

IMF WORKING PAPER

© 1992 International Monetary Fund

This is a Working Paper and the author would welcome any comments on the present text. Citations should refer to a Working Paper of the International Monetary Fund, mentioning the author, and the date of issuance. The views expressed are those of the author and do not necessarily represent those of the Fund.

WP/92/50

INTERNATIONAL MONETARY FUND

Research Department

Independent Currency Authorities: An Analytic Primer

Prepared by Kent Osband and Delano Villanueva*

Authorized for Distribution by Malcolm Knight

July 1992

Abstract

This paper provides an analytic overview of independent currency authorities (ICAs), sometimes called currency boards. ICAs issue and redeem domestic currency against an exchange standard on demand and back such operations through a 100 percent marginal foreign reserve cover. They also impose significant constraints on the banking system and the budget of the country that operates them. When supporting institutions have been put in place, ICAs appear to have promoted price stability, foreign trade, saving, and investment.

JEL Classification Numbers:
E52, E59

*The paper was forged in large part through discussions with Malcolm Knight. The authors are grateful to Manuel Guitián, Pierre-Richard Agénor, Pablo Guidotti, Deena Khatkhate, and Timothy Lane for helpful comments, and to E. Catherine Fleck for editorial assistance.

	<u>Contents</u>	<u>Page</u>
	Summary	iii
I.	Introduction and Overview	1
II.	Operating Principles	3
	1. Key elements	3
	2. Discussion	5
III.	Fiscal Implications	8
	1. Financing constraints	8
	2. Restoring flexibility	9
IV.	Banking Implications	10
	1. Regulatory approaches	10
	2. Scope for reserve money operations	13
V.	Experiences with ICAs	15
	1. The former British colonies	15
	2. North Russia, 1918-19	16
	3. Modern-day ICAs: Hongkong, Singapore, and Argentina	17
VI.	Inflation and Credibility Costs of a Crawling Peg	18
VII.	Closing Remarks	20
	Appendix: The Generation of Seigniorage	21
	References	24
	<u>Tables</u>	
	1A. T-Accounts of the Banking System under an ICA	12
	1B. T-Accounts of a Central Banking System	12

Summary

This paper describes the functions of an independent currency authority (ICA). An ICA issues and redeems notes and coins in exchange for a standardized commodity like gold or a foreign currency. Typically, the exchange rate schedule is preannounced, and new issues of currency are covered 100 percent by reserves. The difference between the yields on assets denominated in the reserve currency and the generally small administrative costs of the ICA accrues as profit to the government owner. For a country interested in having its own currency, an ICA offers a shortcut to monetary stability and convertibility.

An orthodox currency board establishes a fixed exchange rate with a foreign currency and fully backs the entire currency stock with reserves. In a sense, the domestic currency serves as a proxy for the foreign currency, but the currency board intercepts the seigniorage that would otherwise go to the foreign country. A crawling peg currency board allows the exchange rate to change gradually over time. In any case, an ICA retains monetary flexibility in terms of the option to change the reserve currency to which it pegs or to expand into a full-fledged central bank.

An ICA forbids the discretionary printing of money, which eliminates some potentially desirable options for financing the budget. At the same time, it encourages more responsible budget planning. To restore budgetary flexibility under an ICA, the government needs to build up its own financial reserves and demonstrate a determination to repay its debts fully.

The smooth operation of an ICA also requires that the banking system hold sufficient reserves of domestic currency or of assets that can be converted into domestic currency at the ICA. To help achieve this goal, international branch banking should be encouraged, or a separate monetary agency with substantial foreign reserves and credit lines abroad should be established that can offer emergency liquidity to commercial banks.

A crawling peg currency board would appear to have little long-term merit, unless the peg is used to keep domestic inflation below inflation in the reserve currency country. Nevertheless, for a country that is attempting to stabilize an initially high domestic inflation rate, an ICA that operates a crawling peg arrangement involving a preannounced, decelerating rate of depreciation might prove useful as a transitional mechanism to slow inflation gradually.

Historical experiences suggest that, provided supporting fiscal and monetary arrangements are put in place, ICAs do indeed facilitate monetary stabilization and convertibility. In the process, they have helped to encourage saving, investment, and efficient growth.

I. Introduction and Overview

In most countries, the management of currency—that is, the issue and redemption of notes and coins—is bundled with other monetary tasks and is handled by a central bank. Unifying these tasks gives the central bank flexibility, but also breeds uncertainty about the central bank's real objectives. The policy tradeoffs that must be made may tend to reflect political pressures in addition to considerations of monetary stability. The diversity of public interests sends confusing signals to the central bank, while the complexity of banking/monetary outcomes and their potential causes sends similarly confusing signals back to the public. Moreover, the "time inconsistency" of optimal policies (Kydland and Prescott (1977); Barro and Gordon (1983); Blackburn and Christensen (1989)) may undermine the central bank's credibility.

For these reasons, many economists have advocated a narrowing of central banks' mandates, for example, to focus on monetary stability alone instead of some combination of objectives regarding inflation, real GDP growth, and employment. Some recommendations also entail less flexibility for the central bank, for example, by committing it to achieve a pre-determined rate of growth in the money supply or a specified rate of inflation.

One particular way to narrow a central bank's mandate is to delegate the issuance and redemption of currency to a separate institution, which we will call an "independent currency authority" or ICA. For example, the ICA might issue domestic currency convertible at a fixed rate into a specified foreign currency, and back up its commitment to convertibility by holding 100 percent foreign reserve cover. Such an ICA is known as a currency board, although we shall append the prefix "orthodox" to distinguish it from variants considered later. An orthodox currency board is the best known example of an ICA, and the easiest to understand and operate.

Orthodox currency boards were once widespread in the colonial regimes of Africa, Asia and the Caribbean, but now operate only in Hong Kong and Brunei. While some economists view them as anachronistic, others defend them as a relatively easy means to achieve monetary stability and convertibility (Greenwood (1984), Walters (1987), Hanke and Schuler (1991 b)). Recently, they have been advocated for the emerging market economies in Eastern Europe and the former Soviet Union (Hanke and Schuler (1991 a and b), Walters (1992)).

The circle of ICAs is somewhat larger. Singapore's ICA, called the Board of Commissioners of Currency of Singapore, which has existed since independence, is implicitly appreciating its currency against the foreign reserve currency anchor, while maintaining 100 percent reserve cover. One might also include arrangements in which the currency authority, while not formally independent of the central bank, nevertheless operates autonomously. Argentina, for example, has recently opted for a quasi-currency board arrangement in which all newly issued domestic currency, but not the

whole outstanding stock, is 100 percent backed by foreign reserves, and all currency is legally convertible at a fixed rate.

Those functions of a central bank that are not delegated to an ICA have been handled in various ways. In countries with orthodox currency boards, free banking has tended to prevail. In Singapore a separate agency, the Monetary Authority of Singapore, performs all of the non-ICA functions of a central bank, including open-market operations. In Argentina, the issuance of high-powered money is governed by the same principles as that for currency.

This paper endeavors to provide a better understanding of how ICAs operate, what their attractions are, and what constraints they impose on the banking system and on the fiscal position of the government. ^{1/} For the most part, the methodology is deductive. That is, the main options and obligations of an ICA arrangement are derived logically from basic principles, with historical experience serving as illustration rather than proof. One option examined in this paper—a currency board formally bound to a reserve currency by a preannounced crawling peg—has never to our knowledge been tried out in practice, although it may have some practical appeal.

The next section outlines the operating principles of an ICA arrangement. We show that in order to maintain confidence in the currency, the currency board under an ICA arrangement is required to exchange the domestic currency on demand, according to a preannounced exchange rate schedule with a standardized commodity or foreign currency, and to maintain full or close-to-full reserve cover. Thus, to a certain degree price stability and convertibility are built into an ICA.

Section III examines the fiscal implications of ICAs. An ICA need not generate substantially less inflation tax revenue in the long term than a discretionary central bank (a comparison that is explored more formally in the Appendix), but it should have much less leeway for creating inflationary surprises. In a world of imperfect capital markets, this may eliminate some financing options, but it also encourages more responsible budget planning. To enhance flexibility, the government needs to build up budgetary reserves and cultivate a reputation for timely servicing of debt.

Section IV shows that a modern ICA arrangement also demands extra banking discipline. Since the currency board's exchange obligation should not extend to demand deposits, the banking system must maintain extra cash or reserve assets on deposit with the central monetary institution that are readily convertible to cash at the ICA. Domestic debt cannot substitute, unless the government's fiscal position is so strong and reliable that its

^{1/} A less technical (and more partisan) treatment of orthodox currency boards, with greater attention to administrative aspects, can be found in Hanke and Schuler (1991 b).

debt trades near par on world markets. To reduce this extra cash reserve burden and strengthen confidence, international branch banking should be encouraged, and perhaps supplemented by a central monetary institution that holds substantial foreign reserves and can draw on credit lines abroad. To prevent the diminution of its foreign assets, the central monetary agency should be prevented from creating domestic liquidity except perhaps via the provision of emergency credits to banks, subject to strict limits as to amounts and terms of repayments. Such banking arrangements also have the merit of promoting foreign trade and capital investment.

The analytic points developed in Sections II-IV are illustrated in Section V with reference to the actual experience of ICA arrangements. The historical record confirms the need to support an ICA arrangement with strict fiscal and banking discipline. Conversely, ICA arrangements appear to have been very effective when that discipline was present.

Section VI looks more closely at the inflation and credibility costs associated with a crawling exchange rate peg. The costs appear to be too high to justify a sustained long-term depreciation against the reserve currency. Nevertheless, for a country that is attempting to stabilize an initially high domestic inflation rate, an ICA that operates a transitional crawling peg involving a preannounced, decelerating rate of depreciation might prove useful to slow inflation gradually. Section VII offers closing remarks.

II. Operating Principles

A national currency that is managed by an ICA needs to be perceived as a reliable store of value. Otherwise, people will be unwilling to hold the currency, even for transaction purposes, or such willingness may be so volatile as to destabilize goods and factor markets. This section tries to identify the set of operating principles for an ICA that are compatible with the preceding requirement. The set turns out to be fairly narrow.

1. Key elements

It is helpful in the analysis to distinguish two types of operating principles. The first are rules for issuing and redeeming currency. The second describe mechanisms for ensuring that the rule can and will be followed.

Let us begin by looking at the rules for issuance and redemption. Obviously, any license to print currency at will and forego redemption will be suspect. Perhaps a discretionary ICA could inspire public confidence by the august composition of its management or its financial record, but then its discretionary freedom would be more formal than real. Moreover, any asymmetry, apart from small transaction costs, between terms for issuance and terms for redemption is likely to be exploited by the ICA itself or by outside arbitrageurs. In effect, the only viable rule is an "exchange of

equivalents" standard, whereby the domestic currency is traded for something else that is widely regarded as having equal value. To ensure fair and responsible treatment, currency should be issued and redeemed on demand according to a preannounced exchange schedule.

One exchange standard that should not be used is domestic debt, whether government or commercial. Otherwise, debtors could use the ICA as a money pump, forever submitting new IOUs in order to draw currency. The ICA's independence from fiscal and banking pressures would be lost, and a more typical central banking framework would have to be resurrected. A peg to domestic debt could be viable only if the debt were reliably pegged to something else, in which case the intermediary is best dispensed with.

The exclusion of domestic debt leaves an ICA with two possible types of exchange standard. One is a directly consumable (but standardized and durable) commodity, such as gold or oil. The other standard is foreign currency. ^{1/} From the mid-nineteenth century until World War I, the major international currencies and most of the colonial currencies were in effect tied through ICAs to gold, either directly or via the gold-linked pound sterling. The latter had the advantage of being cheaper to transport and hold than gold. Now that the gold standard has been abandoned by the major trading countries, the attraction of a commodity standard for small countries has further diminished, while the transaction cost advantage of foreign currency remains. Hence, for the remainder of this paper we shall assume that the rules for issuance and redemption of domestic currency can be summarized as a preannounced exchange rate schedule against a foreign currency, with full currency convertibility on demand.

Now let us turn to the second element of the ICA, the mechanism for ensuring that the rule for issuing and redeeming currency can and will be followed. On the one side, currency should not be issued without being paid for. This is fundamentally an administrative problem—and not a particularly difficult one—to be addressed through standard accounting and auditing procedures and penalization of malfeasants. On the other side, foreign currency must be available in order for domestic currency to be redeemed. That is fundamentally a problem of reserves. If 100 percent reserve cover is maintained, resources for convertibility are guaranteed, and auditing is simplified. It is possible, however, to reduce the degree of cover below 100 percent without running a significant risk of a reserve-depleting speculative attack. One alternative, which may be useful when an ICA is imposed on a previously unbacked currency, is to cover only a fraction of the initial currency stock, but 100 percent of any subsequently issued currency. Another, and probably inferior, alternative is to provide only fractional backing of foreign reserves for newly issued currency. The

^{1/} The ICA might also use a basket of commodities and/or foreign currencies as the exchange standard. Such a standard would be more complicated to administer and less transparent to the public, but not unmanageable.

main problem with the latter approach is that it would create a strong incentive to fill the gap between new foreign exchange reserves and new currency liabilities with domestic debt, and once again threaten the ICA's independence from banking and budgetary affairs.

2. Discussion

To the extent that purchasing power parity holds (more precisely, to the extent that relative differentials in purchasing power remain constant), domestic inflation is tied to inflation in the reserve currency country. The ready and preannounced convertibility of currency tends to reduce transaction costs in foreign trade and investment, both directly and through its impact, to be discussed later, on fiscal and banking arrangements. ^{1/}

Granted, these benefits might be obtained even more easily by letting the foreign currency circulate directly, without the intermediation of an ICA. Why bother then with the latter? Apart from national pride, there are two reasons. The first is seigniorage. When the foreign currency circulates, seigniorage accrues to the foreign country only. ^{2/} When a domestic currency circulates in an ICA arrangement, the domestic currency takes on most of the foreign currency's characteristics but the ICA intercepts most of the seigniorage. It does so by investing most of its foreign currency receipts in low risk, foreign currency-denominated bonds. The interest earnings, less the administrative expenses of the ICA, accrue to the ICA as profits, which beef up reserves and are periodically turned over to government.

The second reason for establishing an ICA is to retain flexibility for the future. For example, the ICA might improve its control over domestic inflation by shifting to a more stable currency as the reserve anchor, or it might change the anchor so as to promote trade and investment with a given area. Provided the shift is economically justified and the real purchasing power of the domestic currency is maintained, the change need not erode public confidence. Indeed, the very availability of this option might increase public confidence in the country's economic resilience. The ICA could also provide an administrative base for a future full-fledged central bank.

^{1/} The ICA may affect the relative priority of monetary stability and convertibility through its choice of reserve currency anchor. Control over inflation is most easily achieved with a very stable currency as the reserve anchor, while convertibility considerations favor using the currency (basket) of the main trading and investment partner(s).

^{2/} The foreign country might agree to share seigniorage, but it is not easy to monitor changes in currency holdings in different regions of a common currency zone, to calculate an appropriate sharing ratio, or to enforce a sharing agreement. In practice, there would seem to be a tendency to treat imputed seigniorage as simply a form for delivering an independently determined amount of aid.

The simplest, strictest, and most credible type of ICA is an orthodox currency board, in which the exchange rate against the foreign currency is fixed for all time and reserve backing is 100 percent. To make this more concrete, let us consider the hypothetical country of Patria, which entrusts to a currency board the management of its domestic currency, the "pat", pegged one to one with the German mark. Typically, the Patrian currency board would engage in only two types of transactions. In one, a customer comes to the currency board with a mark and demands a pat; the board issues the pat, takes the mark, and buys one mark's worth of high-quality German bonds. In the other, a customer comes to the currency board with a pat and demands a mark; the board sells one mark's worth of bonds and exchanges the mark for the pat.

It was noted above that an ICA needs to follow a preannounced exchange rate schedule. While an orthodox currency board sets an exchange rate independent of the date, one can conceive of ICAs in which this is not the case. Realistically, the exchange rate could not swing too much too quickly, or reserves would be drained through arbitrage. However, the preannounced rate could move slowly, or "crawl", in a variety of ways. Provided foreign reserves were always maintained at 100 percent of currency in circulation, the fundamental operations of the currency board need not change. The institution just described—an orthodox currency board redesigned so that the exchange rate, while preannounced, may vary over time—will be called a "crawling-peg currency board". Obviously, an orthodox currency board can be viewed as a special case of a crawling peg currency board.

In its simplest form, a crawling peg currency board would set an initial rate of exchange and a (preannounced) fixed rate of depreciation δ (or appreciation, for δ negative) between its currency and the reserve currency; i.e., if the foreign currency price is 1 today ($t = 0$), it is $e^{\delta t}$ at time t . As previously required foreign currency reserves become redundant, the currency board could turn them over to the government, or equivalently it could give the government new domestic currency to the amount permitted by existing reserves. To the extent that purchasing power parity applies, domestic inflation should tend to equal the inflation rate in the reserve currency country plus the depreciation rate δ of the peg.

With a fully prespecified peg, an ICA would draw the country into the reserve currency area. The country would gain the credibility of the reserve currency and greater ease of foreign trade. At the same time, it would sacrifice exchange rate defenses against shocks emanating from elsewhere in the reserve currency area. 1/

1/ There is an extensive literature on optimum currency areas, beginning with Mundell (1961) and McKinnon (1963), and recently surveyed in Masson and Taylor (forthcoming).

An ICA could also establish a contingent peg, with the operative exchange rate schedule tied to an observable state of the world. Of course, any exchange standard, whether or not it is managed through an ICA, implicitly brooks the possibility of suspension in national emergencies, such as war. Provided there is also an implicit commitment to restore convertibility after the emergency has passed, confidence can be maintained (Mankiw (1987); Bordo and Kydland (1990)). In less extreme circumstances, an explicit contingent peg for an ICA can help guard against instability in the reserve currency. 1/

In principle, a contingent peg could also be used to buffer more ordinary shocks. For example, Patria's currency board could announce that the pat's depreciation rate against the mark will be $A + By$, where A and B are preannounced constants and y is an observable measure of Patria's terms of trade. However, the perceived complexity of contingent schedules, and the fear that the choice between schedules would be manipulated by the government, might seriously erode their credibility. 2/ For that reason, this paper considers only exchange rate schedules that are fairly simple and transparent.

Once the exchange rate schedule has been set, an ICA is easy to operate. As Hanke and Schuler (1991 b) explain, the ICA might reduce its own handling costs by refusing small-scale transactions and by not dealing directly in the currency of the reserve country. Commercial banks would be left to aggregate purchases and sales and to cash reserve currency checks.

To recapitulate, the need to shore up public confidence in a currency managed by an ICA presses the latter to offer currency convertibility on demand according to a preannounced exchange rate schedule, and to ensure its ability to honor this pledge by maintaining full reserve backing at the margin. While an ICA limits monetary discretion, it promotes price stability and external openness.

1/ For example, the model currency board charter suggested by Hanke and Schuler (1991 b, Annex I) mandates either a refixing of the exchange rate or the selection of a new reserve currency in the event that "the change in the wholesale price index in the reserve-currency country fall[s] outside the range of -5 percent to 25 percent for more than two years, or -10 percent to 50 percent for more than six months."

2/ An ICA could explicitly mix commitment and discretion by committing to an exchange rate schedule only for some T days (months, years) in advance. Naturally, this will discourage longer term investments denominated in the domestic currency, unless such investments are explicitly indexed. Short-term domestic currency holdings should be little affected, provided T exceeds the time needed for exchange.

III. Fiscal Implications

1. Financing constraints

An ICA system narrows the authorities' options in fiscal policy as well as monetary policy. By demanding a preannounced amount of foreign currency for every note it issues and offering convertibility on demand, the ICA prevents the discretionary printing of currency to cover fiscal obligations. It also precludes the surprise devaluation of existing fiscal claims on the government, such as a promise to be paid a given wage or pension, or the devaluation of outstanding government debt denominated in domestic currency. Contrary to a widespread perception, an ICA does not necessarily enlarge the long-term fiscal burden. However, it can limit intertemporal substitution, especially at the ICA's inception, and it does dry up a source of emergency financing (the inflation tax). At the same time, an ICA makes it harder to manipulate the budget recklessly and irresponsibly, and thereby enhances investor confidence.

If capital markets were perfect, the ICA's fiscal restrictions would matter only to the extent that they affected the present value of governmental revenue and expenditures. For example, if prices suddenly jumped by 25 percent, the real fiscal burden of unindexed civil servant salaries and state pensions would initially fall by 20 ($= 25/1.25$) percent. Over time, however, salaries and pensions would presumably adjust to the new price level, so that the budgetary savings would accrue only during the transition period. If civil servants and pensioners expect inflationary shocks, they may press for formal indexation to prevent even a temporary drop in real incomes. Failing that, they will attempt to negotiate an extra wage or pension buffer against potential future inflation shocks. Presumably, for an ICA and central bank pursuing similar long-run inflation paths, real expenditure burdens should roughly coincide over time.

Similar considerations apply to seigniorage. If capital markets were perfect (apart from frictions giving rise to a transactions demand for money), the government would accrue seigniorage on currency in circulation at the domestic rate of interest, which in turn would equal the domestic inflation rate plus the world real rate of interest. ^{1/} The public's willingness to hold currency, which is the other main influence on seigniorage, presumably depends negatively on the expected rate of interest.

To the extent that the time path of inflation is correctly anticipated, a central bank should generate no more or less seigniorage than an ICA pursuing a similar inflation policy. The Appendix investigates the seigniorage comparison in more detail, and finds that these conclusions are only slightly modified when a fuller range of transactions costs is allowed.

^{1/} Alternatively, the seigniorage equals the value of the currency at issuance less the present discounted value of future redemptions.

Thus, the main long-term fiscal advantage of a central bank over an ICA derives from the former's ability, in a world of imperfect capital markets, to inflict inflation surprises. For example, if the central bank quietly issues currency beyond what was expected, prices and real money holdings will not adjust instantaneously to the new equilibrium levels. As a result, in the short term the government can collect extra real tax revenue. ^{1/} Nominal fiscal obligations can also be devalued in this fashion. By contrast, an ICA emits currency only passively, barring a change in the exchange rate schedule, in response to shifts in domestic money demand.

The ability to startle the public is also a disadvantage. For example, agents fearing inflationary surprises from the central bank may permanently reduce their currency holdings or demand a risk premium in nominal wage negotiations. Attempts to raise current seigniorage may lower the long-term average seigniorage, while a policy of undercutting nominal commitments breeds a demand for indexation. More importantly, attempts to manipulate inflation make it more volatile and unpredictable, which in turn tends to sap the real economy. One of the main attractions of an orthodox currency board is that it clearly accords higher priorities to price stability and convertibility than to inflation taxes.

2. Restoring flexibility

To better assess the trade-off between precommitment and adaptability, it is worth reflecting on the reasons the financing constraints might bind. To begin with, note that it is rarely the size and the urgency *per se* of a government's financing needs that make credits difficult to secure. Private capital markets can and do mobilize large credits quickly. In lending to governments, they are backed by a network of governmental and intergovernmental institutions. The main obstacle to sovereign lending, as in most other lending, is fear of default. If the government *cannot* repay, capital markets are right to withhold credit and refer the request to public grantors. If it is feared that the government can repay the debt but *will* not, then the government needs to convince creditors it is willing to earmark a share of future revenues for debt repayment—in a sense to build an off-budget reserve.

Ideally, a government with temporary but urgent needs for financing will have anticipated such problems and have already built up reserves, like a household that accumulates savings towards an expensive purchase because it anticipates difficulties securing a loan. Indeed, the very presence of such savings may be crucial in opening access to external credit.

Therefore, whether one focuses on lack of credit or lack of reserves, the main reason a government with an ICA might have difficulty in covering an unusual fiscal deficit is that in the past it has rarely run a surplus.

^{1/} Khan and Knight (1982) point to empirical evidence of seigniorage being extracted in this manner.

In that case, replacing an ICA with a central bank will not help. The public will suspect, not without cause, that the government will manipulate central bank policies to increase the inflation tax. The public is then likely to restrict its demand for currency and other domestic assets. Also, abandonment of full reserve backing for the currency might send another unfavorable signal about the government's creditworthiness.

Suppose, however, that a government that is determined to pursue responsible fiscal policies is temporarily stuck with a bad or uncertain reputation, and as a result cannot borrow all it wishes. In that context a discretionary central bank offers some immediate fiscal advantages over an ICA. On the other hand, the very decision to establish an ICA, by distancing the government from the mint, may encourage more responsible budget planning, which in turn might enhance a government's fiscal reputation and open doors to credit markets sooner.

Of course, an ICA's restraints on discretionary monetary financing of the government are not absolutely secure. One danger is that the government simply overrides the ICA's charter. Another is that the banking system is obliged to lend to the government at favorable rates. For example, commercial banks might be required to hold a portion of their reserves in the form of low-yielding government bonds. If the bonds were traded freely, their prices would drop. The difference between actual yields and free-market yields (or, in aggregate present value terms, the difference between actual bond prices and their market values) may be viewed as a noncash form of seigniorage. Such evasive measures, which undercut both the ICA and the banking system, should be prohibited.

IV. Banking Implications

1. Regulatory approaches

The smooth operation of an ICA, as compared with a discretionary central bank, requires extra discipline not only from the fiscal authority but also from the commercial banking system. Recall that the ICA has no responsibility to convert demand deposits directly into currency; indeed, its charter should forbid that because it could erode the reserve cover. Hence, in order to ensure sufficient liquidity under an ICA arrangement, the commercial banking system needs to maintain extra reserves of domestic currency or of reserve currency-denominated assets that are easily convertible to domestic currency. There are two possible ways, not necessarily exclusive, to do this reasonably efficiently. One way is to encourage international branch banking. The other is to establish a separate monetary agency with substantial holdings of foreign reserves and credit lines abroad that can back up the commercial banks.

The international banking option is straightforward to analyze. Recall that the domestic currency under an ICA can be viewed as a proxy for the reserve currency to which it pegs. Hence, there is no natural monetary

obstacle to the influx of banks from the reserve currency zone, or indeed of any bank with substantial reserves denominated in the reserve currency. To encourage international banks to set up domestic branches, the licensing procedures, reporting requirements, and tax rules should basically conform to those used in the main reserve currency country. Through an interbank market, the international banks can also supply reserve liquidity to locally-owned banks.

In such a system, domestic supervision could be fairly passive. This could be viewed as free banking, or else as a delegation of supervision to authorities in other countries. Domestic supervision seems most likely to be minimal when, apart from seigniorage, the authorities wish to completely integrate the domestic economy into the reserve currency zone. The authorities could also choose to take a more active role, without directly engaging in any banking operations themselves, in monitoring capital adequacy, setting reserve requirements, and enforcing other prudential regulations. Analysis of the costs and benefits of various forms of supervision falls outside the scope of this paper.

If the penetration of international banks into the domestic market is not very deep, or if it is desired to provide additional backing for domestic commercial banks, the domestic authorities may consider establishing, alongside the ICA, a separate monetary agency that can provide discount facilities, subject to certain strict limits. Indeed, access to the window should be tightly restricted because the monetary agency cannot risk exhaustion of its foreign assets. Restrictions may include penalty interest rates, time limits on outstanding discounts and/or requirements that repayment of reserve borrowing by the commercial banks take precedence over new credits to customers.

To illustrate the conversion of demand deposits into currency in an ICA system, let us return to our imaginary country, Patria, which is now assumed to have established a separate monetary agency alongside its ICA. For reference, Table 1A lists the T-accounts of the ICA, the monetary agency, and the commercial banks (net worth is ignored), assuming 100 percent reserve backing. The exchange rate is one pat for one mark.

Suppose that the public wishes to cash 100 pats' worth of bank deposits, but only 50 pats are in the bank vault. To obtain additional cash, the bank can go to the ICA and exchange 50 marks for 50 pats. Once the relevant transactions are completed, the bank's deposit liabilities, domestic currency holdings, and foreign exchange holdings have fallen by, respectively, 100 pats, 50 pats, and 50 marks. The ICA holds an additional 50 marks of reserve assets and 50 pats of currency liabilities, while the public holds 100 pats more of currency and 100 pats less of deposits. Branches of international banks have relatively easy recourse to this mechanism, since they can draw on parent offices' foreign exchange resources if their own foreign exchange is insufficient. Even local banks might avail themselves of such resources through drawings on an interbank market.

Table 1A. T-Accounts of the Banking System under an ICA

	Assets	Liabilities
ICA	Foreign reserves (FR)	Currency held by public (C ^P)
		" " " banks (C ^b)
		" " " monetary agency (C ^{ma})
Monetary agency	C ^{ma}	Reserves deposited by banks (RES)
	Net foreign assets (NFA ^{ma})	
	Reserves borrowed by banks (BOR)	
Commercial banks	C ^b	Deposits (D)
	RES	BOR
	Net foreign assets (NFA ^b)	
	Loans and investments (L&I)	

Table 1B. T-Accounts of a Central Banking System

	Assets	Liabilities
Central bank	Foreign exchange (FR+NFA ^{ma})	Currency (C ^P + C ^b)
	NDA ^{ma}	RES
	BOR	
Commercial banks	C ^b	D
	RES	BOR
	NFA ^b	
	L&I	

Suppose, however, that a local bank has no marks of its own and for some reason cannot borrow from the interbank market. It will then turn to the monetary agency for a 50 pat loan in cash. The monetary agency may lend out of its existing cash holdings, but eventually it must replenish the latter by exchanging 50 marks for 50 pats at the ICA. At the end of the transactions, banks have made up for the 50 pat cash shortfall by drawing-down their net reserve position at the monetary agency: the latter's net reserve liabilities to banks have declined by 50 pats and either cash or mark assets have fallen by 50. As for the ICA, its pat liabilities to the public have risen by 100, its pat liabilities to banks have fallen by 50, and its mark assets have risen by 50.

2. Scope for reserve money operations

The above illustrations underscore the importance of foreign reserves or established credit lines abroad so that commercial banks or the monetary agency can provide liquidity. The degree to which domestic assets can substitute depends on their tradability for foreign assets, which in turn depends on the strength and reliability of the overall fiscal position. If there are any significant doubts about the government's fiscal strength, then the monetary agency should be prohibited from holding government debt or at least from expanding beyond some base level of holdings. Because the monetary agency's judgment on private nonbanking investments may be suspect or appear to the public as such, holdings of commercial paper should probably also be forbidden or restricted to top grade reserve currency-denominated bills.

Similar considerations apply to loans from the monetary agency to commercial banks, which reinforce the earlier insistence on restricting access to a discount window. For maximum discipline the discount window could be eliminated, but then there is no point to holding reserves at the monetary agency, and the latter becomes a mere supervisory shell. As long as domestic authorities provide a discount window, it seems wise to keep the monetary agency institutionally separate from the ICA to avoid confusion about reserve backing of the currency.

To better appreciate the money supply implications of an ICA, it is helpful to compare the T-accounts of Table 1A with the T-accounts for a typical central banking system, found in Table 1B. There are two main differences. First, the central bank in effect combines the T-accounts of the ICA and the monetary agency. Second, the central bank has an additional asset, consisting of claims on the domestic government and nonbank enterprises (NDA^{ma}). The first difference does not affect the ratio of broad money to adjusted base money, but the second implies that the ratio of broad money to foreign reserves tends to be higher for the central bank than for the ICA/monetary agency. The relevant formulas are derived below.

Since total assets equal total liabilities, Table 1A shows that, under an ICA arrangement:

$$\begin{aligned} FR &= C^P + C^b + C^{ma} \\ C^{ma} + NFA^{ma} + BOR &= RES \\ C^b + RES + NFA^b + L\&I &= D + BOR \end{aligned}$$

If there is no credit window, $BOR = 0$. If there is no monetary agency at all, $RES = BOR = 0$. Consolidation yields the money supply equation:

$$M = C^P + D = \frac{c^P + 1}{c^P + c^b + res - bor} (FR + NFA^{ma}) ,$$

where the terms in lowercase letters denote ratios to deposits D .

For a typical central bank, where the ICA and monetary agency functions are merged, Table 1B shows that:

$$FR + NFA^{ma} + NDA^{ma} + BOR = C^P + C^b + RES .$$

The relevant money supply equation is:

$$M = \frac{c^P + 1}{c^P + c^b + res - bor} (FR + NFA^{ma} + NDA^{ma}) .$$

As expected, the consolidation or separation of the ICA and monetary agency functions does not affect the ratio of broad money to adjusted base money. However, the ratio of broad money to foreign reserves is higher in a typical central bank than for the ICA/monetary agency, because base money for the central bank includes its holdings of government and enterprise debt (NDA^{ma}). If the ratio of NDA^{ma} to foreign reserves at the central bank is α , then the ratio of broad money to foreign reserves is 100α percent higher, all other things being equal, for the central bank than for the ICA/monetary agency. 1/

1/ If the monetary agency under an ICA arrangement were allowed to hold domestic government paper, the money multiplier formulas for the ICA arrangement would be indistinguishable algebraically from those for the central bank, although the magnitudes of the parameters might differ.

For a given money supply, it is straightforward to compute the foreign reserve requirements under various monetary arrangements. For illustration, let $c^P = 0.2$, $c^b = 0$, $\text{res-bor} = 0.1$, $M = 1,000$, and $NDA^{ma} = 100$. ^{1/} The total net foreign reserves work out to 250 for the ICA/monetary agency, and 150 for the central bank. If the central bank increases NDA^{ma} to 200, the foreign reserve falls to 50.

If a country wants an ICA but is concerned about its ability to obtain sufficient foreign reserves, it could consider providing reserve backing to only a portion of the previously accumulated currency stock. Provided that new issuance is fully covered by foreign exchange, the marginal money multipliers remain the same. If the country wants to reduce its marginal needs under an ICA for unencumbered reserves, it should try to attract international banks that can provide their own reserves.

Over time, the expansion and qualitative improvement of banking can be expected to reduce the currency-to-deposits ratio. For a given level of reserve money, the money stock will accordingly grow under either an ICA arrangement or a central banking system. The growth mechanisms may be different, however, in the two cases. If the monetary agency holds no domestic assets, an increase in reserve money requires an equivalent increase in foreign reserves via a trade surplus or foreign loans. This is typically a market-driven adjustment. In contrast, under a central banking arrangement part of the increase in reserve money usually is engineered through an administrative decision to issue new domestic credit. This discretionary authority to pump up reserves, like the discretionary authority to issue currency, has an inherently inflationary potential.

V. Experiences with ICAs

This section illustrates the analytic points made in previous sections with reference to the historical and expositional experience of ICAs. Provided the supporting fiscal and monetary institutions were put in place, ICAs appear to have not only promoted price stability and trade, but also to have encouraged saving and investment.

1. The former British colonies

Orthodox currency boards proliferated in the British colonies of Asia, Africa, and the Caribbean. Their establishment and evolution were shaped by two general considerations: first, the desire to enable local governments to reap seigniorage that would otherwise accrue to the Bank of England; second,

^{1/} The values for c^P and res-bor appear to be roughly representative of developing country banking systems. Because of facilities provided either by the central bank or monetary agency, banks tend to hold negligible cash in their vaults ($c^b \approx 0$). The ratio of NDA^{ma} to M of 0.1 is very low and is used only for illustrative purposes.

the need to insulate domestic monetary policy from domestic political pressures (Collyns (1983)). Currency boards in the British colonies issued notes and coins backed 100 percent by sterling-denominated liquid assets, and exchanged local currency for the British pound, and vice versa, at a fixed exchange rate. Most maintained foreign reserves exceeding 100 percent of currency issue in order to cushion against a decline in the value of sterling assets.

Currency boards in the British colonies proved successful in promoting price stability and in achieving and maintaining convertibility of the local currency at a fixed exchange rate. 1/ External transactions on both the current and capital accounts were undertaken freely in the British colonies. Because residents had access to foreign capital at competitive interest rates, an adequate supply of notes and coins rarely presented any problem, even in the face of trade deficits. Interest rates and relative prices evolved roughly in line with those in the reserve center. Savings, investment, exports, and national income grew rapidly in an environment of price stability. Guaranteed convertibility at a fixed rate promoted massive foreign investment, as in Malaya (now Malaysia) and British West Africa, which were transformed between the 1880s and the 1930s from subsistence to market agricultural economies. 2/ Capital movements were facilitated by the network of London bank branches in the colonies, which the currency board arrangement made easier to set up and run. Government-run monetary agencies were not established.

2. North Russia, 1918-19

In 1918, at the suggestion of John Maynard Keynes, an ICA called the Caisse d'Emission began to issue notes and coins for the anti-Bolshevik government of North Russia (Spring-Rice (1919)). The Caisse d'Emission's ruble, unlike the currencies issued by other civil war governments in Russia, maintained a fixed exchange rate against the pound. The allied armed forces used it for their local purchases. The Caisse d'Emission earned profits for the North Russian government on the difference between the interest earned on its sterling deposits at the Bank of England and the cost of printing the ruble. The main departure from an orthodox currency board was the insistence on using up to 25 percent of the currency issue to buy bonds issued by the North Russian government. The Caisse d'Emission was disbanded in 1919 when the North Russian government was overrun by the Bolsheviks.

1/ For historical evidence, see Walters (1987 and 1992), Edwards (1987), the Monetary Authority of Singapore (1989), and Hanke and Schuler (1991 a and b).

2/ The transformation from subsistence to market agriculture was characterized by massive expansion of rubber, cocoa, and other export crops that were produced on land mostly owned and cultivated by non-Europeans. For details, see Hanke and Schuler (1991 a and b).

3. Modern-day ICAs: Hongkong, Singapore, and Argentina

Today, only a handful of ICA arrangements remain, notably those of Hongkong and Singapore, two highly open and fast growing economies. Hongkong had an orthodox currency board until 1972, then switched for 10 years to a floating currency, and in 1983 returned to an orthodox currency board (pegged to the U.S. dollar) out of fears that political uncertainties might induce financial instability (Walters (1987)). Domestic inflation has fallen since the return to a currency board, while interest rates and the prices of export goods have closely tracked U.S. levels (Hanke and Schuler (1991 b)).

In Singapore, as mentioned earlier, the ICA arrangement is characterized by a currency board (Board of Commissioners of Currency of Singapore, or BCCS) that coexists with a monetary agency (Monetary Authority of Singapore, or MAS). The BCCS originally issued Singapore currency against the pound sterling at the parity rate. After the pound was floated and new exchange controls were imposed by the United Kingdom, the Singapore ICA switched in 1972 to the U.S. dollar as its intervention currency. Today the Singapore dollar is pegged to a basket of currencies (Edwards (1987), Monetary Authority of Singapore (1989)).

The BCCS issues and redeems Singapore dollars against U.S. dollars on demand. By law, the Singapore dollar must be 100 percent backed by foreign reserve assets; in practice, the foreign exchange cover has always substantially exceeded 100 percent. Reflecting a strong foreign reserve position, Singapore's ICA in recent years has opted to gradually appreciate the Singapore dollar against the U.S. dollar (an implicit crawling peg).

The MAS formulates and implements banking, reserve and exchange rate policies, regulates all financial institutions, and acts as banker to the government and the financial institutions. It maintains a clearing system for the financial institutions, through which it also acts as an intermediary between the BCCS and commercial banks in the settlement of their currency requirements.

Singapore's government has run consistently strong fiscal surpluses. Also, the MAS carries foreign reserves of its own that amount to several times its liabilities. Hence, it has been possible for the MAS to hold government securities without undermining the ICA.

In the case of Argentina, an ICA arrangement was adopted in 1991 in large part to promote fiscal discipline, in the absence of which inflation had soared to 15 percent per month. As part of a stabilization program that also involved tax and expenditures measures to reduce the fiscal deficit and a substantial depreciation of the domestic currency (called austral), the Argentine authorities imposed a freeze on public sector wages, pensions, and charges for public sector services through the remainder of 1991. Congress passed the Convertibility Law, which provided for the convertibility of the austral at a fixed rate (A10,000 per U.S. dollar, which was twice the rate

from a year earlier) and for 100 percent foreign reserve cover of new issues (but not the existing stock) of reserve money. Inflation fell during the year, but considerable uncertainties persist; these uncertainties are reflected in lending rates that remain about twice as high for australs as for dollars. 1/

VI. Inflation and Credibility Costs of a Crawling Peg

Various aspects of a crawling peg currency board have already been addressed. The Appendix relates the rate of crawl to the generation of seigniorage. This section looks more closely at the inflation and credibility costs associated with a crawling peg, in order to better assess its likely merits and demerits.

The economic costs associated with inflation appear to fall into three categories. First, high expected inflation tends to be associated with high uncertainty about its actual level, which can deter productive investment. 2/ Second, high aggregate inflation tends to be associated with high variance of inflation across sectors, which again adds to business risk. 3/ Third, even a steady, fully anticipated inflation can complicate business and household decisions. Conceptually, it is useful here to distinguish these types of costs, because a crawling peg currency board serves to contain some of them better than others.

Consider first the ideal case in which all goods are tradable and trading costs are negligible. In that case, complete purchasing power parity should apply so that domestic inflation less inflation in the reserve currency country exactly equals the rate of depreciation δ of the domestic currency. Hence, a currency board pegging to a stable currency could gain immediate control of inflation—in the sense of knowing what the rate will be—regardless of the value of δ or its movement over time. This would eliminate the first type of inflation cost mentioned above. The second type of inflation cost would be reduced by foreign trade arbitrage, at least for relative prices that vary more domestically than on world markets. The third type of inflation cost would not be affected.

1/ For a survey of experiences of "mini-states" with ICAs, see Khatkhate and Short (1980).

2/ This could reflect the political volatility and/or fiscal pressures that tend to yield a high expected inflation, rather than a direct outcome of high inflation *per se*. For empirical evidence on the negative effects of expected inflation on private investment in developing countries, see Greene and Villanueva (1991).

3/ Caplin and Spulber (1987) attribute this phenomenon to the costs of changing posted prices. This causes posted prices to move in discrete jumps at odd intervals, which in turn implies that the variance of inflation rises with the mean.

Next allow, more realistically, for frictions in trading. Over the long term, the average rate of domestic inflation should remain close to reserve currency inflation plus δ , as major violations of purchasing power parity should continue to trigger corrections. The guaranteed convertibility of currency will itself facilitate adjustment. Nevertheless, in the short term domestic inflation could depart quite a bit from the currency board target. The lower the proportion of tradables in total domestic expenditures and the higher the tariff and non-tariff trading barriers, the weaker will be the short-term linkage between domestic inflation and the target.

Since domestic inflation can "wobble" from the target even under an orthodox currency board arrangement, the relevant question is whether a depreciating peg would add to this wobble. It seems likely that it would, since the average lags and/or overshooting of individual prices are likely to rise with the average rate of inflation, but it is not clear how significant the effect would be.

The main attraction of fixing domestic inflation permanently higher than inflation in the reserve center is the possibility of generating more seigniorage. However, this attraction is likely to fade in the long run. As the country develops the capacity to collect other forms of taxes, there is less need to focus on seigniorage. It appears that currency to GDP ratios tend to shrink with development (except for very underdeveloped countries), so the seigniorage per unit of GDP collected from a given inflation rate would tend to shrink too. Also, if a domestic-to-foreign inflation differential is locked in for long periods of time, households and firms would presumably grow better at evading the inflation tax. In particular, they would seem to have strong incentives to substitute the reserve currency for the domestic one, both as a unit of account and as a medium of exchange. The domestic currency would lose credibility.

Even if currency substitution could be held in check, the very choice of a long-term crawling peg would tend to undermine public faith in the currency. As mentioned earlier, it makes the currency more difficult to use, and invites suspicions that the currency will be devalued more quickly in the future.

Hence, a crawling peg currency board would appear to have little long-term merit, unless the peg is used (possibly in a state-contingent manner) to keep domestic inflation *below* inflation in the reserve currency country. Nevertheless, a depreciating crawling peg might be useful as a transitional mechanism. If contracts for future wages and prices lock in inflationary expectations to varying extents, a sudden shift in monetary policy might temporarily disrupt relative prices more than a gradual shift would, and might also precipitate greater output shocks. From this perspective, it might be better to slow down an existing inflation gradually rather than to stop it all at once. This would argue for a decelerating crawling peg. The rate of depreciation would be high at first, reflecting the initially large difference between the domestic inflation rate and that in the reserve

center. But the rate of depreciation would gradually decline in line with (or, should the ICA wish to retain such an option, faster than) the programmed reduction in inflation.

VII. Closing Remarks

The independence of an ICA consists of its insulation from immediate fiscal and banking concerns rather than freedom from monetary rules. To maintain public confidence, an ICA is in effect compelled to choose an exchange standard like gold or a foreign currency, and offer convertibility on demand. Typically, the exchange rate schedule is preannounced, and new issues of currency are covered 100 percent by reserves. The difference between the yields on international reserve investments and the generally small administrative costs of the ICA accrues as profit to the government owner.

For a country interested in having its own currency but uncertain of its ability to manage this currency and make it acceptable in international trade and payments, an ICA offers a shortcut to monetary stability and convertibility. The domestic currency serves as a proxy of sorts for the reserve currency, but the ICA intercepts seigniorage for the government and retains more flexibility for the future (say, in terms of the option to change the reserve anchor or to expand into a full-fledged central bank). A fixed exchange rate peg is the simplest to operate and offers maximum credibility, but more complicated schedules may be useful in periods of transition.

The ICA's independence from fiscal and banking affairs requires extra discipline in the management of the latter. Since discretionary monetary financing of the budget is or should be prohibited, governments must build up other reserves or credit lines to maintain fiscal flexibility. Since the ICA does not redeem demand deposits, the banking system must maintain or have ready access to extra reserves of cash or foreign assets.

Historical experiences with ICAs suggest that, provided supporting fiscal and monetary arrangements are put in place, they do indeed facilitate monetary stabilization and convertibility. In the process, they also appear to have encouraged saving, investment, and efficient growth.

The Generation of Seigniorage

This Appendix sketches, from an analytic perspective, the impact of monetary institutions on the generation of seigniorage. In general, a central bank that does not maintain foreign exchange backing for its notes may be able to save, relative to an ICA, on the difference between foreign and domestic transaction costs. By accelerating the rate of growth of money, a central bank can, up to a point, also expand seigniorage. This depends, however, on the sensitivity of money demand to inflation, and also on public confidence. To illustrate these considerations, let us return to the hypothetical Patrian example and work through a five-step thought experiment.

Step 1: Suppose an orthodox currency board is in place. For a pat to be issued, a Patrian good or service typically has to be exported for marks, or else a foreign investor brings marks in. After the currency board's transactions are completed, Patrian citizens have exchanged a Patrian good—or, in the event of a capital inflow, a claim on future Patrian goods—for a pat; the currency board has exchanged a pat for an interest-bearing mark bond (essentially, the right to receive a stream of German goods in the future); and Germany has exchanged a mark bond for a present or future Patrian good. Assuming the pat is never redeemed, then with perfect competition and no other transaction costs, the government's net present gain and the household sector's net exports would both be valued at one mark. More realistically, the household sector's net exports will be worth one mark plus the cost of transporting and selling the Patrian good for marks, while the government's net present gain will equal one mark less dealer commissions on the mark bond and other currency board expenses. Also, the extra export for marks may hurt Patria's terms of trade. 1/

Step 2: Suppose the fixed exchange rate of the currency board is replaced by a crawling peg, so that the pat depreciates [appreciates] at a preannounced rate relative to the mark. Also, assume that real demand for domestic notes is unchanged from Step 1, and that depreciation increases [appreciation reduces] domestic inflation. It follows that a depreciating peg would generate more seigniorage, and an appreciating peg less seigniorage, than in Step 1.

For example, let the supply of pats be 1 at the initial time $t = 0$, with real money demand growing at exponential rate g , a constant German inflation rate of π , and strict purchasing power parity. If the pat is pegged one to one with the mark, nominal money demand will be $e^{(g+\pi)t}$, and the

1/ The immediate direct loss is $1/\eta$ per mark of sales, where η is the elasticity of demand for Patria's exports, but an ICA may bring offsetting gains in terms of lower transaction costs in foreign trade and the corresponding stimulus to exports. Also, to the extent that Patria can attract capital inflows—which again is facilitated by an ICA—the pressure to export under unfavorable conditions is eased.

currency board will emit pats at rate $(g+\pi)e^{(g+\pi)t}$. If the pat depreciates relative to the mark at rate δ , the currency board will emit pats at rate $(g+\pi+\delta)e^{(g+\pi+\delta)t}$, or $(g+\pi+\delta)e^{(g+\pi)t}$ in terms of marks. The relative seigniorage gain is a factor $1/(g+\pi)$ per unit of δ , which for typical values of g and π represents a substantial increase.

Step 3: Same as Step 2, except that citizens conserve on currency in response to a higher inflation tax. Seigniorage will fall relative to Step 2 for a depreciating peg, and rise for an appreciating peg. If depreciation [appreciation] is rapid and money demand is sufficiently sensitive to inflation, seigniorage may fall below [rise above] the level in Step 1.

As illustration, let us modify the previous example to allow for a Cagan (1956) specification of money demand C^d ; that is, the latter decreases log-linearly with domestic inflation at some constant rate β . A shift from the fixed peg to the depreciating peg causes domestic inflation to jump from π to $\pi+\delta$. The currency stock drops immediately from 1 to $e^{-\beta\delta}$. Thereafter, pats are emitted at the rate of $e^{-\beta\delta}(g+\pi+\delta)e^{(g+\pi+\delta)t}$. At a real discount rate of $r > g$, the nominal discount rate is $r+\pi+\delta$, so that the present value of seigniorage under the crawling peg works out to:

$$\begin{aligned} & -1 + e^{-\beta\delta} + \int_0^{\infty} e^{-\beta\delta}(g+\pi+\delta)e^{(g+\pi+\delta)t} e^{-(r+\pi+\delta)t} dt \\ & = -1 + e^{-\beta\delta} + \frac{g+\pi+\delta}{r-g} e^{-\beta\delta} = -1 + \frac{r+\pi+\delta}{r-g} e^{-\beta\delta} . \end{aligned}$$

This is maximized when the domestic inflation rate equals $1/\beta - r$. Empirical estimates suggest that β typically exceeds 2, in which case the seigniorage-maximizing rate of inflation is less than 50 percent.

Step 4: Suppose the crawling peg currency board is replaced by a central bank, but the central bank maintains the peg, and this peg is so credible that no mark reserves are needed. To receive a pat, the citizen sells a good to the central bank, which turns its profits over to the government. The citizen relinquishes a pat plus a noncash domestic sales cost, while the government's gain is the mark equivalent of the pat less central bank expenses. Relative to Step 3, the central bank captures an extra profit equal to the difference between foreign and domestic transaction costs, plus any improvements in the terms of trade.

Step 5: Finally, allow in Step 4 for uncertainty about the Patrian central bank's monetary aims and/or its ability to implement them. Now the Patrian central bank will need to retain and manage some gold and/or foreign currency reserves, which reduces the savings on transaction costs relative to a currency board. Commercial banks will have to offer a risk premium on

pat deposits, which raises the social costs of seigniorage. Also, increased risk may affect households' total currency holdings.

In reviewing the passage from an orthodox currency board to a fully discretionary central banking system, we see that the maximum potential seigniorage gain occurs at Step 2, when a higher inflation tax is imposed on a given money demand. This gain is at least partially offset in Step 3 by households' efforts to conserve on money. Step 4 eliminates foreign intermediaries, while Step 5 imposes various credibility costs.

Hence, the seigniorage gain from an orthodox currency board to a crawling peg currency board (Step 3) is potentially large. The seigniorage change from a crawling peg currency board to a central bank pursuing the same peg (Step 5) is unlikely to be large and may not even be positive. To the extent that monetary policies and household behavior are anticipated, considerations of seigniorage would not seem to significantly favor a central bank over an ICA, except perhaps for very closed economies.

With incomplete anticipation, as discussed in the text, the ability to inflict inflation surprises allows the central bank to generate extra seigniorage quickly, but it also adds to the credibility and uncertainty costs in Step 5. Hence, for a given average inflation rate, the discretionary central bank may be able to generate more seigniorage than an ICA. For a given degree of price predictability, however, the seigniorage advantage goes to the ICA.

References

- Barro, Robert J. and David Gordon, "Rules, Discretion, and Reputation in a Model of Monetary Policy," Journal of Monetary Economics, 12 (1983), pp. 101-121.
- Blackburn, Keith and Michael Christensen, "Monetary Policy and Policy Credibility: Theories and Evidence," Journal of Economic Literature, Vol. 27 (March 1989), pp. 1-45.
- Bordo, Michael D., and Finn E. Kydland, "The Gold Standard as a Rule", NBER Working Paper No. 3367, May 1990.
- Caplin, Andrew and Daniel Spulber, "Menu Costs and the Neutrality of Money," Quarterly Journal of Economics, Vol. 102 (November 1987), pp. 703-25.
- Cagan, Phillip, "The Monetary Dynamics of Hyperinflation," in Studies in the Quantity Theory of Money, ed. by Milton Friedman (University of Chicago Press, 1956), pp. 25-117.
- Collins, Charles, Alternatives to the Central Bank in the Developing World Occasional Paper 20 (Washington: International Monetary Fund, July 1983).
- Edwards, Anthony (ed.), Singapore: A Guide to the Structure, Development, and Regulation of Financial Services (London: The Economist, 1987).
- Greene, Joshua and Delano Villanueva, "Private Investment in Developing Countries: An Empirical Analysis," Staff Papers, International Monetary Fund (Washington), Vol. 38 (March 1991), pp. 37-58.
- Greenwood, J.G., "Why the HK\$/US\$ Linked Rate System Should Not Be Changed," Asian Monetary Monitor Vol. 8, No. 6 (1984).
- Hanke, Steven and Kurt Schuler, "Ruble Reform: A Lesson from Keynes," The Cato Journal, Vol. 10, No. 3 (1991 a), pp. 655-66.
- _____, Currency Boards for Eastern Europe, Heritage Foundation (Washington), (1991 b).
- Khan, Mohsin S. and Malcolm D. Knight, "Unanticipated Monetary Growth and Inflationary Finance," Journal of Money, Credit, and Banking, Vol. 14, No. 3 (August 1982), pp. 347-64.
- Khatkhate, Deena and Brock Short, "Monetary and Central Banking Problems of Ministates," World Development, Vol. 8 (December 1980), pp. 1017-25.

- Kydland, Finn E. and Edward Prescott, "Rules Rather Than Discretion: The Inconsistency of Optimal Plans," Journal of Political Economy, Vol. 85, No. 3 (June 1977), pp. 473-91.
- Mankiw, N. Gregory, "The Optimal Collection of Seigniorage—Theory and Evidence," Journal of Monetary Economics, Vol. 20 (1987), pp. 327-341.
- Masson, Paul R., and Mark P. Taylor, "Common Currency Areas and Currency Unions: A Survey of the Issues", in Policy Issues in the Operation of Currency Unions, (Cambridge University Press, forthcoming).
- McKinnon, Ronald I., "Optimum Currency Areas," American Economic Review, Vol. 53 (September 1963), pp. 717-725.
- Monetary Authority of Singapore, The Financial Structure of Singapore (Singapore: MAS, 1989).
- Mundell, Robert A., "A Theory of Optimum Currency Areas," American Economic Review, Vol. 51 (September 1961), pp. 657-665.
- Spring-Rice, D., "The North Russian Currency," Economic Journal, Vol 29 (September 1919), pp. 280-89.
- Walters, Alan, "Currency Boards," in The New Palgrave: A Dictionary of Economics, J. Eatwell, et. al. (eds.), Vol. 1 (London: MacMillan Press, 1987), pp. 740-42.
- _____, "A Hard Ruble for the New Republics," National Review, Vol. 44, No. 2 (February 3, 1992).

