyperinflation.¹⁴ That prospect changed with the invention of fiat money, i.e., money whose status is determined by "legal enactment".¹⁵ Since the costs of producing fiat money are relatively low, its supply can be augmented rapidly.¹⁶

One important advantage of fiat money was "social savings".¹⁷ Commodities that formerly served as money and monetary reserves could be used elsewhere. Some commodities such as gold have retained a monetary role particularly for international transactions, both legal and extra-legal. Other commodities that served as money --- silver, raffia cloth, copper bars, cowrie shells, and so on --- were re-absorbed into the normal flow of commerce, or became collector's items. A further advantage of fiat money was that it sharply reduced the costs of intermediation and transactions thereby serving to raise economic efficiency.¹⁸

The disadvantage of fiat money (already alluded to) was that because its costs of production were low, it was subject to abuse. Indeed, since fiat money has no intrinsic worth, it can retain its value only when strict control is exercised over its rate of emission. Annex A reviews two papers which attempt to set out the conditions needed for deficits to be financed on a “sustainable” basis through seignorage. As the analysis there shows, these conditions are more stringent than the authors surveyed are prepared to admit. Without such control, major damage can occur. Keynes made this point when he stated:

There is no subtler, no surer means of overturning the existing basis of Society than to debauch the currency. The process engages all the hidden forces of economic law on the side of destruction...¹⁹

There is an added twist: fiat money can only retain its value if asset-holders remain confident that its rate of emission will continue to be strictly controlled. This condition follows directly from the fact that the demand for fiat money is *derived* from how readily it is accepted rather than how fully it is “backed”.²⁰ Historical events illustrate this point.²¹ And, the recent financial turbulence in Asia (particularly Thailand and Indonesia), Russia, and Brazil reconfirm it. All of these governments had agencies that “backed” their currencies. Yet, many individuals and organizations (domestic and foreign) who were holding financial instruments backed by these agencies lost confidence that the respective governments would act in ways that could sustain the values of their currencies. As events from mid-1997 onwards have shown there have been dramatic changes in the exchange rates for the rupiah, baht, ruble and *real* as asset-holders substituted away from these financial instruments.²²

Indeed, when confidence has been shaken by episodes of gross monetary mismanagement, the general public will tend to expect the turmoil to continue. Governments committed to reform face two tasks. The first is to end the monetary mismanagement. The second is to convince the general public that the mismanagement will not be repeated. The second task is often profoundly more difficult than the first.²³

Moreover, until confidence revives, asset-holders will have a strong incentive to develop and maintain alternative arrangements, such as currency substitution and the holding of large commodity inventories, real estate and other assets whose values are not undermined by inflation and devaluation. These “safety-first” strategies help minimize the private costs of further monetary disruption.²⁴

b. Measuring Seignorage

The most common estimate of seignorage is the real “rent” from issuing reserve money, defined as currency in circulation plus reserves of banks held by the monetary authority. The rent is typically computed as the change in reserve money divided by the price level.²⁵ Letting SE be seignorage, M reserve money, P the price level, and d denote “change in”:

$$(1) \quad SE = dM/P$$

Cukierman, Edwards and Tabellini (1992:538), whose contribution is discussed further in Annex B, define seignorage as:

... the ratio of the increase in base [i.e., reserve] money to total government revenues (the latter inclusive of seignorage).²⁶

These definitions highlight the gain to the authority that issues (or emits) the reserve money. The rent accrues as a capital gain to the issuing authority and is widely viewed as its (appropriate) reward for providing a valuable resource, namely (fiat) money.

Letting $g(P)$ be the growth of prices, i.e., the rate of inflation, the right-hand side of (1) can be transformed to give:²⁷

$$(2) \quad SE = d(M/P) + g(P) \cdot M/P$$

The first term on the right is the change in real reserve money. It measures the increased command over real goods and services available to the monetary authority through its emission of additional reserve money. The second term is the “inflation tax”. That is:

$$(3) \quad IT = g(P) \cdot M/P$$

It measures the capital loss due to the change in the price level incurred by the individuals and firms who hold reserve money.²⁸ When the amounts of reserve money issued are larger than asset-holders will hold at stable prices, the “new money” debases previously issued money (and other official liabilities whose nominal values are fixed). For those holding these financial instruments the tax is manifest as a capital loss at the rate at which prices increase (the variable capital levy noted earlier).²⁹

The literature has tended to cast seignorage in a positive light. It is something governments gain from their legal status. By contrast, the “inflation tax” has negative connotations.³⁰ In the United States, for example, most Americans generally share the view of former president Calvin Coolidge that “inflation is repudiation”.³¹ Furthermore, America's recurring “tax revolts” suggest that taxation, in any form, is unwelcome.³²

Similar attitudes are evident elsewhere. In Germany, the Bundesbank has an institutionalized responsibility to maintain monetary stability. This followed the havoc created by hyperinflation in the 1920s. In Indonesia, the upheaval associated with monetary mismanagement in the early 1960s induced the Suharto government to forswear domestic borrowing.³³ New Zealand, after decades of persistent inflation, fundamentally altered its approach to fiscal and monetary management.³⁴ Several other countries, including Canada and the United Kingdom, have taken similar steps. Finally, in 1991 Argentina ended decades of rapid inflation (punctuated by bouts of hyperinflation) by adopting a currency board.³⁵ Argentina's currency issue is fully matched by reserves of U.S. dollar assets. Recent discussions in Argentina about full dollarization shows that some countries (especially those with a long history of monetary turmoil) are prepared to voluntarily forego seignorage as part of the effort to sustain price stability.³⁶

The implication is that many developing and developed countries have found that money creation is no longer an unacceptable means of financing public sector deficits. No one doubts that inflation acts as a tax.³⁷ Moreover, few observers underestimate the damage that rapid inflation can cause.³⁸

Some studies do not distinguish between SE and IT.³⁹ Nonetheless, for analytical purposes, the distinction is useful. Generating seignorage requires the active emission of reserve money. By contrast, inflation erodes the real value of (fixed coupon) monetary assets as long as they are held.

Why do asset-holders continue to accept money when its value is eroding? Fiat money provides a number of useful services (convenience, liquidity, denomination, legality)⁴⁰ that *at the margin* compensate for the capital loss. By economizing on their monetary balances, individuals and firms can often keep the costs of these losses below the benefits they gain from using the money.⁴¹

3. Empirical Estimates of Seignorage

a. Conventional Estimates

The majority of empirical studies measure seignorage and the inflation tax using some concept of reserve money. Some analysts, however, have attempted to include the gains to official entities on their interest-bearing liabilities held at sub-market rates of interest by non-public organizations (i.e., captive markets).⁴² These analyses raise the question of whether all rents generated by officially induced monetary distortions should be considered as seignorage. Custom (and practical considerations) have tended to restrict the analysis to the immediate effects of changes in reserve money.

In their empirical work, few analysts distinguish between gross and net seignorage. It is largely taken for granted that creating the financial instruments that generate seignorage is “costless” or “virtually” so.⁴³ As shown below, this assumption is not valid even in well-managed financial systems.⁴⁴

Derivations of the inflation tax regularly assume that the elasticity of demand for real money balances with respect to the general price level is unity.⁴⁵ This assumption, implicit in (2), does not hold. As inflation accelerates, asset-holders rapidly reduce their holdings of real money balances by shifting into real property, foreign currency, or domestic assets whose value is indexed to the rate of inflation.

Most of the estimates of SE and IT in the literature are derived according to (1) and (2) above. (Neumann’s (1992) “extended” measure is discussed below.) The main differences in the estimates are the time period chosen and the base (GDP or government revenue) used for

international comparisons. Table 1 has selected estimates of seignorage and the inflation tax and their sources.

With few exceptions, the estimated gain relative to government revenue and GDP from both seignorage and the inflation tax is small. This outcome is consistent with a wide range of theoretical and empirical analysis showing that a Laffer curve response of both seignorage and the inflation tax to rising rates of reserve money emission. The maximum “yield” typically occurs at low (single-digit) rates of inflation.⁴⁶

A number of studies convey the impression that governments devote considerable attention to the generation of seignorage.⁴⁷ Some literature suggests that government set their macroeconomic policies so as to optimize seignorage.⁴⁸ In practice, few, if any, governments behave that way. Indeed, macroeconomic managers typically have far more pressing matters than whether their policies will or will not generate seignorage, let whether it can be optimized.⁴⁹ Moreover, since seignorage is so small in rich countries, policy makers have no reason to emphasize it as a source of “revenue”.⁵⁰

And, in developing countries, it stretches the point to argue that policy makers explicitly create inflation in order to increase the “yield” from seignorage.⁵¹ Economies with high rates inflation are fundamentally mismanaged and, in a very real sense, out of control. Under these circumstances, whatever might pass for macroeconomic policy is akin to gross negligence and opportunism rather a sustainable strategy for monetary management of which the optimal generation of seignorage is a part.

The data in Table 1 confirm these points. All of the developed countries, if they were so inclined, could potentially gain more seignorage. Few of them have had inflation rates (or rates of reserve money emission) that put them at the optimum point on their “seignorage Laffer curve”. By contrast, the history of inflation in developing countries suggests that most of them (Singapore has been an exception) are well beyond the combination of inflation and rate of money emission that would optimize seignorage.

Since most countries (rich or poor) are not close to their respective seignorage optimization points, their monetary policies have to be driven by other considerations.

Taken on their own terms, however, the results in Table 1 raise a number of questions. What, for example, can we make of the estimates of IT in cases such as Bolivia and Peru? If they are to be believed, they show that through reserve money creation both governments have orchestrated a real transfer of resources roughly equivalent to GDP on an annual basis for more than a decade (1980 to 1991). If true, this is a prodigious rate of taxation through the financial system that makes all other revenue collection efforts appear ineffectual.

Table 1. Annual Rate of Seignorage and Inflation Tax for Selected Countries *

Country / Period	Estimated Seignorage (percent of Gov. Revenue **)	Country / Period	Estimated Inflation Tax (percent of GDP)
1975-85 ¹		1980-91 ³	
Peru	29.7	Bolivia	91.5
Mexico	18.7	Burundi	0.9
Brazil	18.4	France	1.8
Korea	10.7	Indonesia	1.0
United States	6.0	Kenya	1.8
United Kingdom	5.3	Mexico	4.7
		Nigeria	3.4
1971-82 ²		Peru	110.4
Bolivia	21.6	Singapore	0.7
Burundi	6.4	United Kingdom	1.7
France	2.1	United States	0.9
Indonesia	9.0		
Kenya	4.5		
Mexico	23.6		
Nigeria	7.2		
Peru	20.7		
Singapore	8.8		
United Kingdom	1.7		
United States	2.3		
1980-91 ³			
Bolivia	111.6		
Burundi	4.5		
France	0.9		
Indonesia	4.5		
Kenya	4.6		
Mexico	25.0		
Nigeria	6.9		
Peru	65.3		
Singapore	5.2		
United Kingdom	0.6		
United States	1.8		

* Average for the period of annual data
 ** Non-seignorage Government Revenue

Sources:

¹ Sachs and Larrain 1993: Table 11.3

² Cukierman, Edwards, and Tabellini 1992: Table 1, pp.538-539

³ Agenor and Monteil 1996: Table 4.1

In principle, it might be possible for any government to commandeer 100 percent of real GDP. But, in the case of Peru, who supplied the additional 10.4 percent of GDP annually for such a long period? There is a further puzzle. Since government expenditure in both Peru and Bolivia were relatively small fractions of GDP, what happened to the implied government savings? Moreover, why did the government require such large amounts of “revenue” from the inflation tax when its real expenditures were so much smaller?

There are two answers. The first is that the estimates are the nonsensical result of mechanically (and inappropriately) applying the formula for IT that only provides a useful approximation when inflation and the rate of increase in reserve money are both low.⁵² The second answer recalls an observation by Keynes that there is no such thing as the liquidity of economy as a whole.⁵³ It is impossible for any government, using financial means alone, to capture such a large proportion of real resources over such an extended period. Who sells to whom and buys from whom when the government has commandeered the entire national product?

A further problem with these estimates is that, in Bolivia at least, the real money supply collapsed (Sachs and Larrain 1993:Fig.23.5, p.744). What then was the real resource base from which the inflation tax was extracted? With such a small (in fact, minuscule) “tax base” how was the “revenue yield” so large for so long?

As already noted one problem is that the formulae for SE and IT are only valid approximations when inflation and reserve money growth are low. A more general problem is that the analysis has been too narrowly conceived. Seignorage is a general equilibrium phenomenon. Both theory and practice show that a sustained increase in reserve money significantly affects output, employment, prices, interest rates, wages, the exchange rate, the balance of payments, and external indebtedness. By confining their attention to the formulae above, analysts have considered seignorage only in partial equilibrium terms.

Indeed, most discussions of seignorage rarely venture beyond the immediate effects of changes in the real supply of reserve money. And, even when the discussion is extended, the questions remain narrowly focused. To illustrate, Sachs and Larrain (1993:343-4) asked: “can a government earn seignorage under fixed exchange rates?” Their answer was a qualified “yes”. However, since Sachs and Larrain devoted so much attention to the pathological monetary situation in Bolivia during the 1980s, a question more in keeping with the thrust of their analysis would have been: can a government lose seignorage when the exchange rate depreciates? Sachs and Larrain did not address this question.

This was unfortunate because in their more detailed discussion of hyperinflation in Bolivia (*ibid.*:737ff.), they circle around this very point. Observing that there had been a rise in seignorage during the period when inflation was most rapid (1982-II to 1985-III), Sachs and Larrain continued:

(P)art of the explanation for this rise in seignorage was a rise in the budget deficit which was caused importantly by the rising cost of servicing foreign debt.⁵⁴

During that time, Bolivia's foreign debt was roughly equal to its GDP. Attempts by the government to service this debt had it caught on a “carousel”. That is, the capital loss in local currency terms on foreign debt service from the depreciation of the exchange rate (leaving aside the capital loss on the debt stock itself) more than absorbed the real transfer of resources from those who were willing to continue holding local currency.

The circular nature of the process gave an illusion of gain. The government was issuing reserve money to buy foreign exchange to service debt whose local currency costs had increased due to the exchange rate depreciation that resulted from inflation induced by earlier monetary emission.

A further problem was that while seignorage provided a temporary capital gain, the shift in the exchange rate raised the local currency cost of debt service *for all periods* until the debt was retired. In reality, the government of Bolivia did not “gain” real resources to “cover” its deficit through the inflation tax! When all changes in capital values are accounted for, it lost, and by a large margin.

This point applies more generally to all heavily indebted countries that experience high rates of inflation. It helps explain, for example, Russia’s recent debt difficulties (August 1998) and why the Russian government was prepared to default on its foreign debt.⁵⁵ Lacking access to foreign exchange, the government faced the prospect of generating hyperinflation as it emitted reserve money in an attempt to “capture” the foreign exchange needed to service the debt. Caught between a rock (the prospect of hyperinflation) and a hard place (of debt default), Russia opted for the latter. Some commentators have argued that the default has had devastating consequences for Russia’s re-integration with the world financial system.⁵⁶ One could easily argue that the consequences of delayed debt service much less devastating for Russia’s longer term recovery than another bout of hyperinflation.

Seen within its broader context, the steps taken by Russia at this stage of its recovery may have been wiser than has been initially portrayed. As shown in Annex C, heavily-indebted countries can only gain more in seignorage than they lose through changes in the local currency value of their external debt, if their rate of inflation remains *below* comparable rates of inflation in the rest of the world. Most developing countries do not meet this restriction. Certainly Bolivia in the mid-1980s and Russia in the second half of 1998, did not meet it.⁵⁷

Yet, the capital losses in domestic currency terms on net foreign liabilities are only one aspect of the costs that accompany rapid inflation. Apart from losing seignorage, rapidly inflating heavily indebted developing countries often take years to repair the damage created by their government’s fiscal and monetary “irresponsibility”.⁵⁸ The experiences of Germany and Indonesia suggest that the time required spans decades.

b. Broadening the Analysis

The capital gains and losses induced by the rapid expansion of reserve money can be measured by broadening the analysis in several ways. Some potentially fruitful directions have already been explored. McKinnon (1979:283) used a stylized set of accounts for the monetary authority. Total assets consist of reserves and investments, I, and total liabilities consist of deposits, D. Seignorage is then computed as:

$$(4) \quad SE = rI - r^*D - C$$

where: r is the “open-market rate of interest on investments”
 r^* is the deposit rate of interest on holdings of international currency
 C is the cost of servicing the outstanding stock of money.

Based on this identity, monetary authorities with large external liabilities, making $I < 0$, will lose seignorage.

Neumann (1992) adopted a similar format to estimate what he called “extended seignorage”. His analysis used a simplified set of financial accounts that consolidates the assets and liabilities of the Federal Reserve and the U.S. Treasury. His identity is:

$$(5) \quad SM = SE + (iD + i^*F + GR)/P$$

where SM is “extended seignorage”
 SE is seignorage as defined in (1) above
 i is the interest rate on the stock of private debt (D) held by the monetary authority
 i^* is the interest rate on official foreign loans (F) made by the U.S. monetary authority
 GR is the unrealized capital gain on assets; and
 P (as earlier) is the consumer price level.⁵⁹

Short of building a simultaneous equation model that links seignorage, inflation, exchange rate movements, the fiscal deficit, external debt service, interest rates, and other relevant variables⁶⁰, these models provide a number of hints on how to proceed. The link between seignorage and exchange rate movements can be easily represented using a simplified version of the monetary authority's accounts. Reserve money changes whenever there are changes in the balance sheet of the monetary authority.⁶¹ In symbols, the change in reserve money (dM) is the sum of the changes in net foreign assets (dF), net domestic credit (dD) and the change in other items net ($dOIN$). That is:

$$(6) \quad dM = dF + dD + dOIN.$$

Dividing through by the price level, P , gives an expression that links dM/P , seignorage, to the principal monetary “formation factors”. Including $dOIN$ in dD for convenience, this can be written:

$$(7) \quad dM/P = dF/P + dD/P$$

Using (2) above we can write dF/P and dD/P , respectively, as the sum of changes in the real values of net foreign assets and net domestic credit and terms that are related to the rate of inflation.

$$(8) \quad dM/P = d[F/P] + g(P) \cdot F/P + d[D/P] + g(P) \cdot D/P$$

Viewed in this way, the generation of seignorage depends on the factors that change net foreign assets and net domestic assets of the monetary authority. To determine how seignorage is related to changes in the exchange rate we note that:

$$(9) \quad F = e \cdot f$$

where e is the nominal exchange rate; and
 f is the stock of net foreign assets denominated in U.S. dollars.

Expanding this expression allows us to write dF/P as:

$$(10) \quad dF/P = [de/e + df/f] \cdot F/P^{62}$$

Under conditions of rapid money emission, both the exchange rate and the dollar value of foreign liabilities will be increasing. That is, de and df will be positive. For a highly indebted developing country, F/P , net foreign assets, will be negative. Thus, the term dF/P will be negative and will subtract from the seignorage.⁶³

Table 2 presents some recent data from Kenya, Zambia, Zimbabwe, and Russia, to illustrate the relative size of some of these components. The countries have been chosen because they provide a range of experiences. Four points stand out.

First, the direct gains from seignorage relative to GDP (column 3) are low especially when the growth of reserve money has been rapid. This is particularly in the case of Zambia where inflation has been high. Second, seignorage is an unstable source of “revenue”. Indeed, it is difficult to imagine any policy maker who would relish the task of framing a budget based on these “yields”.

Third, when net foreign assets of the monetary authority are large and negative, the effects of exchange rate changes (measured by dF/P in column 4) subtract *in a major way* from the generation of seignorage. Again, the Zambian data are striking. But so, too, are the Russian data. Before 1998, when net foreign assets of the monetary authority in Russia were positive, the changes in net foreign assets contributed positively and significantly to the generation of seignorage. As the country’s difficulties mounted in 1998, that contribution became sharply negative. These data support the point made earlier that Russia would have compounded its difficulties in 1998 had it attempted to capture foreign exchange for debt service through the creation of reserve money.

Fourth, these results highlight the need for more detailed analyses of the dynamics of reserve money creation. Countries in which reserve money is growing rapidly (or accelerating) show progressive signs of unraveling. The data for Zimbabwe are illustrative. The intensification of its economic difficulties were reflected in both the large (adverse) change in net foreign assets of the monetary authority and the similarly large change in domestic credit. The net seignorage “yield” was small. Subsequent events have shown that Zimbabwe was then on an unsustainable

path. During 1998, growth declined, inflation accelerated, the budget deficit widened, the exchange rate depreciated sharply, and international debt rose significantly.⁶⁴

Table 2. Seignorage and Its Components (percent of GDP)

Country	Year	dM/P *	dF/P *	dD/P *	F *	a **	b **	c **
Kenya	1994	1.83	0.05	1.79	2.48	-0.05	0.11	-0.004
	1995	2.91	-0.84	3.75	1.02	-0.13	-0.77	0.063
	1996	0.89	3.39	-2.50	5.43	0.07	2.99	0.330
	1997	0.21	0.01	0.20	4.79	0.10	-0.08	-0.002
Zambia	1994	1.83	-9.26	11.09	-37.2	-10.70	0.98	0.47
	1995	-0.88	-10.08	9.21	-39.5	-6.77	-2.59	-0.73
	1996	0.98	-5.18	6.17	-36.8	-8.87	2.63	1.06
	1997	1.22	-0.15	1.36	-28.6	-2.27	1.92	0.21
Zimbabwe	1994	1.14	1.29	-0.15	0.65	-0.18	1.17	0.30
	1995	0.12	2.31	-2.19	3.37	0.03	2.15	0.13
	1996	2.54	0.61	1.92	3.14	0.31	0.26	0.04
	1997	1.96	-8.39	10.35	-8.29	0.44	-7.37	-1.46
Russia ***	1994	6.84	1.16	5.69	4.02	5.28	-1.45	-2.68
	1995	4.24	1.86	2.38	3.41	0.48	1.06	0.33
	1996	1.61	-0.85	2.46	1.61	0.49	-1.12	-0.22
	1997	1.76	0.49	1.27	1.85	0.10	0.36	0.03
	1998 I	-3.73	-1.40	-2.33	7.06	0.21	-1.57	-0.04
	1998 II	0.72	-1.19	1.91	5.28	0.10	-1.27	-0.02
	1998 III	2.09	-13.41	15.50	-8.86	7.24	-7.97	-12.68
	1998 IV	6.02	-2.97	8.99	-9.31	-1.81	-0.90	-0.26

Notes: * M - Reserve Money F - Net Foreign Assets D - Net Domestic Assets P - Prices (CPI)

** a = (de/e)*F/P - Exchange Rate effect

b = (df/f)*F/P - Debt effect

c = (de/e)*(df/f)*F/P - Interactive term

*** Relative to GDP, Production Based. The percentages for the last two quarters of 1998 are based on estimated GDP numbers assuming constant GDP in real terms.

Source: International Financial Statistics, March 1999, IMF

c. Transition Dynamics

Since so much has been written on seignorage for such an extended period, it seems curious that the dynamic effects of reserve money creation have not been examined in detail. One explanation is that most discussions of seignorage have been couched in terms of the dynamics of the “steady state”. This approach can be traced to the origins of the modern seignorage literature as reflected in the contributions by Bailey, Mundell, and Friedman. Their focus on steady state dynamics is understandable given their concern with seignorage in developed countries where, at the time, inflation was exceedingly low. Under these conditions, there was little to distinguish between transition and steady state dynamics. The same formulae (1, 2 and 3 above) apply.

What is more puzzling, however, are the cases where authors have highlighted the existence of a Laffer curve relating seignorage to the rate of inflation and reserve money growth in circumstances of high inflation. (Examples include Sachs and Larrain, Agenor and Montiel, and Romer.) These discussions typically skip how the economic system makes the transition to the “optimum” seignorage point and what might occur beyond that point.

But, as the data above for Zambia, Russia, and Zimbabwe show, these transitions are exceedingly important *particularly in highly indebted countries that have reached (or moved beyond) their international credit limits*. In these circumstances, countries find themselves caught in a spiral of accelerating emission of reserve money as they attempt to gain access to the increasing amounts of foreign exchange needed to meet debt service *and* amortization. That task quickly proves to be overwhelming as the rate of reserve money emission increases. The resulting hyperinflation, as Keynes pointed out in his *Tract on Monetary Reform*, not only destroys all debt but destroys all credit as well. The Russian authorities evidently understand this point and were not prepared to run the risk. A debt standstill will annoy creditors and raise credibility problems. These, however, hold fewer adverse consequences from risking hyperinflation in the (futile) attempt to service external debt using resources generated through reserve money emission.

That the dynamics to and beyond “steady state” seignorage are important is evident from the analysis in Annex A. A major result of that exercise is that the change in the exchange rate is directly related to the acceleration of reserve money. (A similar result can be obtained by substituting (10) in (8) above and taking the total derivative. This gives the rate of acceleration of reserve money $d[d(M/P)]$ as a function of the rate of acceleration of the exchange rate depreciation and the change in the exchange rate squared.) All of these terms contribute in important ways to the transitional dynamics.

Of course, at low rates of reserve money emission, any feedback from the exchange rate to reserve money is minimal. This is why feedback terms are essentially irrelevant for analyses of seignorage in developed countries. Furthermore, in steady state, these terms are zero since reserve money is not accelerating. This is not the case in highly indebted countries when reserve money begins to grow rapidly (for example, as the budget deficit begins to widen).⁶⁵ Under these circumstances, the feedback from changes in the exchange rate to money emission is both direct and large, and typically cannot be dismissed.

Analyses that focus on steady state results systematically and inappropriately ignore these effects. Indeed, one can go further, analysts have made a major error when they have couched their discussions of seignorage in developing countries (where inflation is high, deficits are large, and foreign debt is burdensome) in “steady state” terms. Rapid reserve monetary growth invalidates all of the conditions that are fundamental to the stability required of a “steady state”.

4. Benefits and Costs of Seignorage

a. Benefits

The discussion so far has shown that control over the emission of reserve money provides governments (and their money issuing authorities) with the potential for substantial capital gains.

However, in addition to seignorage and the inflation tax, there are other benefits from increasing reserve money. These include:

- monopoly rents due to yield differentials on official liabilities
- real gains to issuers of financial instruments
- second and higher order effects from market distortions.

Monopoly rents accrue when official financial instruments are held by the private sector at rates below market rates. The most frequently cited example is the reserve requirements of financial institutions. The rent is equivalent to the difference paid on reserves (typically zero) and the interest rate payable on the financial instruments in an unconstrained market.

Fixed coupon bonds provide a gain to the issuer because their real value is correspondingly lower when they mature due to the inflation generated by the rapid growth of reserve money in the years over which the bond is held. The gain to their issuer is the difference between its face value at maturity and that value deflated by the change in prices over the life of the bond.

Second and higher order benefits associated with the generation of seignorage are reflected in the gain (or costs avoided) by the monetary authority and government through monetary restrictions. A common restriction is exchange control. Under a fixed (or “managed”) exchange rate, rising local prices provide the monetary authority with a rent on the foreign exchange that is surrendered through formal channels at sub-market prices.⁶⁶ For some countries these gains appear to be large. Frequently, however, the agencies that comply with the exchange controls are state-owned. Thus, the transfer of resources is entirely within the public sector. Private enterprises and individuals can readily evade the controls, and normally do. The practical effect is to redistribute assets within the public sector rather than provide the government with access to additional “cheap” resources.⁶⁷

b. Costs

There are several explicit and implicit costs associated with reserve money creation. They include:

- the resource costs of generating seignorage
- official losses due to the inflation tax
- capital loss (to non-government issuers) of financial instruments
- currency substitution and capital flight
- the dynamic effects (including efficiency losses) of financial repression
- the loss of reputation and credibility by the monetary authority

An important cost of seignorage (no less because it is so widely ignored) is the resource cost of printing, issuing, storing, and maintaining the stock of fiat money.⁶⁸ Money may be “cheap” to produce, but it is not “costless”. For countries undergoing rapid inflation a major import item has been the cost of bank notes.⁶⁹

The negative effects of the “inflation tax” have been widely noted.⁷⁰ The views of Coolidge and Keynes (cited above) were clear. Bauer and Yamey (1957:206) suggested that inflation could produce some “beneficial” redistribution of wealth, but they doubted the “...ability of the social fabric to stand the strain of inflation”. Indeed, they concluded “... the possibilities [of the inflation tax] are readily exaggerated” (*ibid.*). Dornbusch and Helmers (1988:238) stated “the inflation tax, ..., can easily be used to excess”. Finally, Hanke and Schuler (1994:93) asserted “...resources gained from the inflation tax are costly”.

The capital loss on fixed-value liabilities has been widely ignored in discussions of seignorage and the inflation tax. When a nation makes a commitment to repay a foreign liability, it assumes a number of risks.⁷¹ International interest rates may rise, or the exchange rate may depreciate. Both of these raise the cost of debt service. The former increases the cost in foreign exchange; the latter increases the cost in domestic currency.⁷² The evidence given earlier shows that the second cost is high in countries that have large external debt burdens and are inflating rapidly.

Currency substitution is one of several consequences of the inflation tax that is not widely treated as an adverse effect of seignorage. Numerous authors, however, note that through asset substitution, the public can sharply reduce its holdings of local financial instruments.⁷³ Asset holders in developing and transition economies have become adept at using this device to insulate their assets and activities from the effects of monetary disruption. This point has been evident in countries where inflation has been high --- Bolivia, Zaire, Argentina, Peru, Russia, Ukraine and Serbia. Asset-holders (local and foreign) have rapidly switched away from local financial instruments sharply limiting the inflation tax “yield”.

One reason for the rapid response has been the globalization of financial markets. This has made currency substitution safe, convenient, and inexpensive. Indeed, because of the array of financial services offered in rich countries, currency substitution frequently offers important advantages.⁷⁴

It needs to be noted that all currency substitution cannot be attributed to the effects of excessive reserve money creation. Political factors and regional instability raise “country risk” leading asset holders to reorganize their portfolios.

Whatever its cause, however, currency substitution generates seignorage for the country whose currency is being held. The main beneficiary so far has been the United States.⁷⁵ The irony of this type of transfer from poor countries to rich (equivalent to foreign aid in reverse) is that it is entirely voluntary. Local asset holders would have no incentive to substitute away from local currency if the respective governments were to pursue prudent fiscal and monetary policies.

Capital flight represents a direct transfer of wealth from a particular country. During the 1970s and 1980s, billions of dollars were transferred out of developing countries.⁷⁶ It was one of the counterparts of the rapid rise in official foreign debt. It also helps explain why investment declined and per capita real incomes have fallen so extensively, particularly in Africa.

The decline in income raises an issue that is generally overlooked in discussions of seignorage. When real income is declining, the monetary authorities should *withdraw* reserve money from the system.⁷⁷ In practice, the opposite occurs. As incomes decline, the budget deficit typically widens leading monetary authorities to inject additional reserve money into the system.

Accordingly, it is no mystery why inflation accelerates as incomes decline. In some situations, the changes have been explosive. For example, in Zaire over the period 1991 to 1994, reserve money increased by a factor of 1.36 million while prices increased by a factor of 4.2 million. A somewhat milder situation occurred in Nicaragua. Over the period 1988 to 1990, reserve money increased by a factor of 296 thousand and prices by a factor of 364 thousand.⁷⁸ Since output was falling in both countries during these periods, the monetary authorities, if they were to have acted prudently, would have removed reserve money from the system not added it.

The dynamic efficiency costs of financial repression have been widely studied.⁷⁹ Financially repressed economies have many distortions. Moreover, one of the most common responses by the government to the difficulties created by financial distortions is to impose further controls.⁸⁰ Such cascading of controls fails to address the sources of the distortions. Accordingly, they aggravate rather than resolve the economy's problems.

To illustrate, financially repressed economies are often characterized by negative real interest rates on formal sector loans, high reserve requirements on financial intermediaries, official interference in the allocation of credit, and “managed” nominal exchange rates (that often imply seriously over-valued real exchange rates). Commercial banks and public enterprises often serve as “captive markets” for assorted official financial instruments. Few asset-holders have any incentive to use local financial instruments. As a consequence, financial intermediation is limited and the financial system remains shallow. Rapid inflation fostered as a result of a government's attempt to generate seignorage compounds all these problems.

High inflation damages the reputation of the fiscal and monetary authorities and undermines their effectiveness. This is manifest through the loss of confidence by the general public in the

competence, integrity, and fairness of the monetary authority.⁸¹ Asset holders do not readily forget their government's monetary irresponsibility.

A major cost stemming from the loss of confidence is the time and effort needed by the "reformed" monetary authority to induce firms and individuals to re-convert their wealth into local financial assets. A major constraint on financial reform over the last two decades (especially in Africa) has been that few governments, or their monetary authorities, have behaved as though they appreciate the rigor of the performance standards they need to meet if confidence is to revive.⁸²

For countries where attempts to generate seignorage have spun out of control, a dramatic shift in policy is required. Typical responses have been currency reforms, the introduction of cash budgets, and the use of an exchange rate "anchor". All of these changes seek to sharply limit the rate of reserve money emission. Some of these efforts succeeded. Others have unraveled with renewed bouts of inflation. Brazil, for example, has had several currency reforms with little success. The cash budget worked in Bolivia, but failed in Zambia. After many years of backsliding on reform, Argentina appears to have been able to make an exchange rate anchor "hold".⁸³

c. Overview

Why have analysts tended to ignore the dynamic costs associated with the generation of seignorage? There seem to be four reasons. First, the capital losses (in local currency terms) on external debt are not a *direct* result of reserve money emission. They occur because of exchange rate changes that are related, in turn, to inflation and money creation.⁸⁴ The problem, noted earlier, is that seignorage has typically been analyzed in partial equilibrium terms. Since rapid increases in reserve money foster economy-wide changes, seignorage needs to be understood and analyzed as a general equilibrium phenomenon.

Second, standard treatments typically model the inflation tax as a stream of income just like other taxes.⁸⁵ This may be convenient but it is incorrect. The inflation tax is not an income flow but a wealth transfer that results from the creation of a capital asset (i.e., reserve money). To fully model such transfers would require a set of public sector accounts that include income flows *and* changes in the value of both assets and liabilities. Such a requirement has been far too cumbersome for analysts whose main concern is to gain some idea of the first-round size of the "inflation tax".

Third, the majority of exercises that revalue official assets and liabilities in developing countries occur irregularly. Most attention is devoted to the balance sheet of the central bank where many adjustments show up in "other items net". In practice, changes in this component of the financial accounts are typically treated as being incidental for the determination of monetary policy.⁸⁶ Furthermore, outside the central bank, debt monitoring is often incomplete in many developing countries. Large amounts of the foreign assets and liabilities of the public sector frequently are not properly recorded let alone systematically revalued.

And fourth, most discussions of seignorage in the literature focus on the impact of reserve money creation on, or close to a "steady state" growth path. Under these conditions, all of the key magnitudes (income, debt, prices, money, exchange rates, government spending, and government revenue) increase at the same rate. As pointed out earlier, there is no room for transition or "non-neutral" effects such as the feedback to the budget from local currency financing of external debt service due to rapid exchange rate depreciation. The results of this paper contradict the analysis of Anand and van Wijnbergen (discussed in Annex A). Their search for "steady-state" rates of seignorage and inflation tax lead to a dead-end in highly indebted developing countries. With reserve money increasing so rapidly, there is no steady state.

5. Concluding Comments

Some estimates of the gains from seignorage in the literature give the impression that imprudent monetary policy is highly lucrative. These apparent gains result from a partial accounting of the effects of high rates of reserve money emission. A more complete accounting of the benefits and costs of seignorage shows that the net gains are overstated. For developing countries with large external debts there are often major losses.

This outcome re-confirms what many historical examples have already shown, namely that at a national level monetary irresponsibility has high costs. On a net basis, governments in the richest countries with the deepest and the most resilient financial systems gain access to only modest amounts of real resources through money creation. Their capacity to commandeer additional resources by "cranking the growth rate of reserve money up another notch" is exceedingly limited. Governments in poor countries are subject to even tighter constraints. They can gain small amounts from seignorage on a sustained basis by creating the conditions that promote financial development. They will typically lose significant amounts of real resources with monetary policies that generate inflation. In fact, for heavily indebted countries, there will be net losses even at inflation rates that have been commonly seen as "low".

These results are unlikely to fundamentally alter the behavior of policy makers who put countries such as Bolivia, Peru, Ukraine, Zaire, and Serbia through periods of accelerating (and hyper-) inflation.⁸⁷ These results, however, should give economists reason to pause. In particular, they indicate that the generation of seignorage should be considered and accounted for within a general equilibrium setting. Such an approach makes the policy implications clearer as well. When the gains and losses of seignorage are properly computed, the minimization of the net loss of national wealth requires that governments in heavily indebted developing countries manage their monetary affairs so that inflation rates are kept at or below comparable world rates.

It is difficult to determine how well such an apparently "neo-liberal" suggestion will be received.⁸⁸ Most governments in developing countries act as though prudent monetary and fiscal policies restrict their broader "development" agendas. Economists, however, do not have to follow suit. At a time when our profession is under attack for its "puzzling [policy] failure"⁸⁹, we have an opportunity to correct the impression that monetary mismanagement is rewarding. Indeed, the result is even stronger. When all aspects of the process by which seignorage is

generated are accounted for, governments in developing countries have little to gain from accelerating the growth rate of reserve money. Indeed, if their country has large external debts, much will be lost.

References

- Abel, A.B. and B.S. Bernanke (1992) *Macroeconomics* Reading, MA: Addison-Wesley Publishing
- Agenor, P-R and P.J. Montiel (1996) *Development Macroeconomics* Princeton: Princeton University Press
- Allison, T.E. and R.S. Pianalto (1997) "The Issuance of Series-1996 \$100 Federal Reserve Notes: Goals, Strategies, and Likely Results" *Federal Reserve Bulletin* vol. 83, no.7, July:557-564
- Anand, R. and S. van Wijnbergen (1989) "Inflation and the Financing of Government Expenditure: and Introductory Analysis with and Application to Turkey" *The World Bank Economic Review* vol.3, no. 1:17-38
- Auernheimer, L. (1974) "The Honest Government's Guide to the Revenue from the Creation of Money" *The Journal of Political Economy* vol. 82, no.3, May/June: 598-606
- Bailey, M.J. (1956) "The Welfare Cost of Inflationary Finance" *The Journal of Political Economy* vol.64, no.2, April:93-110
- Bailey, M.J. (1971) *National Income and the Price Level A Study in Macroeconomic Theory* 2nd Edn. New York: McGraw-Hill
- Ball, L. (1993) "The Dynamics of High Inflation" NBER *Working Paper Series* No. 4578, December
- Bartlett, J. (1968) *Bartlett's Familiar Quotations* 14th Edn. Boston: Little, Brown and Company
- Bauer, P.T. and B.S. Yamey (1957) *The Economics of Under-Developed Countries* Chicago: University of Chicago Press
- Black, S. (1989) "Seignorage" in (eds.) J. Eatwell, M. Milgate, and P. Newman *The New Palgrave Money* New York: W.W. Norton
- Blackburn, K and M. Christensen (1989) "Monetary Policy and Policy Credibility" *Journal of Economic Literature* vol. XXVII, no. 1, March:1-45
- Cagan, P. (1989) "Hyperinflation" in (eds.) J. Eatwell, M. Milgate, and P. Newman *The New Palgrave Money* New York: W.W. Norton
- Carrizosa, M, D.M. Leipziger, and H. Shah (1996) "The Tequila Effect Argentina's Banking Reform" *Finance and Development* vol.33, no. 1, March:22-25
- Choudhry, N.N. (1992) "Fiscal Revenue, Inflationary Finance and Growth" *IMF Working Paper* WP/92/23 March
- Collier, P. (1991) "Africa's External Economic Relations: 1960-90" Ch.6 in (ed.) D. Rimmer *Africa 30 Years On* London: The Royal Africa Society in association with James Currey
- Cohen, B.J. (1998) *The Geography of Money* Ithaca: Cornell University Press Cukierman, A., S. Edwards, and G. Tabellini (1992) "Seignorage and Political Instability" *American Economic Review* vol.82, no.3, June: 537-555

- Dooley, M.P. (1996) "A Survey of Literature on Controls over International Capital Transactions" *IMF Staff Papers* vol.43, no.4, December:639-687
- Dornbusch, R. and F.L.C.H. Helmers (1988) (eds.) *The Open Economy Tools for policymakers in developing countries* New York: Oxford University Press for the World Bank
- Dornbusch, R. and A. Giovannini (1990) "Monetary Policy in the Open Economy" Ch. 23 in (eds.) B.M. Friedman and F.H. Hahn *Handbook of Monetary Economics* vol. II New York: North-Holland
- Duesenberry, J.S. (1964) *Money and Credit: Impact and Control* Englewood Cliffs: Prentice Hall
- ECA/OAU (1989) *African Alternative Framework to Structural Adjustment Programmes for Socio-Economic Recovery and Transformation (AAF-SAP)* United Nations Economic Commission for Africa E/ECA/CM.15/6/Rev.3 Addis Ababa
- Eatwell, J. M. Milgate, P. Newman (eds.) (1998) *The New Palgrave A Dictionary of Economics* (in four volumes) New York: The Stockton Press
- Easterly, W. and K. Schmidt-Hebbel (1993) "Fiscal Deficits and Macro-economic Performance in Developing Countries" *The World Bank Research Observer* vol. 8, no. 2, July:211-237
- Economist* (1997) "The puzzling failure of economics" 23rd August, p.11
- Einzig, P. (1966) *Primitive Money* 2nd. Edn. New York: Pergamon Press
- Evans, L., A. Grimes, B. Wilkerson and D. Teece (1996) "Economic Reform in New Zealand 1984-95: The Pursuit of Efficiency" *Journal of Economic Literature* vol. XXXIV, no. 4:1856-1902
- Fischer, S. (1982) "Seignorage and the Case for a National Money" *The Journal of Political Economy* vol. 90, no.2:295-313
- Fischer, S. (1990) "Rules versus Discretion in Monetary Policy" Ch. 21 in (eds.) B.M. Friedman and F.H. Hahn *Handbook of Monetary Economics* vol. II, Amsterdam: North-Holland
- Frenkel, J.A. and M.L. Mussa (1985) "Asset Markets, Exchange Rates and the Balance of Payments" Ch.14 in (eds.) R.W. Jones and P.B. Kenen *Handbook of International Economics* vol. 2 Amsterdam: North-Holland
- Friedman, B.M. (1975) "Targets, Instruments, and Indicators of Monetary Policy" *Journal of Monetary Economics* vol.1:443-473
- Friedman, M (1971) "Government Revenue from Inflation" *The Journal of Political Economy* vol.79, no.4, July-August:846-856
- Friedman, M. (1992) *Monetary Mischief Episodes in Monetary History* New York: Harcourt, Brace and Jovanovich
- Fry, M.J. (1988) *Money, Interest, and Banking in Economic Development* Baltimore: The Johns Hopkins Univ. Press
- Galbraith, J.K. (1958) *The Affluent Society* London: Hamish Hamilton

- Giddy, I.H. (1976) "An Integrated Theory of Exchange Rate Equilibrium" *Journal of Finance and Quantitative Analysis* December
- Gil Diaz, F. (1987) "Some Lessons from Mexico's Tax Reform" Ch. 12 in (eds.) D. Newberry and N. Stern *The Theory of Taxation for Developing Countries* New York: Oxford University Press for the World Bank
- Gillis, S.M, D.H. Perkins, M. Roemer, and D. Snodgrass (1987) *Economics of Development* 2nd. Edn. New York: W.W. Norton [4th Edition published in 1996]
- Goode, R. (1984) *Government Finance in Developing Countries* Washington D.C.: The Brookings Institution
- Goodhart, C.A.E. (1989) *Money, Information and Uncertainty* 2nd Edn. Cambridge: The MIT Press
- Goodhart, C.A.E. (1994) "Game Theory for Central Bankers: A Report to the Governor of the Bank of England" *Journal of Economic Literature* vol. XXXII, no. 1, March:101-114
- Gray, C. and A. Martens (1983) "The Political Economy of the 'Recurrent Cost Problem' in the West African Sahel" *World Development* vol. 11, no. 2:101-117
- Haliassos, M. and J. Tobin (1990) "The Macroeconomics of Government Finance" Ch. 17 in (eds.) B.M. Friedman and F.H. Hahn *Handbook of Monetary Economics* vol. II, New York: North-Holland
- Hallwood, P. and R. Macdonald (1986) *International Money: Theory, Evidence and Institutions* London: Basil Blackwell
- Hanke, S.H. and K. Schuler (1994) *Currency Boards for Developing Countries* San Francisco: ICG Press (Number 9 in ICG Sector Studies Series)
- Hanke, S.H. (1999) "How to Make the Dollar Argentina's Currency" *The Wall Street Journal* Friday, February 19th: A19
- Haslag, J.H. (1998) "Seignorage Revenue and Monetary Policy: Some Preliminary Evidence" Federal Reserve Bank of Dallas *Economic Review* Third Quarter:10-20
- Heller, P.S. (1974) "Public Investment in LDC's with Recurrent Cost Constraints" *Quarterly Journal of Economics* vol. 88, May:251-277
- Hubbard, R.G. (1994) "Investment under Uncertainty: Keeping One's Options Open" *Journal of Economic Literature* vol. XXXII, no 4, December:1816-1831
- IIF (1990) "Financial Sector Reform: Its Role in Growth and Development" The Institute of International Finance Inc. Washington, D.C., February
- Ibi Ajayi, S. (1997) "An Analysis of External Debt and Capital Flight in the Severely Indebted Low Income Countries in Sub-Saharan Africa" *IMF Working Paper* WP/97/68, June
- Isard, P. (1978) "Exchange Rate Determination: A Survey of Popular Views and Recent Models" *Princeton Studies in International Finance* No. 42
- Johnson, H.G. (1966) "Is Inflation the Inevitable Price of Rapid Development or a Retarding Factor in Economic Growth" *The Malayan Economic Review* vol. XI, no.1, April:21-28

- [Reprinted as Chapter 9 in H.G. Johnson *Essays in Monetary Economics* Cambridge: Harvard University Press 1967]
- Johnson, H. G. (1969) "Seignorage and the Social Saving from Substituting Credit for Commodity Money" in (eds.) R.A. Mundell and A.K. Swoboda *Monetary Problems of the International Economy* Chicago: University of Chicago Press [Reprinted as Chapter 10.2 in H.G. Johnson *Further Essays in Monetary Economics* Cambridge: Harvard University Press 1973]
- Johnson, H.G. (1970) "Is There an Optimal Money Supply" *Journal of Finance* vol. 25, no. 2, May:435-442 [Reprinted as Chapter 5 in *Further Essays in Monetary Economics* Cambridge: Harvard University Press 1973]
- Johnson, H. G. (1973) "Some Aspects of the Theory of Economic Policy in a World of Capital Mobility" Ch. 6 *Further Essays in Monetary Economics* Cambridge: Harvard University Press
- Keynes, J.M. (1923) "Social Consequences of Changes in the Value of Money" pp. 80-104 in *Keynes Essays in Persuasion op. cit.*
- Keynes, J.M, (1936) *The General Theory of Employment, Interest, and Money* New York: Harcourt, Brace and World
- Keynes, J.M. (1963) *Essays in Persuasion* New York: W.W. Norton & Co.
- Kindleberger, C.P. (1989) *Manias, Panics and Crashes: A History of Financial Crises* Rev. Edn. New York: Basic Books
- Laidler, D. (1982) *Monetarist Perspectives* Cambridge: Harvard University Press
- Leijonhuvud, A. (1968) *On Keynesian Economics and the Economics of Keynes A Study in Monetary Theory* New York: Oxford University Press
- Lessard, D.R. and J. Williamson (eds.) (1987) *Capital Flight and Third World Debt* Washington D.C.: Institute for International Economics
- Mankiw, N.G. (1994) *Macroeconomics* 2nd Edition New York: Worth Pubs.
- McKinnon, R.I. (1973) *Money and Capital in Economic Development* Washington D.C.: The Brookings Institution
- McKinnon, R.I. (1979) *Money in International Exchange* New York: Oxford University Press
- McKinnon, R.I. (1981) "The Exchange Rate and Macroeconomic Policy: Changing Post War Perceptions" *Journal of Economic Literature* vol. XIX, June, pp. 531-557
- McPherson, M.F. (1979) *An Analysis of the Recurrent Cost Problem in The Gambia* Harvard Institute for International Development Cambridge, MA.
- Meier, G.M. (1995) *Leading Issues in Economic Development* 6th Edn. New York: Oxford University Press
- Mundell, R.A. (1965) "Growth, Stability and Inflationary Finance" *The Journal of Political Economy* vol. 73, no.2, April:97-109
- Neale, W.C. (1976) *Monies in Societies* San Francisco: Chandler and Sharp

- Neumann, M.J.M. (1992) "Seignorage in the United States: How Much Does the U.S. Government Make from Money Production?" *Federal Reserve Bank of St. Louis Review* vol. 74, no.2, March/April:29-40
- Newbury, D. and N. Stern (eds.) (1987) *The Theory of Taxation for Developing Countries* New York: Oxford University Press for the World Bank
- Niehans, J. (1978) *The Theory of Money* Baltimore: The Johns Hopkins University Press
- OAU (1980) *The Lagos Plan of Action for the Implementation of the Monrovia Strategy for the Economic Development of Africa* Lagos: Organisation of African Unity, April
- Obstfeld, M. and K. Rogoff (1997) *Foundations of International Macroeconomics* Cambridge: The MIT Press
- Orphanides, A. and R.M. Solow (1990) "Money, Inflation and Growth" Ch. 6 in (eds.) B.M. Friedman and F.H. Hahn *Handbook of Monetary Economics* vol. 1. New York: North-Holland
- Pearce, D.W. (1989) *The MIT Dictionary of Modern Economics* 3rd Edn. Cambridge: The MIT Press
- Persson, T. and G. Tabellini (1990) *Macroeconomic Policy, Credibility and Politics* London: Harwood academic publishers
- Pindyck, R.S. (1991) "Irreversibility, Uncertainty, and Investment" *Journal of Economic Literature* vol. XXIX, no.3, September: 1110-1148
- Pinto, B. (1990) "Black Market Premia, Exchange Rate Unification, and Inflation in Sub-Saharan Africa" *The World Bank Economic Review* vol.3, no. 1:321-338
- Polak, J.J. (1997) "The IMF Monetary Model A Hardy Perennial" *Finance & Development* December:16-19
- Porter, R.D. and R.A. Judson (1996) "The Location of U.S. Currency: How Much is Abroad?" *Federal Reserve Bulletin* vol. 82, no.10, October:883-903
- Pou, P. (1997) "What Lessons Can be Learned from Recent Financial Crises? The Argentine Experience" Federal Reserve Bank of Kansas City *Maintaining Financial Stability in a Global Economy* A Symposium Jackson Hole, Wyoming, August 28-30
- Radelet, S. and J. Sachs (1998) "Asia's Reemergence" *Foreign Affairs* vol. 76, issue 6, pp.44-58
- Reisen, H. (1989) "Public Debt, External Competitiveness, and Fiscal Discipline in Developing Countries" *Princeton Studies in International Finance* no. 66, November
- Romer, D. (1996) *Advanced Macroeconomics* New York: The McGraw-Hill Companies
- Sachs, J.D. and F. Larrain B (1993) *Macroeconomics in the Global Economy* Englewood Cliffs: Prentice Hall
- Sachs, J.D., A. Tornell and A. Velasco (1996) "The Collapse of the Mexican peso: what have we learned?" *Economic Policy* no. 22, April:15-63
- Sargent, T. (1987) *Dynamic Macroeconomic Theory* Cambridge: Harvard University Press

- Schumpeter, J.S. (1954) *History of Economic Analysis* New York: Oxford University Press
- Severn, L. (1996) "Irreversibility, Uncertainty and Private Investment: Analytical Issues and Some Lessons for Africa" Paper prepared for the AERC Workshop, May 1996, Nairobi, Kenya
- Shaw, E.S. (1950) *Money, Income, and Monetary Policy* Chicago: Richard D. Irwin Inc.
- Shaw, E.S. (1973) *Financial Deepening in Economic Development* New York: Oxford University Press
- Sibert, A. (1994) "The allocation of seigniorage in a common currency area" *Journal of International Economics* vol. 37:111-122
- Stiglitz, J.E. (1993) *Economics* New York: W.W. Norton & Co.
- Taylor, M. (1995) "The Economics of Exchange Rates" *Journal of Economic Literature* vol. XXXIII, no. 1, March:13-47
- Taylor, L. (1996) "Sustainable Development: An Introduction" *World Development* vol.24, no.2:215-225
- Taylor, L. (1997) "Editorial: The Revival of the Liberal Creed -- the IMF and the World Bank in a Globalized Economy" *World Development* vol.25, no.2:145-152
- van Wijnbergen, S. (1989) "External Debt, Inflation, and the Public Sector: Toward Fiscal Policy for Sustainable Growth" *The World Bank Economic Review* vol.1, no.3:297-320
- Von Pischke, J.D. (1991) *Finance at the Frontier Debt Capacity and the Role of Credit in the Private Economy* Washington D.C.: The World Bank
- Walsh, C.E. (1996) "Accountability in Practice: Recent Monetary Reforms in New Zealand" *FRBSF Weekly Letter* 96-25, 9th September
- World Bank (1981) *Accelerating Growth in Sub-Saharan Africa: An Agenda for ACTION*, Washington D.C.: World Bank
- World Bank (1984) *Towards Sustained Development in Sub-Saharan Africa* Washington D.C.: The World Bank
- World Bank (1986) *Financing Adjustment with Growth in Sub-Saharan Africa, 1986-90* Washington D.C.: The World Bank
- World Bank (1989) *Sub-Saharan Africa From Crisis to Sustainable Growth A Long-Term Perspective Study* Washington D.C.: The World Bank
- World Bank (1997) *World Development Indicators 1997* Washington D.C.: The World Bank

Annex A: “Sustainable” Deficits and “Sustainable” Borrowing

Anand and van Wijnbergen (1989) (hereafter AvW) develop a framework to determine the “...consistency between fiscal deficits and output growth, the rate of inflation, and other macroeconomic targets” (*ibid*:17). They aim to answer the question: “...what is the *sustainable* fiscal deficit given targets for inflation, output growth, real exchange rate developments, and others” (*ibid*:18, emphasis in original). Similarly, van Wijnbergen (1989) (hereafter vW) focuses on how highly indebted countries might devise “...strategies to deal with their external debt and formulat[e] internal policies to allow sustainable growth within the limits of creditworthiness and macroeconomic stability...” (*ibid*:297). Both papers seek to establish the level of “sustainable borrowing” (*ibid*:302-308). Data are taken from Turkey. During the period considered, Turkey’s external debt was high and the economy was growing relatively rapidly.

AvW base their approach on the standard IMF financial programming framework.⁹⁰ Their main identity is (*ibid*:23):

$$(1) \quad D + i \cdot B + i^* \cdot (B^* - NFA^*) \cdot e = dB + (dB^* - dNFA^*) \cdot e + dM$$

where: D is the non-interest deficit;

$i(i^*)$ is the domestic (foreign) rate of interest on government debt;

B (B^*) is the stock of domestic (foreign) debt;

NFA* is net foreign assets of the central bank;

e is the nominal exchange rate (in local currency units per dollar);

M is base money; and

d denotes “change in”.

They transform this identity into real terms by converting the interest rates and the exchange rate to their constant price counterparts. The variables are then divided by national income. They conduct several exercises.

The main one seeks the deficit (deemed “sustainable”) that maintains stable ratios of domestic and external debt to income. The former depends upon the relation between the growth of the real economy and the real rate of interest on domestic debt. The latter depends on the relationship between real income growth and the rate at which the real exchange rate depreciates.

The outcome is a “consistency condition” (*loc. cit.*:27):

...the non-interest deficit,...., plus real interest payments on domestic and foreign debt, cannot exceed what can be financed through debt issued at target debt-output ratios, plus the revenue from the steady-state seignorage and the inflation tax.

AvW note several factors that might reduce these “steady-state” magnitudes (currency substitution, high short-term real interest rates) and provide data from Turkey showing that, in 1985, the inflation tax and foreign financing yielded, respectively, 4.5 percent and 2.7 percent of Gross National Product to cover an actual deficit of 6.6 percent of GNP. By their calculations,

the "financeable" deficit at constant inflation and debt ratios was only 5.6 percent of GNP (*loc. cit.*:31). Thus, Turkey was beyond the "consistency" point. Indeed, as noted below inflation subsequently accelerated.

A similar exercise appears in vW but the focus is the "non-interest current account surplus" of the balance of payments. He manipulates this variable, again in real terms and relative to national income, and concludes (*loc. cit.*:305):

...the non-interest current account surplus, to be sustainable, should on average at least equal the initial debt times the difference between the real interest cost on foreign debt and the real output growth rate.

Data from Turkey are used to indicate whether fiscal policy has been consistent with such a debt strategy. The outcome of the exercise (see Table 4, p.311) is that Turkey could have inflation of between 15 to 55 percent per annum and "finance" a deficit (largely through the inflation tax) of 4.4 to 5.7 percent of real GNP. The paper concludes with some qualifications. The most notable from the perspective of the discussion in the main text is that capital losses on foreign debt due to movements in the real exchange rate would lower the "financeable deficit".

Commentary The exercises in both articles explicitly include the impact of capital losses on foreign debt through movements in the *real* exchange rate. Nonetheless, vW drops this component from the calculation of the "financeable" deficit reported in his Table 4. He explained: "Capital losses on external public sector debt are excluded, not because they would not constitute a real increase in public sector liabilities but because they are unlikely to recur in the future" (*loc. cit.*:311). The rationale is that vW presumes Turkey is unlikely to experience further depreciation of the *real* exchange rate. This was an unrealistic presumption in view of Turkey's high rate of inflation relative to its main trading partners.

A major problem with both exercises is that the quest for "steady state" outcomes and "consistency results" led to a hasty and inappropriate switch from nominal to real terms. Such a switch appears to make sense in view of the authors' pursuit of longer-term results. But, in economies like Turkey that have chronically high inflation, the short-run monetary dynamics to and from the steady state cannot be ignored. Accordingly, the "steady state" results in both papers have a number of weaknesses.

First, neither paper provides any evidence that the Turkish economy (or any other high inflation, high-debt economy to which their analysis might apply) is structured in ways that will ensure the "steady-state" results can be achieved while inflation remains chronically high. Indeed, Turkey's experience from 1985 onwards indicates that the basic "steady state" limits derived in the two papers were exaggerated. For example, during the period 1986 to 1997, reserve money in Turkey increased by a factor of 422, consumer prices rose by a factor of 385, and the exchange rate changed by a factor of 224.⁹¹ These data are not consistent with sustainable deficits, sustainable borrowing, or anything approaching a "steady state".

Second, the move from nominal to real terms, while useful for deriving "steady-state" results (when monetary effects are supposed to be "neutral") produces anomalies. These are important in high inflation economies with specific rigidities (like Turkey). One anomaly is the derivation of "consistency results" using real national income as the *numeraire*. When prices are rising rapidly, a far more important benchmark for the government is its tax revenue. Indeed, it is surprising to find so much emphasis on the ratios of "sustainable deficits" and "sustainable borrowing" to GNP and so little emphasis on whether government tax revenues can be maintained under high inflation. Most governments find that even moderate rates of inflation erode their "traditional" revenue base (taxes, fees, and public enterprise surpluses). As inflation accelerates, the problem is compounded by "collection lags" (the Olivera-Tanzi effect), increasing fraud and evasion, and the erosion of public enterprise surpluses due to price controls and government interference.

The use of tax revenue as the *numeraire* (rather than GNP) would dramatically tighten the "consistency" constraint. Indeed, since the elasticity of tax revenue with respect to inflation typically falls as inflation rises, high inflation countries such as Turkey may find that its "sustainable" deficit and "sustainable" level of external borrowing are both close to zero and, until credibility is restored, may even be negative.

Third, focusing on steady-state results misses some important short-term monetary dynamics. Governments do not settle their accounts on a day-to-day basis using real resources; nor do they collect revenue in real terms. Moreover, even in instances where indexing is common (treasury bill yields, tax brackets), leads and lags modify the real effects. One of the nominal effects, which "washes" out in the "steady state" analysis when inflation is presumed to have a uniform impact on all nominal values, is the change in the nominal value of foreign debt due to exchange rate movements. This effect can be directly derived from the identity given by AvW. Rearranging (1) above, we obtain:

$$(2) \quad dM = D + i \cdot B - dB + [i \cdot B^* - NFA^* - dB^* + dNFA^*] \cdot e$$

Differentiating (2) provides an expression for the acceleration of base money. Assuming that domestic and foreign real interest do not change:

$$(3) \quad d(dM) = dD + i \cdot dB - d(dB) + [i \cdot dB^* - dNFA^* - d(dB^*) + d(dNFA^*)] \cdot e \\ + [i \cdot B^* - NFA^* - dB^* + dNFA^*] \cdot de$$

The last term on the right hand side is the change in the local currency value of foreign debt due to the change in the exchange rate. When inflation is rapid, the lag between the emission of reserve money and changes in prices and exchange rates is short. This identity shows that the relationship between the acceleration of reserve money growth and the changing capital value (in domestic currency terms) on foreign debt is direct. For highly indebted countries which will be under pressure to reduce their foreign debt, meaning dB^* will be negative and $dNFA^*$ will be positive, the effect will also be large and positive. (This feedback from debt payments to reserve money growth is noted in the text.)

Fourth, the wisdom of attempting to illustrate “steady state” results using evidence from a country like Turkey that has had such a persistent record of monetary mismanagement and macroeconomic instability is questionable. In view of this history, why would any asset-holder in Turkey accept a steady-state capital loss on money when alternative arrangements (currency substitution, inventories of real property) are so readily available and potentially profitable? Moreover, what does a “steady-state” (or “financeable”) deficit of 5 percent of GNP imply for long run financial development and economic growth? Turkey’s own history provides some indications --- it means growth at below the economy’s potential, chronic inflation, punctuated with intermittent macroeconomic crises.

By not addressing these questions, both papers are less than they might have been. They have taken special care to account for the factors contributing to the public sector deficit and how it might be financed. But, they did not extend the analysis to link the deficit (through money creation) to prices and the exchange rate. This omission is of second-order importance in economies with low inflation. However, in a case like Turkey which has had (and continues to have) high inflation, the omission is a critical flaw in the analysis. It excludes important elements of the monetary dynamics involved in financing deficits through money creation. These cannot be ignored in highly indebted developing countries.

Annex B: "Seignorage and Political Instability": A Critique

The Argument Cukierman, Edwards and Tabellini (1992), hereafter CET, provide cross-country regression results to test the hypothesis that "...after controlling for the stage of development and structure of the economy, more unstable and polarized countries collect a larger fraction of their revenues through seignorage, compared to more stable and homogeneous societies" (*ibid.*:338). CET base their analysis on what they call plausible political hypotheses. Using a two-sector closed economy model --- with a government that taxes and spends and a private sector that consumes and pays taxes with money issued by the government --- they find support for the null hypothesis (*ibid.*:553).

The Basic Assumptions To develop their model, CET presume:

- a. seignorage is equivalent to reserve money creation (p.538);
- b. as a matter of strategy, unstable governments "choose" to leave their tax systems undeveloped and dysfunctional and to build up the national debt in order to constrain their successors (pp.538, 541;552);
- c. seignorage carries "...no administrative costs" (p.541) but tax collection does;
- d. "...a more inefficient tax system discourages public spending and forces the government to rely more on seignorage and less on regular taxes as a source of revenue" (p.543); and
- e. the model excludes foreign assets and liabilities. Indeed, the only asset is fiat money issued by the government (pp.541-544).

In their discussion, CET cite estimates of seignorage as a proportion of government expenditure which, for the decade 1971 to 1982, average as much as 28 percent (for Ghana).

Commentary Few analysts would question the basic conclusion that unstable, polarized, societies rely heavily on money creation (and therefore seignorage) to transfer resources to the government. This conclusion was noted by Gillis *et al.* (1987:334-336) some years earlier. But, what of reverse causation? When weak governments rely more heavily on money creation to transfer resources through seignorage, does this generate instability and lead to polarization? Keynes' comments in 1919 about the consequences when governments "debauch the currency" left no doubt about his views. CET, however, consider the possibility and reject it (p.550). They do this on *a priori* grounds even though their model (especially equation 10) could be inverted to make seignorage an exogenous variable and thereby allow them to test the proposition.

The definition of seignorage as the ratio of the increase in base money to government expenditure is not unusual (Fischer 1982). Most analysts split out the inflation tax component from seignorage. CET do not (p.541).

CET present, without comment on their plausibility, estimates of seignorage for 79 countries which range from .4 percent of government revenue (Papua New Guinea) to 28 percent (Ghana). Ghana was in an advanced state of dissolution during the period examined (1971 to 1982).⁹² It is surprising that CET reserved comment on this and similar cases, particularly since the governments appeared to have been profiting so handsomely from their monetary irresponsibility. Based on these data, the government of Ghana gained more than a quarter of its real expenditure for more than a decade by simply printing money.

At a minimum, CET should have attempted to explain why they believed that the capital gain on reserve money (i.e., seignorage) was appropriate compensation for the capital loss (in domestic currency terms) on Ghana's foreign debt. No one doubts that the government of Ghana gained access to real resources from issuing reserve money. Nonetheless, it is totally arbitrary to truncate the analysis by ignoring the losses that the rapid expansion of reserve money set in motion.

CET attribute a remarkable degree of control and ingenuity to "governments" in the unstable, polarized economies they identify. These governments, we are told, have the capacity to ensure that their tax systems remain dysfunctional and that the national debt increases in ways which effectively limits the degrees of freedom available to successor governments. Readers are told that this behavior is part of the "strategic choices" made by the various governments. Readers are left wondering, however, that if these governments have the capacity to organize themselves in ways that allow them to act so strategically, why they do not decide to stabilize the economy. Indeed, from a strategic point of view, such action would be astute. It would remove the country from the deficit/money creation/debt/inflation treadmill that has been widely shown to jeopardize a government's grip on power.

There seem to be two explanations why this does not occur. The first is that the governments that need to rely on seignorage have no capacity to behave strategically. At best they lurch from

one crisis to another with no clear goal except to retain power whatever the economic costs. The second is that few governments have any concern for the actions of their successors. Their main concern is to manipulate the system to their advantage and that of their key constituencies for as long as they can.

A common assumption in the literature is that gross and net seignorage are equal. The usual argument is that the direct costs of printing and issuing money are minimal. This is not even true in stable countries such as the United States. For example, the operating costs associated with the issue and maintenance of the U.S. money stock over the period 1951 to 1990 was 7.2 percent of gross seignorage (Neumann 1992:Table 1). This is significantly higher than the net costs (relative to revenue raised) of operating the United States tax system. Thus, there is no justification, either in principle and in practice, for assuming that seignorage costs are zero. It does not "simplify" the discussion as many analysts assert; it adds to the error. However, for monetarily unstable countries (i.e., those that are attempting to "capture" real resources through high inflation) this assumption is invalid. The costs of issuing and re-issuing money are large relative to the government budget and the balance of payments.

At a minimum, CET should have included collection costs for both conventional taxes and seignorage. This would have reinforced the point that low revenue yield, increasing debt and seignorage costs are serious limits for *existing* governments, and not just their successors.

There is nothing in principle or in practice to substantiate the idea that a "...more inefficient tax system discourages public spending...". Were this the case, few governments would be in the deficit/debt cycles that are now so common. Indeed, a major problem in many African countries especially over the last three decades is that their governments have grossly over-extended themselves. The attendant inefficiencies have been widely noted (OAU 1980, ECA/OAU1989; World Bank 1981, 1984, 1986, 1989, 1994; Gray and Martens 1982; Heller and Aghevli 1989).

A major weakness of CET's analysis is the exclusion of foreign assets and liabilities. Their footnotes partially acknowledge the problem. In note 6, they suggest that "public debt" may be used as a strategic variable in the manner noted earlier. Note 8 states that neither the public nor the private sector has access to the "capital market". This "complication" is excluded "...in order to focus on the novel issue of how the political system of a country governs the evolution of its taxing institutions" (p.541).

The problems with this approach are that the idea is not "novel" and the ability to borrow (both domestically and abroad) is not an incidental feature in the "evolution" of a country's "taxing institutions". Much of the "debt problem" of developing countries arose because governments that were unwilling to tax more heavily or more efficiently found it more convenient to borrow abroad. That the borrowing was carried to excess is one issue. That the debt problem emerged, however, is intimately connected to the government's ability and willingness to tax. Since the period examined by CET (1971 to 1982), covers the time when many developing countries became heavily indebted, their discussion is incomplete without the inclusion of foreign debt.

Annex C: Seignorage Gains and Capital Losses on External Debt

Let M/P be the real value of reserve money and F/P the real (local currency value) of official net foreign debt. The gain from expanding the stock of real base money (seignorage), SE , can be written:

$$(1) \quad SE = g(M) \cdot M/P$$

The capital loss, L , on net official foreign debt in real domestic currency terms is:

$$(2) \quad L = g(e) \cdot F/P$$

where $g(e)$ is the rate of depreciation of the nominal exchange rate, e .

The basic argument in this paper is that in highly indebted developing countries L can exceed SE . To demonstrate that, suppose that SE exceeds L . We will derive a contradiction.

If $SE > L$,

$$(3) \quad g(M) \cdot M > g(e) \cdot F$$

Since in highly indebted poor countries, $F \gg M$, (3) implies:

$$(4) \quad g(M) \gg g(e)$$

When reserve money has been increasing rapidly, the rate of depreciation of the exchange rate approximates the rate of inflation. (This can be shown using the definition of the real exchange rate and assuming that the rate of change of the real exchange rate approximates the rate of change of foreign prices.) That is:

$$(5) \quad g(P) \approx g(e)$$

To derive a relation between prices and reserve money we need the money multiplier identity linking broad money ($M2$) to reserve money and the demand for money function. That is:

$$(6) \quad M2 = m \cdot M$$

where m is the money multiplier, and:

$$(7) \quad M2 = k \cdot P \cdot y$$

where k is the inverse of the velocity of money; y is real income. Combining (6) and (7) and converting to growth rates gives:

$$(8) \quad g(m) + g(M) = g(k) + g(P) + g(y).$$

In highly indebted countries in which $g(M)$ (and $g(P)$ and $g(e)$) are changing rapidly, $g(m)$ will be positive, $g(k)$ will be negative, and $g(y)$ will be close to zero. This implies:

$$(9) \quad g(P) > g(M).$$

Drawing the results together. We combine (4), (5) and (9) to give:

$$(10) \quad g(M) \gg g(e) \approx g(P) > g(M).$$

This is a contradiction. Thus, the original premise that SE exceeds L is false.

For SE to exceed L, $g(M)$ needs to be greater than $g(P)$.

This condition will hold in two cases. The first is when $g(P)$ is negative. We might recall that such a condition is consistent with earlier theoretical work on the "optimal quantity of money".⁹³

The second case is that some combination of $g(m) < 0$, $g(k) > 0$, and $g(y) > 0$ would yield $g(M) > g(P)$.

Such a dynamic combination would emerge from an economy undergoing significant financial deepening. In practical terms, this would imply that the currency to deposit ratio would be increasing (reflecting greater confidence in the persistence of low stable interest rates), the velocity of circulation would be declining (reflecting increases in financial intermediation), and real income would be growing (as a result of increased savings and investment, boosted perhaps by foreign direct investment).

In the absence of sharp, broad-based improvements in productivity, such a combination would be sustainable only if the real exchange rate, R , were depreciating. Based on the real exchange rate identity this would imply that $g(P) < g(P^*)$, i.e., the domestic rate of inflation would be less than the rate of inflation of the country's trading partners.

Endnotes

¹ Pearce 1989:383.

² Dornbusch and Giovannini 1990:1291; Romer 1996:420

³ Bailey 1956:93; Friedman 1971:847; Gillis *et al.* 1987:335; Reisen 1989:11; Anand and van Winbergen 1989:19; Sachs and Larrain 1993:339

⁴ Bailey 1956; Bauer and Yamey 1957:204-208; Mundell 1965; Johnson 1966; 1969; Friedman 1971, Auernheimer 1974, Fischer 1982, Laidler 1982:134-135; Gillis *et al.* 1987:334-336; Dornbusch and Helmers 1988:111,238, 360; Fry 1988; Black 1989, Persson and Tabellini 1990:110ff ; Neumann 1992, Sachs and Larrain 1993; Ball 1993; Hanke and Shuler 1994:93; Sibert 1994, Romer 1996, Agenor and Montiel 1996, Obstfeld and Rogoff 1997; Haslag 1998

⁵ Johnson 1969; Friedman 1971; McKinnon 1979:283-291; Fischer 1982:Appendix; Hallwood and Macdonald 1986:173; Sargent 1987:299-301; Fry 1988:30; Anand and van Wijnbergen 1989; Cukierman, Edwards and Tabellini 1992:538-539; Neumann 1992:Table 1; Easterly and Schmidt-Hebbel 1993:Table 1; Sachs and Larrain 1993:737-739; Hanke and Schuler 1994:8-9; Porter and Judson 1996:883; Agenor and Montiel 1996:Table 4.1, Allison and Pinalto 1997:561; Haslag 1998; and Hanke 1999

⁶ Gillis *et al.* (1987:336) noted:

Paradoxically,...the inflation tax device can work best where it is needed the least: in those countries having tax systems that are most responsive to growth in overall GDP and which involve low efficiency costs.

⁷ Haslag (1998) shows this empirically.

⁸ Schumpeter (1954:298-299) noted:

The old feudal privilege of kings and princes to coin money and levy a tax in doing so, often in addition to a fee (brassage as it was sometimes called), was onerous even when it did not lead to frequent recoinage and produced an irresistible popular demand for free coinage. Accordingly, in England seignorage was abolished in 1666, while in other countries the tendency was to reduce it to the cost of coinage.

⁹ Black in Eatwell *et al.* (1998:287). This feature is stressed by Hallwood and Macdonald (1986:173) who described seignorage as: "...the right to the difference between the spending power [of money] and its cost of production".

¹⁰ Black (1989) and Porter and Judson (1996, n1) make the same point. Porter and Judson state:

Seignorage is defined as the government's gain from converting valuable metal into more valuable coins. We use the term here in the looser sense that includes the central bank's income from issuing paper currency.

¹¹ Kindleberger 1989; Friedman 1992

¹² Schumpeter 1954:299; Fischer 1982; Cohen 1998:39-41

¹³ *Webster's New Collegiate Dictionary* (1973:1141). The Oxford English Dictionary 2nd Edition (available on the web) traces the term sterling back to 1085 or 1104. It was the name given to the "English silver penny of the Norman and subsequent dynasties." The desire to maintain standards caused the Whig government under William III in 1698 to restore at State expense the original composition of the silver penny (Schumpeter 1954:298-299).

¹⁴ In a commodity-based system, money *is* wealth. In non-commodity based systems, money *represents* wealth.

¹⁵ Pearce 1989:151

¹⁶ Keynes 1923; Black 1989; Friedman 1992. Shubik in *The New Palgrave* vol.2 (1998:316-7) noted:

Money is a creation of law. A commodity money is a money which would have intrinsic utilitarian worth as a commodity even if it were demonetized. A fiat money is a money which if demonetized would scarcely be worth the paper it is printed on.

¹⁷ Johnson 1969 [Reprinted in Johnson 1973:Ch.10]

¹⁸ According to McKinnon (1973:3), economic development can be defined as the general reduction in intermediation costs over time. A similar view appears in North (1997:150) who argued that economic development was facilitated by innovations and institutions that lowered transaction costs.

¹⁹ Keynes "Inflation and Deflation" (1919) in *Essays in Persuasion* 1963:78

²⁰ Duesenberry 1964. Einzig 1964, Neale 1976

²¹ Many currencies have been readily accepted in areas well beyond the jurisdiction of the authority formally providing its "backing". The Austrian St. Augustine silver thaler circulated widely in West Africa and the United States during the 19th century. (Indeed, the expression "two bits" refers to the pieces derived from this coin.) The "acceptability" of the United States dollar has not been affected by removal of the legal provision that the U.S. Government must "back" the currency issue with a fixed percentage (as much as 25 percent at one point) of reserves of gold and silver (or claims against gold and silver). That provision was selectively diluted between the 1930s and the early 1960's. In 1971, all formal official commodity based backing for the U.S. dollar, both domestically and abroad, was dropped. (I am grateful to Professor James Duesenberry for discussions on this point.)

²² There is now a large literature on the "Asian crisis". Some (Radelet and Sachs 1998) have argued that the realignment of currency values was exaggerated and totally unjustified by the underlying "strengths" of the various economies. This argument reflects confusion about where fiat currency derives its value.

²³ There are many reasons. One of these is derived from the theory of "option values" (Pindyck 1991; Hubbard 1994; Severn 1996). Investors who may be "locked in" have an incentive to "wait". For them, waiting is an investment in greater certainty. For governments that are attempting to restore confidence, the delay imperils stabilization and recovery.

²⁴ There are several examples from the last few years. The European Monetary System was disrupted in 1992 when both the U.K. and Italy had to abandon their "fixed" exchange rate bands. Mexico experienced a financial melt-down in 1994. This has a knock-on "tequila effect" to other countries in Latin America (Sachs, Tornell and Velasco 1996; Carrizosa, Leipziger and Shah 1996; Pou 1997). The Asian, Russian and Brazilian turmoil are more recent. In all these instances, the exchange rate policies of the respective governments were unsustainable. By switching away from the currencies, asset-holders intensified the crises.

²⁵ This definition forms the basis of most analytical exercises. See, for example, Friedman 1971:849; Sargent 1987:293-4; Sachs and Larrain 1993:340; Ball 1993:4; Agenor and Montiel 1996:111; Haslag 1998. By contrast, the World Bank defines seignorage in nominal terms as the "annual change in holdings of reserve money" (World Bank 1997:189).

²⁶ These authors also define seignorage as:

-
- a. the ratio of the change in high-powered money to government expenditure;
 - b. the rate of inflation multiplied by the ratio of high-powered (or base) money and government expenditure;
 - and
 - c. the rate of inflation multiplied by the ratio of high-powered money and GNP.

²⁷ Sachs and Larrain 1993:341-342; Agenor and Montiel 1996:112. This expression can be derived by totally differentiating $d(M/P)$. This yields $dM/P - (M/P).dP/P$ which upon rearranging gives (2) in the text. Friedman (1971:849) derived a similar result starting from a money demand equation.

²⁸ Gil Diaz (1987) traced the incidence of the inflation tax by income class in Mexico. His results show that this tax is highly regressive. They support a widely held belief that "inflation is the cruelest tax on the poor".

²⁹ Taylor (1996:217) defines the "inflation tax" as the "...erosion of wealth by inflation which leads asset-holders to save more to compensate for capital losses".

³⁰ In the early 1960's, just as many countries were actively promoting "development", Harry Johnson (1966) argued that some inflation may be the "inevitable" consequence of rapid economic growth. Over time, however, government involvement led to rapid inflation with little or no growth.

³¹ Speech to the Hamilton Club, Chicago, 11th January 1922 (Bartlett 1968:911a).

³² John Kenneth Galbraith has remarked that "Americans have never liked paying taxes, with or without representation."

³³ This prohibition remains in force. It prevents the Bank of Indonesia from lending directly to the government. Special measures have ensured that public entities do not become surrogate borrowers for the government. Few other developing country governments, especially in Africa, have imposed such restrictions on their behavior. Collier (1991) argued that the absence of such "agencies of restraint" accounts for much of the stagnation in Africa over recent decades.

³⁴ Evans *et al.* 1996; Walsh 1996.

³⁵ Hanke and Schuler 1994; Pou 1997

³⁶ Hanke 1999; *Economist* "Time for a Redesign: A Survey of Global Finance" January 30th 1999

³⁷ Gillis *et al.* (1987:335 fn 7) demonstrate that inflation is equivalent to a tax on the holding of real balances. Bailey (1956:102) and Friedman (1971:849) made the same point. The tax base is the real stock of money in the initial period; the tax rate is the rate of inflation divided by one plus the rate of inflation during the period being examined. The incidence of the tax, considered in detail by Gil Diaz (1987), is borne most heavily by those who have limited potential for substituting away from local currency. The rich do not bear the inflation tax because they can (and do) diversify their assets into real property, financial instruments with inflation-adjusted rates of return, or foreign currency.

³⁸ As the earlier quote from Keynes makes clear, inflation is socially destructive. Galbraith (1958:Ch.18) stated that "...nothing so weakens government as persistent inflation".

³⁹ Goode 1984:Ch. 9; Pinto 1990:325; Abel and Bernanke 1992:669-678; and Cukierman, Edwards, and Tabellini 1992: Table 1. In a *closed economy*, SE equals IT only when real balances are constant (Sachs and Larrain 1993:342). Divide SE by IT to give: $SE/IT = g(M)/g(P)$. The right hand side is the elasticity of money growth with respect to inflation. It equals unity, implying $SE=IT$ only when $g(M)=g(P)$, or M/P is constant.

⁴⁰ Cagan 1989:180-181

⁴¹ Goode 1984:218-219

⁴² Gil Diaz (1989: 356) attempted to determine the size of the inflation tax with existing financial market distortions and relate it to estimates of the "potential" inflation tax if those distortions were removed. In his analysis, he defined the inflation tax relative to a situation of zero inflation. He noted:

The inflationary tax collected by the government can be obtained by multiplying the government's debt by the difference between the real interest rate it would pay on its domestic debt in a non-inflationary situation and the real interest rate it currently pays for the stock of the debt.

This approach is meant to highlight the implicit tax on interest bearing and non-interest bearing government debt. Its principal draw-back is that the real interest rate applicable to a non-inflationary situation cannot be observed.

⁴³ Friedman 1971:855; Cukierman, Edwards and Tabellini 1992; Ball 1993; Sachs and Larrain 1993:339; World Bank 1997:189; Haslag 1998:10.

⁴⁴ Black 1989:314; Neumann 1992; Allison and Pianalto 1997; Obstfeld and Rogoff 1997:525; Hanke 1999.

⁴⁵ Bailey (1956:105) and Friedman (1971:849) derive this as a consequence of choosing a rate of inflation that maximizes government "revenue" from inflation. This is a standard result from demand theory.

⁴⁶ Bailey 1956:105; Goode 1984: 217; Choudry 1992; Neumann 1992:37-39; Sachs and Larrain 1993:741-742; Agenor and Montiel 1996:112-118.

⁴⁷ Cukierman *et al.* 1992 (reviewed in Annex B); Haslag 1998; Balino 1998.

⁴⁸ See Orphanides and Solow 1990; Sibert 1994, Agenor and Montiel 1996:112-115; Romer 1996:422-428; Cohen 1998:41.

⁴⁹ I am grateful to Professor James Duesenberry for raising this point.

⁵⁰ Haslag (1998) regresses seignorage revenue on overall tax collections and variables (he uses reserve ratios) to reflect the stringency of "monetary policy". The estimated relations are positive and statistically significant. The results we derive raise doubts about the explanatory power of his single equation results. Despite his suggestion, his results are *not* evidence that governments "rely" on money creation for revenue (*ibid.* 10, 19). Indeed, he notes that the positive relations he derives are driven by several outliers (*ibid.*:13-14). Moreover, based on the evidence cited in Annex B, Haslag's equations may be picking up the effects of other factors such as political instability.

⁵¹ Cukierman, Edwards and Tabellini (1992) make this argument. Annex B has a critique.

⁵² When inflation accelerates (as it did in Bolivia and Peru) linear approximations to SE and IT are no longer appropriate. Nonetheless, Agenor and Montiel continued to use such an approximation (see their note to Table 4.1). Taking a Taylor Series expansion of dM/P or $g(P) \cdot M/P$ around the mean of M and P , respectively, yields second and third order terms that under conditions of rapid changes in reserve money and prices are large and cannot be ignored.

⁵³ The actual quote is "...there is no such thing as liquidity of investment for the community as a whole" (Keynes 1936:155).

⁵⁴ A similar problem was noted by Agenor and Montiel (1996:Ch.13.1). The quote from the *Financial Times* (14th April 1999) at the head of this article describes the same situation.

⁵⁵ I am most grateful to Professor James Duesenberry for suggesting I consider the Russian case in more detail.

⁵⁶ Balino 1998

⁵⁷ Data from the *Economic Outlook* published twice yearly by the IMF (May and October) confirm this point.

⁵⁸ Haliassos and Tobin 1990:951

⁵⁹ The same concept is not used in other Federal Reserve studies of seignorage. For example, Allison and Pianalto (1997) and Porter and Judson (1996) provide different estimates of the seignorage gains to the United States when U.S. currency is held abroad. Porter and Judson argue that this seignorage is equivalent to the opportunity gain from the saving in treasury bills. By contrast, Allison and Pianalto (1997:561) see it as the value of the net increase in currency held abroad.

⁶⁰ Preliminary work on such a model using data from Zambia and Russia has already been undertaken. It will be presented in a subsequent paper.

⁶¹ *International Financial Statistics* country tables, lines 11 to 17.

⁶² For discrete changes, there is an interaction term as well. See Table 2 in the text.

⁶³ This result holds even if the debt stock in dollars is constant.

⁶⁴ *International Financial Statistics* March 1999:698-703

⁶⁵ The same effect would result from a rise in the velocity of reserve money with no change in the size of the budget deficit.

⁶⁶ Pinto (1990) traced the types of monopoly gains available to the government through the deliberate distortion of the foreign exchange market. In developing countries, a typical pattern has been for the monetary authorities to insist that state-owned enterprises surrender their foreign exchange earnings at a price significantly below the price in the (often illegal) parallel/black market. This requirement gives the government access to foreign exchange at sub-market prices. The government's gain is the enterprises' loss. The outcome for the enterprise is a slower rate of expansion or, more usually, larger borrowing to cover operating costs. When this borrowing is from abroad, it increases the official debt. When it occurs locally (often from a State-owned bank) it adds to domestic credit creation. Thus, through exchange control, the government has obtained "cheap" foreign exchange but at the cost of the financial viability of its own enterprises. A further cost is incurred when, as is often the case, the government uses this "cheap" foreign exchange inefficiently -- on official foreign travel, the maintenance of excessive numbers of missions abroad, and military hardware.

⁶⁷ It might be argued that foreign exchange received from aid agencies represents a gain to the government since the foreign exchange is converted at the "official" (typically over-valued) exchange rate. The government however incurs an opportunity cost in local currency terms equal to the difference between the official and parallel market exchange rate.

⁶⁸ Hanke and Schuler (1994:9) distinguish "gross" from "net" seignorage. The former is "...the income from issuing notes and coins"; the latter is "...gross seignorage minus the costs of putting and maintaining the notes and coins in circulation".

⁶⁹ The former Zaire and Ukraine are recent examples.

⁷⁰ Schumpeter (1954:298) has references to the early literature.

⁷¹ A further risk is that export revenues may fall, thereby increasing the overall burden of debt on the economy.

⁷² This comes from reversing a point made by Neumann (1992). His concept of "extended seignorage" included the gain by the U.S. monetary authorities on their official foreign loans. (Seignorage on currency held abroad is included as a separate item.) Seen from the debtor's perspective, any capital gain accruing to U.S institutions is their capital loss. The extension of the argument from seignorage to the inflation tax is automatic.

⁷³ Bailey (1956:101), Mundell (1965:103) and Friedman (1971:851) emphasize adjustments to rapid inflation which occur through a rise in the velocity of circulation. As analysts have expanded their attention to the "global" effects of inflation, the importance of currency substitution has been recognized. For example, Dornbusch and Helmers (1988:360) noted "(It is well known that people shift out of domestic currency to avoid the inflation tax)". Sachs and Larrain (1993:344) added: "...because of a history of monetary instability, the country's residents also use a foreign currency for domestic transactions". A similar point is made in Cohen (1998:164-5).

⁷⁴ Allison and Pianalto (1997:559) note "Rapid inflation makes domestic currency an unattractive medium for saving and transacting and, at the extreme, impractical even as a unit of account". And, referring to the instability which led to the world-wide demand for dollars, Porter and Judson (1996:885) stated "...long after the crisis episodes have passed, many residents continue to hold dollars as an instantly liquid form of insurance against further political or economic upheaval".

⁷⁵ The resource transfers amount to billions of dollars each year. Foreigners demand large denominations U.S. notes, especially \$100 bills. Data in Porter and Judson (1996) and Allison and Pianalto (1997) suggest that, at the end of 1995, between 55 and 70 percent of the \$375 billion of U.S. currency outstanding was held abroad. (See also Cohen 1998:123-124; 154.) This is equivalent to an interest-free loan to the U.S. by the rest of the world. If the notes were to remain abroad, it would be a direct grant.

⁷⁶ Estimates of capital flight are imprecise at best. Some attempts have been made in Williamson and Lessard (1987), Ibi Ajayi (1997), and Collier and Gunning (1999). However, capital flight occurs for reasons other than monetary mismanagement and rapid inflation. Corrupt leaders and their cronies regularly seek "safe havens" for their ill-gotten gains.

⁷⁷ Though theoretically possible, the decline in real income could be offset by a corresponding rise in "liquidity preference". But, even this would require a constant (not increasing) real supply of reserve money.

⁷⁸ The data are from the *International Financial Statistics Yearbook* 1998

⁷⁹ McKinnon 1973; Shaw 1973; Fry 1988; IIF 1990; von Pischke 1991; Meier 1995:174-179; Gillis *et al.* 1996:Ch.14

⁸⁰ Dooley (1996:656-657) adds an interesting twist. His analysis suggests that the governments that benefit from the distortions that generate seignorage are reluctant to reform for fear of losing those benefits.

⁸¹ Keynes' collection of essays under "Inflation and Deflation" in *Essays in Persuasion*, written from 1919 to 1930, remains an exceedingly penetrating discussion of the issues related to confidence in a monetary context (Keynes 1963:Pt.II).

⁸² Perhaps the principal constraint would be for the government to forswear deficit financing both directly and through the public enterprises. Such behavior would result in the reduction of the country's external and domestic debt. The change would remove the budget as the major source of macroeconomic instability.

⁸³ Hanke and Shuler 1994; Cohen 1998:54-55

⁸⁴ In theory and practice, rapid reserve money creation and high rates of inflation will lead to depreciation of the exchange rate. The monetary theory of the balance of payments provides a direct link from the excess supply of money to a balance of payments deficit. With a fixed exchange rate, the loss of reserves eventually forces a change in the exchange rate. With a freely floating exchange rate, the change is automatic. (Managed floats are less automatic, although changes will occur if inflation persists.) Moreover, both the purchasing power parity and interest rate parity approaches to exchange rate determination explain the dynamics of the exchange rate in terms of deviations between local and external rates of inflation and real rates of interest (Giddy 1976; Isard 1978; McKinnon 1981; Frenkel and Mussa 1985; Hallwood and Macdonald 1986; Goodhart 1989:444-452; Taylor 1995).

⁸⁵ It is not clear how this practice began. Certainly, Friedman's (1971) discussion of the "revenue" from inflation was influential. Bailey (1971:78), Neihens (1978:116), and Agenor and Montiel (1996:111-121) are other examples.

⁸⁶ These losses enter the official accounts as an implicit claim against future profits of the central bank, or as items to be normalized by the issue of NIB notes (or similar instruments) by government to the central bank. NIB notes are non-interest bearing, non-redeemable paper which are used as an asset by the central bank to offset the credit it has created to cover the (often massive) official losses on foreign exchange. This accounting device rationalizes past capital losses. It does not eliminate them.

⁸⁷ Evidently, policy makers in Russia understood the danger of once more resorting to reserve money creation.

⁸⁸ Taylor (1997) sharply criticized the extent to which the (so-called) "neo-liberal" approach to economic policy has dominated the development "debate" and the degree to which the "Washington consensus" has been "globalized".

⁸⁹ *The Economist* (23rd August 1997) argued that the "failure" of "modern economics" was most noticeable in areas directly related to policy.

⁹⁰ This approach is used in Reisen (1989) who examined the impact of debt service payments on the budgets of heavily indebted developing countries. His analysis is also in real terms.

⁹¹ *International Financial Statistics Yearbook 1998*:868-873

⁹² Curiously, Haslag (1998:14) identified Ghana as an outlier as well.

⁹³ Johnson (1970) [Reprinted in Johnson 1973] Because of the restriction that interest is not paid on currency, the optimal supply of money is such that prices would decline at a rate equal to the return on capital.