

Bordo, Michael D.; Jonung, Lars

Working Paper

Monetary Regimes, Inflation And Monetary Reform: An Essay in Honor of Axel Leijonhufvud

Working Paper, No. 1994-07

Provided in Cooperation with:

Department of Economics, Rutgers University

Suggested Citation: Bordo, Michael D.; Jonung, Lars (1994) : Monetary Regimes, Inflation And Monetary Reform: An Essay in Honor of Axel Leijonhufvud, Working Paper, No. 1994-07, Rutgers University, Department of Economics, New Brunswick, NJ

This Version is available at:

<https://hdl.handle.net/10419/94312>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

MONETARY REGIMES, INFLATION AND MONETARY REFORM:
AN ESSAY IN HONOR OF AXEL LEIJONHUFVUD

Michael D. Bordo
Rutgers University
New Brunswick, New Jersey
and
National Bureau of Economic Research

Lars Jonung
Prime Minister's Office
Government of Sweden
and
The Stockholm School of Economics

Revised: March 1994

Paper prepared for the conference "Inflation, Institutions and Information:
Theories and History" held in honor of Axel Leijonhufvud at the Central Bank
of Uruguay, Montevideo, Uruguay. September 6-7, 1993.

1. Introduction *

Over the past decade and a half Axel Leijonhufvud has written extensively on monetary regimes and their connection to nominal and real economic performance. Monetary regimes are important because they determine whether countries follow stable or unstable monetary policies and hence have stable or inflationary price levels. Each monetary regime is associated with a given set of inflationary expectations of the private sector and a pattern of reactions to these expectations by the monetary authorities. The state of the private sector's expectations, specific to each regime, in turn greatly influences the response of real variables to monetary policy actions.

Leijonhufvud has created a number of useful taxonomies for the study of different monetary regimes in history based on: their abilities to conform to constitutional rules; by their form of monetary control -- monetary aggregate control versus the convertibility principle; and by the inflationary expectations responses.

Leijonhufvud has also contributed to our understanding of inflation. Traditional neoclassical models of the inflation tax with perfectly anticipated money growth and inflation rates imply minimal welfare losses associated with the loss of consumer surplus under the money demand curve. He argues that real world inflationary regimes are characterized by unreliable and unpredictable policy making which engender price level uncertainty and substantial inflation forecast errors. The resultant uncertainty costs of inflationary monetary regimes are substantial and for high inflation regimes such as those of Latin America they are disastrous. The costs elucidated include: excessive relative price variability and its attendant resource misallocation, the drying up of key asset markets, misallocation and reduction in capital formation, and the misallocation of both employment and economic activity towards inflation guessing activity.

To restore inflationary monetary regimes to price stability, Leijonhufvud has made a number of proposals for monetary reform. For the low to moderate inflation regimes that have characterized the industrialized countries since the mid 1960s he recommends: A Peel's Act-Friedman rule which would combine the stable nominal anchor characteristics of Friedman's (1960) constant money growth rule (the Issue department) with flexibility to deal with emergencies (the Banking department); a return to some form of convertibility regime based on

a commodity basket; Bluebacking -- issuing a parallel currency to appreciate in step with the expected depreciation of the existing currency. For high inflation countries, Leijonhufvud along with Daniel Heymann advocates orthodox stabilization policies of fiscal reform and nominal anchoring, combined with incomes policy and bluebacking in the transition stages. Interestingly, Argentina followed the bluebacking proposal in its 1985 Austral plan and the more orthodox program in its 1991 stabilization.

This paper discusses Leijonhufvud's writings on monetary regimes and inflation in Section 2. Section 3 considers his various proposals for monetary reform and compares them to alternatives including recent proposals for currency boards. A brief discussion of the recent stabilization experiences of a number of countries highlights the main points. Section 4 then examines evidence for 15 countries (the G-10 plus Switzerland and 4 high inflation countries) over the past century through the experience of diverse monetary regimes. The performances of both nominal and real variables across regimes are compared to the predictions of Axel Leijonhufvud's theoretical writings. Finally, in conclusion, Section 5 presents a brief appraisal of Leijonhufvud's contribution to the analysis of monetary regimes and inflation.

2. Monetary Regimes and Inflation

In Leijonhufvud's work the nature of the monetary regime determines the state of the private sector's price expectations and hence, the response in real activity to monetary policy. A monetary regime is defined as "first, a system of expectations governing the behavior of the public. Second, it is a consistent pattern of behavior on the part of the monetary authorities such as will sustain these expectations." (Leijonhufvud, 1984a, p.95).¹

By also considering expectations, the monetary regime differs from the earlier concept of a monetary standard which referred simply to the institutions and arrangements governing the money supply. In the present lexicon, the private sector with rational expectations makes forecasts and decisions based on its understanding of the policymakers' underlying model and likely policies consistent with that model. Policymakers in turn make their forecasts and decisions based on how they expect the private sector to react. Under such a scheme, the private sector's response to, for example, expansionary monetary policy, will differ dramatically if price level expectations

are anchored by the knowledge that the money supply process is constrained by adherence to a fixed exchange rate or to a constitutional rule restricting the growth rate of the money supply to the long-run growth rate of the economy, than if price expectations are based on guessing the monetary authorities' actions in a discretionary regime.

A distinction is made between a constitutional and a discretionary regime (Leijonhufvud, 1984a, 1987a,b). Under a constitutional regime, a set of constraints, often determined by force of law, puts limits on money growth. Under a discretionary regime, no such limits prevail -- money growth is at the hands of the monetary authorities. This distinction is similar to the recent approach taken in the literature on the time inconsistency of optimal government policy (Kydland and Prescott, 1977; Barro and Gordon, 1983). The absence of a credible commitment mechanism or monetary rule, leads governments, in pursuing stabilization policies, to produce an inflationary outcome. In the discretionary regime, once the monetary authority has announced a given rate of monetary growth, which the public expects it to validate, the authority then has an incentive to create a monetary surprise to either reduce unemployment or capture seigniorage revenue. The public, with rational expectations, will come to anticipate the authorities perfidy, leading to an inflationary equilibrium. A credible precommitment mechanism or rule, by preventing the government from changing planned future policy can preserve long-run price stability by anchoring the public's expectations.

Constitutional regimes or rules, according to Leijonhufvud, (1984a, p.95) should be contingent rules or have escape clauses.² The monetary authority follows the rule, e.g., under the gold standard regime it keeps the price of the currency in terms of gold fixed -- except in the event of a well understood emergency such as a major war, financial crisis or supply shock. Under these circumstances the monetary authority can temporarily suspend the rule (gold convertibility) and use seigniorage to finance its expenditures. The rule is contingent in the sense that the public understands that the suspension will only last for the duration of the emergency plus some period of adjustment. It assumes afterwards that the government will follow the deflationary policies necessary to restore the rule (resume gold payments at the original parity). Should the authorities misuse the escape clause, e.g., not return to parity under the gold standard,

the system of expectations consistent with following the original rule will change to that of a discretionary regime.

Leijonhufvud distinguishes between two types of monetary constitutions based respectively on the quantity principle and the convertibility principle (1984a, p.99). According to the former, the price level is determined by the monetary authorities' control of some monetary aggregate. A leading example of such a regime is to have the monetary authority follow a Friedman (1960) constant money growth rule. Such a regime requires the monetary authority to have a monopoly over the issue of fiduciary money. It also requires a floating exchange rate. According to the latter, the monetary authority is committed to fixing the price of some commodity in terms of its currency (historically gold, or silver, or both). Given the fixed commodity price, the private sector then determines the quantity of fiduciary money and the price level consistent with maintaining parity with the rest of the world.

Both types of constitutional regime anchor price level expectations. Under the Friedman rule, assuming no drift in long-run velocity, setting money growth equal to the long-run growth rate of the economy should produce stable prices (zero inflation) and similar expectations. Under the convertibility regime, assuming for example that it is based on gold, long-run price movements are determined by the fundamentals driving the demand and supply for monetary gold. Indeed, over the century in which the gold standard prevailed, the world price level underwent a series of alternating waves of deflation and inflation, but ultimately returned to its original level. Price expectations under such a rule would be mean reverting.

The two constitutional regimes differ in their possible short-run roles for monetary policy. The Friedman rule regime allows no short-run role for monetary policy to influence real variables -- in the sense of a contingent rule -- since fully anticipated money growth is completely neutral. By contrast, under the convertibility regime, because price expectations are anchored, the monetary authorities could temporarily influence ex ante real interest rates and hence affect investment expenditures and real activity (Leijonhufvud, 1984a, p.101; 1990, p.144).

In contrast to constitutional regimes, Leijonhufvud describes the operation of a discretionary fiat regime dubbed the Random Walk Monetary Standard (RWMS) (Leijonhufvud, 1986, 1988). Under the RWMS, the monetary authority decides one period at a time whether

to change money growth. In making its decisions, only current economic and political considerations are employed. The authority is not concerned with the future. Under such a regime the formation of price expectations is characterized by considerable uncertainty, which increases as the time horizon is lengthened. Moreover, in addition to the forecast errors of inflation increasing exponentially with the time horizon -- because the nature of the policy making process is so uncertain, individual price expectations tend to become increasingly dispersed. In addition, since policy makers make judgements based on the anticipated responses of the private sector to their actions, as the private sector's forecasts became more unreliable, the likelihood increases that policy makers will in time become more unpredictable in their actions.

A distinction is made between the RWMS regimes of low and moderate inflations and that of high inflation. Under low inflation, there need not be a direct connection between the fiscal deficit and the rate of growth of the monetary base. In the high inflation RWMS regimes, it is the inability of the fiscal authorities to successfully raise revenues because of an inefficient and often corrupt tax system and the inability to stick to a 'hard' budget, that makes seigniorage the primary source of finance for government expenditure (Leijonhufvud and Heymann, 1992, Chapter IV). In the high inflation regime once the rate of inflation increases so that price change is measured in monthly rather than annual time, the degree of uncertainty reaches a level that economic activity is seriously affected. At this point the regime becomes unreliable. Only a drastic monetary reform returning the system back to a more transparent, rules-based regime can prevent the chaos of hyperinflation.

2.1 The History of Monetary Regimes

The history of monetary regimes in the past century can be described in terms of the taxonomy developed above. The gold standard evolved from a regime of 'tight convertibility' in its early stages to 'loose convertibility' at the end (Leijonhufvud, 1987d, pp. 60-62; 1990, pp. 142-144;). Under a tight convertibility regime, for a closed economy with commercial banks, the monetary authority fixes the price of gold, banks issue notes and the public prevents overissue by threatening to redeem their notes for coin. For the open economy, gold flows keep the domestic price level in line with the rest of the world. For the world as a whole, the price level is determined by the world's demand and supply for monetary gold.

The world moved away from 'tight convertibility' to 'loose convertibility' whereby the link between nations' monetary gold stocks and their money supplies became increasingly tenuous.³ This reflected a number of forces including: the substitution of fiduciary money for coin by the private sector to economize on scarce resources; the substitution of fiat money for coin as base money by the banking system to lessen the risk of banking panics; the use of foreign exchange as a substitute for gold as international reserves. These developments led, by 1880, to the 'managed' gold standard whereby central banks were supposed to follow the 'rules of the game' to speed up adjustment to balance of payments disequilibrium. In fact, by the turn of the century many countries used their tools of monetary policy to shield their domestic economies from the full costs of adjustment (Bordo, 1984).

However, despite evidence of failures to conform to the rules of the game, the pre-World War I gold standard worked (Schwartz, 1984). Under fixed exchange rates individual countries had some leeway to control their prices and interest rates in order to extend the period for adjustment. Ultimately they observed the restraints the standard imposed.

Further loosening of the gold constraints occurred with the development of the Gold Exchange Standard in the interwar period when most countries extensively used the pound and the dollar as international reserves. The system only lasted for six years. It foundered because holdings of reserve currencies expanded relative to the stock of monetary gold, so the convertibility commitment lost credibility. Gold maldistribution and perverse sterilization policies flouted the requirements that adherence to the gold standard imposed.

According to Leijonhufvud (1987a), the shift from 'tight' to 'loose' convertibility also meant a shift towards a 'quantity controlled regime.' The Bretton Woods System (1946-1971) he views as a regime based on quantity control, in which gold convertibility only loosely constrained one country - the United States - but which operated as if it were following gold standard convertibility rules.

The Bretton Woods system, following the return in 1958 to current account convertibility by the Western European countries, evolved into a gold dollar exchange standard whereby the world increasingly created dollars as international reserves.⁴ The U.S. maintained convertibility (for official transactions) of dollars into gold at \$35. per ounce. The rest of the world pegged

their currencies to the dollar. For the rest of the world, to the extent that they followed the 'rules of the game' the gold convertibility principle operated in full; however, the nominal anchor was the pegged exchange rate to the dollar.⁵ For the U.S., as key reserve center, the balance of payments was not a binding constraint on money issue. According to Leijonhufvud, although the U.S. was not ultimately constrained by the convertibility principle, the monetary authorities acted as if they were, at least until the mid 1960s, by limiting monetary growth to the long-run growth rate of the economy.

The system broke down in the late 1960s and ended in August 1971 with the closing, by President Nixon, of the gold window. Leijonhufvud and others attribute its collapse in large part to the complete abandonment of the convertibility principle both in the face of the growing demands of the Vietnam War induced fiscal deficit and belief in the use of monetary policy to maintain full employment. The de facto convertibility regime, by anchoring price expectations, allowed the use of discretionary stabilization policy. However, the shift to inflation finance and the vigorous manipulation of monetary policy led to a change in the public's expectations (Leijonhufvud, 1987a, p. 132). As the Federal Reserve switched to a discretionary monetary regime, the private sector tried to second guess its actions, in turn attributing extrapolative rather than mean reverting expectations to short-run movements in the monetary base. Although in theory a constitutional regime could be based solely on the quantity control principle it has not yet occurred.

2.2 The Real Effects of Alternative Monetary Regimes

Leijonhufvud (1984,a,b; 1988; with Heymann, 1992) criticizes the standard neoclassical theory of expected inflation for trivializing the costs of unstable money.⁶ According to that theory if money growth and inflation are fully anticipated then the only costs to society of maintaining say a 15% inflation rate forever is the loss of consumer surplus under the demand for money. Against this cost is then weighed the much greater cost of disinflating which would break existing expectations and lead to significant output losses. The prohibitive costs of disinflation are then used to make the case against reducing inflation.

Leijonhufvud argues that focus on the monetary regime and its expectations generating mechanism can lead to a clearer understanding of the causes of inflation. Under the Random

Walk Monetary Standard the cost of inflation is considerably higher than in the simple world of fully anticipated steady money growth. Under the RWMS, price level uncertainty, manifest in forecast errors, increases with the time horizon. Increased price level uncertainty, manifest in forecast errors, has serious implications. The inability to forecast inflation will lead to mistakes in resource allocation. For example, if different agents have different inflationary expectations, ex ante real interest rates will differ, leading to misallocation of investment (Leijonhufvud, 1984a, p. 34). In addition, as the dispersion of inflation increases with time, both lenders and borrowers become increasingly reluctant to engage in long-term contracts. Hence long-term markets will thin out (ibid. p. 32). Moreover, with the increase in inflation uncertainty, resources and talent will be reallocated from production and distribution towards second guessing the monetary authorities and shielding wealth from the effects of depreciating purchasing power. Increased inflation uncertainty is associated with increased relative price variability. This adds noise to the system, in turn, increasing the likelihood of resource misallocation. Finally, as the increase in price uncertainty leads to the disappearance of markets, the political process emerges as an alternative and less efficient way to allocate and redistribute resources.

The losses associated with high inflation RWMS regimes are even greater. In the face of massive inflation uncertainty (for a case such as Argentina in 1989), a multiple currency standard emerges: spot markets for long-term assets are dollarized; rents and wages are indexed, and wholesale and retail markets for consumer goods use domestic currency (Leijonhufvud, 1992, p. 217; Heymann and Leijonhufvud, Chapter V). Multiple standards in turn create serious problems such as, for example, in the real estate market where prices are quoted in dollars yet no mortgage market exists. In the end, as inflation degenerates into hyperinflation, all transactions become speculative, shops begin to display signs reading 'closed for lack of prices' and monetary reform is the only alternative to anarchy.

3. Proposals for Monetary Reform

Axel Leijonhufvud has made a number of proposals to reform the monetary regimes of both low and high inflation countries.

3.1 Low Inflation

For low to moderate inflation RWMS regimes he has proposed: the Peel's Act-Friedman rule; a convertibility rule and Bluebacking. We describe each and then compare them to a number of alternative proposals.

3.1.1 The Peel's Act-Friedman Rule

Leijonhufvud's suggestion for a constitutional amendment to move the U.S. from the present discretionary RWMS regime to a constitutional regime based on quantity control is a hybrid of the British Bank Charter Act of 1844, which created a rule for the managed gold standard, and Milton Friedman's (1960) constant money growth rate rule (Leijonhufvud, 1984a; 1986). According to the Bank Charter Act, the Bank of England was to be divided into two departments: the Issue department and the Banking department. The Issue department set the basic convertibility rule for the gold standard. It could issue up to 14 million pounds in unbacked Bank of England notes, any extra issue had to be fully backed by gold reserves. Thus the monetary base would expand and contract with gold inflows and outflows, and the mixed specie, fiduciary system by following the "Currency Principle", would act like a pure gold standard. The Banking department followed normal banking practices and also served as lender of last resort to the commercial banking system. However, it was constrained in its loan-making capacity by the note issue and gold reserves of the Issue department.

Under Leijonhufvud's hybrid scheme, the Federal Reserve would be divided into an Issue and a Stabilization department. The Issue department would follow the Currency Principle and provide a nominal anchor by expanding the monetary base at the same rate as the long-run growth rate of the real economy adjusted for drift in base velocity to reflect financial innovation. The Stabilization department would act like the Banking department of the Bank of England. It would engage in short-run stabilization policy. The reserves required for the Stabilization department to conduct its policies would be provided by initially setting the base some 10, 15, 20% higher than the actual base before putting into motion the constant growth rate rule. The excess monetary base would then serve the same role as excess international reserves under the Bretton Woods system -- to offset unexpected shocks to the economy. Because the long-run growth rate of the base is anchored by the Friedman rule, market agents will follow mean

reverting price expectations and not view the policies of the Stabilization department as a form of random walk monetary standard.

3.1.2 A Convertibility Rule

Because financial innovation could make monetary control following the quantity principle no longer feasible, Leijonhufvud, (1984a, p. 103) suggested that the monetary authorities peg the price of some basket of commodities (such as the scheme proposed by Robert Hall in 1982) and then let the private sector endogenously determine the monetary aggregates.

3.1.3 Bluebacking

Leijonhufvud has proposed a scheme to restore price stability from a well-anticipated inflation while avoiding the "traditional" output costs of cutting money growth and breaking the expectations of a well-established regime. His scheme is based on the issuance of a parallel currency called "bluebacks". These blueback notes would by law appreciate by the same amount as the existing currency-greenbacks, depreciates (Leijonhufvud, 1984b; Heyman and Leijonhufvud, 1992, Chapter III). For example, if the anticipated rate of inflation in greenbacks is 15% per year and we start with the two types of currency trading at par, then after one year 85 blueback cents would equal one greenback dollar; after two years 71 blueback cents would equal one greenback dollar and so on.

If expectations are rational, zero inflation would be quickly achieved and it would avoid the output losses and redistribution of wealth associated with conventional disinflation. In practice, a necessary condition for instituting such a scheme is that the original reason for inflation -- to finance fiscal deficits -- is reversed and that the public believes this. In that scenario, a bluebacking scheme would serve as a low cost way of transiting from an inflationary to a stable price environment.

3.1.4 Alternative Proposals

The rich literature on monetary reform contains a number of proposals for long-run price stability. The traditional approach to keeping inflation at bay for open economies is to maintain a fixed exchange rate. The basic idea is to create low inflation credibility for the domestic currency by pegging it to a foreign currency issued by a highly credible central bank, such as the Federal Reserve or the Bundesbank. The pegged rate represents a method of "importing"

credibility and thus creating expectations of low rates of inflation. This was a major argument given in the late 1980's for the ERM-system under which several European central banks tried to create credibility for their domestic currencies by tying them, at a pegged rate, to the DM (Giavazzi and Pagano, 1988). Moreover the success of the Bundesbank in turn was attributed to its independence from the fiscal authority. However, as history has shown, fixed rate systems tend to break down sooner or later as the monetary authorities prove unable to maintain credibility in their commitments to the pegged rates in the face of massive shocks (Bordo 1993b). This has most recently been demonstrated by the breakdown in 1992-93 of the ERM.

For economies with a flexible exchange rate a number of well-known rules have been designed to maintain price stability including: Milton Friedman's (1960) k-percent rule; various proposals to target GNP growth as well as recommendations to stabilize the growth of the monetary base; and recent proposals for an independent central bank whose sole purpose is to maintain stable prices (Cukierman, 1992). In an earlier era two proposals made were: Knut Wicksell's norm of price stabilization of 1898 and David Davidson's norm where the price level should fall in proportion to the increase in productivity.⁷

A fundamental weakness with all these plans to create low and stable inflation, including Leijonhufvud's proposals, judging from the historical record, is that they do not contain a mechanism that creates sufficient credibility. As long as money is produced by a government controlled monopolist, that is by a central bank, the money supply process will be the subject of political pressure. Sooner or later the monetary system will be exposed to a disturbance that induces political manipulation of the money supply, creating inflation. Once inflation begins, it tends to become entrenched in the monetary regime.

One method to create strong credibility for the purchasing power of the currency is to take the money supply out of the control of the political system. Creating a truly independent central bank whose only responsibility is to maintain price stability is one way to do this, as has seemingly been successful in New Zealand (Svensson, 1993 and Wood, 1994). An alternative is to establish a currency board, which is a monetary institution that issues domestic notes and coins fully backed by a reserve currency and fully convertible into the reserve currency at a fixed exchange rate on demand. The foreign reserve currency may be either a currency of a foreign

central bank or specie. Under a currency board, there is no room for discretionary monetary policy and thus for inflationary policies -- the money supply is completely isolated from the domestic political system.⁸

Currency boards were common in the nineteenth century. About 50 - 60 boards were operating in various European colonies in Africa, Asia and the Caribbean (Schwartz, 1993 and Hanke, Jonung and Schuler 1993). When these former colonies obtained independence, one of their first steps commonly was to set up a central bank. Eventually, most of these former colonies experienced high inflation, with the principal exception of those like Singapore and Hong Kong, that maintained variants of currency boards.

The currency board solution, as we suggest below, may be practical for newly independent countries facing the task of establishing credibility for their currencies or for countries with a history of high and variable inflation, where the credibility of the existing central bank is low and most likely to remain so in the foreseeable future. However, because currency boards require a country to completely give up its monetary sovereignty and because they do not have a provision for a lender of last resort they are unlikely to be adopted by countries with a history of low to moderate inflation.

3.2 High Inflation

To extricate economies from high inflation RWMS regimes, Heymann and Leijonhufvud (1992, Chapter VI) propose a very orthodox set of measures. The basic ingredients consist of fiscal reform leading to a long-run balanced budget and nominal exchange rate anchoring. Streamlining tax collection, raising taxes and rationalizing the budgetary process will remove the imperative for monetization of fiscal deficits. Fixing the nominal exchange rate will quickly reduce the prices of traded goods and act as a strong signal to price setters to reduce domestic goods prices. Other policies to ease the transition include: incomes policies to offset the price inertia associated with backward looking indexation; and the bluebacking scheme.

3.2.2 Recent Stabilization Plans

Two recent stabilization plans in Argentina: the Austral Plan of 1985 and the Convertibility Law of 1991; illustrate key elements of the Heymann and Leijonhufvud proposals.

3.2.3 The Austral Plan

Argentina has instituted five plans in the past 20 years to deal with an extremely serious high inflation problem -- from 1980 to 1990 consumer prices increased on average by 300% per year. The Austral Plan of June 1985 is of great interest because it incorporated Leijonhufvud's (1984b) bluebacking scheme. In mid 1985 inflation was running at 30% per month and the fiscal deficit at above 15% of GDP. The plan aimed at rapid disinflation to break inflationary expectations (Heymann, 1987 and Heymann, 1991).

The plan contained three elements. First, the central bank would no longer finance the fiscal deficit. It was assumed that the reduction in inflation, in addition to other fiscal measures, would increase tax revenues sufficiently to relieve the inflationary pressure. Second, wages and prices were frozen. Third, a new currency - the austral - was created worth 1000 pesos. According to the blueback scheme, payments denominated in pesos, resulting from previous contracts, would be made in australs at a conversion rate that changed daily, in such a way as to make the peso depreciate relative to the new currency.

Initially the plan was successful. Inflation fell to 3% per month as did the fiscal deficit. Output initially declined then recovered. However, the results were not permanent. Residual inflation led to further pressure on wages and prices and the fiscal deficit expanded. By the end of 1986 inflation was up to 6 - 8% per month and rising. The Austral Plan was shortlived because permanent fiscal balance was not achieved.

Thus Leijonhufvud's blueback scheme, when instituted under the Argentine Austral Plan of 1985, did not become credible because the monetary and fiscal processes of Argentina were not changed in a significant way at the same time as the Austral plan was introduced. In other words, the monetary regime remained unchanged. Hence there was little reason for the Argentine public to revise its expectations about the future long-run behavior of inflation. Inflation was expected to return to a high chronic level and it eventually did so.

3.2.4 The Convertibility Law of April 1991

The Menem administration, which entered office in June 1989, faced a legacy of hyperinflation (greater than 20% per month), a high fiscal deficit (11% of GDP) and declining real output. In the next year, it enacted a number of important reforms to reduce the fiscal deficit. These included: simplification of the tax structure; reduced government expenditures; and

privatization of state owned enterprises. These initiatives succeeded in reducing the deficit to 1.8% by 1991 and converting it to a surplus in 1992 (Levin, 1993).

High inflation continued, leading the administration to implement an exchange rate based convertibility plan on April 1, 1991. The Law established full convertibility of the Argentine currency at the rate of 10,000 australes per U.S. dollar. It was required that the monetary base be fully backed by international reserves. The indexation of austral denominated contracts was outlawed. The Central Bank immediately suspended all rediscounting and open market operations -- effectively ending the use of discretionary monetary policy and the lender of last resort facility. Finally on January 1, 1992 a new currency was instituted, the peso, equal to 10,000 australs.

The convertibility law transformed the Argentine central bank into a form of Currency Board pledged only to buy and sell pesos at the fixed exchange rate. Since Argentine international reserves in 1991 exceeded the dollar value of the monetary base (greatly eroded by hyperinflation), the new currency was fully backed.

The Plan was highly successful initially. Within a year inflation was reduced to less than 20%. This plan is regarded by observers as more credible than earlier stabilization plans because of both the elimination of the fiscal deficit and the full backing of the currency (Levin, 1993). However instituting a nominal exchange rate peg has created the potential for future difficulties. Pegging the exchange rate quickly led to rapid declines in the prices of traded goods (determined in world markets) relative to the prices of non-traded goods (which are subject to considerable inflation inertia). This increase in the real exchange rate created a current account imbalance. At the same time removal of capital controls, combined with exchange rate stability, encouraged private capital inflows (largely repatriation of domesticly owned funds) sufficient to finance the deficit. The future impact of the high real exchange rate on aggregate demand and economic activity is likely to put increased pressure on the government to devalue -- although a speculative attack on the peso was successfully rebuffed in November 1992. Given Argentina's history of hyperinflation, to do so may seriously harm the government's credibility.

The Convertibility Law of 1991 incorporated many elements of proposals suggested by Heymann and Leijonhufvud. The costs of high inflation, which they elaborately describe, may have finally induced a sea change in a country with a long history of currency instability.

3.2.5 Other Stabilization Experiences

A number of countries have suffered from extremely high inflation in recent decades and as a consequence of this experimented with various stabilization programs. Vegh (1992) surveys the experience of ten stabilization programs in six high inflation countries (Argentina, Brazil, Chile, Israel, Mexico and Uruguay) in the past three decades.⁹ Two types of programs are distinguished: heterodox stabilizations that rely on nominal exchange rate anchoring and incomes policies; orthodox policies that do not include incomes policies. In all of the heterodox cases inflation converged slowly to the rate of devaluation; real exchange rates appreciated; the current account deteriorated and real activity followed a boom and bust cycle.

Of the ten cases: three were successful in permanently reducing the inflation rate to low levels: Chile (1978); Israel (1985) and Mexico (1987). The common element in the unsuccessful cases was the lack of a credible commitment to stick to the nominal anchor. Belief by agents that the peg would eventually be abandoned resulted in sustained inertia in domestic price inflation, in turn precipitating the effects described above.

By comparison, in the case of the Bolivian hyperinflation, the stabilization of 1985 was successful in immediately restoring price stability. This may have been the case, according to Vegh, because under hyperinflation the need for seigniorage to finance the fiscal deficit is more apparent than under high inflation, so that a credible fiscal reform is viewed as sufficient to ensure price stability and, because under hyperinflation conditions have deteriorated so badly that the imperative for reform is accepted by all. In contrast, under high inflation people seem to learn to live with it thus keeping demand for anti-inflationary measures at bay.

Thus the Argentine stabilization of 1991, successful so far, may, in addition to containing all the elements of an orthodox reform, have been successful because the economy had deteriorated into hyperinflation. This created the belief that there was no alternative to a fundamental change.

3.2.6 Currency Boards As A Method To Reduce High And Chronic Inflation

The fundamental obstacle facing the monetary and political authorities in countries with high and chronic inflation in planning a stabilization program to reduce the rate of inflation and keep it permanently at a low level, is to obtain ex ante credibility for the disinflationary policy package. In principle, if a program of disinflation is fully credible, there would be no output loss caused by disinflation. Under these circumstances, the rate of inflation can be reduced quickly and painlessly. The history of various stabilization programs to reduce high and chronic inflation shows, however, that it is extremely difficult to get instantaneous as well as lasting credibility.¹⁰

The challenge to economists is to design a monetary regime that creates instant as well as lasting credibility in an economy with chronic inflation. A common method, often adopted, is to "borrow" credibility from foreign sources. The orthodox approach is to tie the high inflation domestic currency to a low-inflation foreign currency through a fixed exchange rate. The weakness with this approach is that the fixed rate initially lacks credibility which commonly forces the domestic central bank to maintain high domestic real rates to defend the fixed rate, in turn contracting the domestic economy and thus undermining the long run credibility of the fixed rate. Another technique of borrowing credibility is to have an international organization, like the League of Nations or the IMF enforce the commitment. (See for example Santaella [1993]). Such foreign intervention however can easily lead to domestic political resentment which undermines credibility, in turn threatening the longevity of the regime.

One proposed method to stop high inflation, that avoids the weaknesses of the above-mentioned approaches, is for a currency board to introduce a new currency for domestic circulation that has immediately high credibility relative to the existing currency. The currency board would then function as a binding commitment both in the transition to a low rate of inflation and to subsequent maintenance of permanent stable rate. It would rely on an external arrangement to create credibility but here the commitment would be much stronger than with a pegged exchange rate cum a central bank.

The transition to a low inflation monetary system based on a currency board may follow two strategies. The first one is to convert the existing inflationary central bank into a currency board -- the strategy recently followed by Argentina.

The second strategy would be to set up a currency board that issues a currency parallel to that of the existing central bank. The advantage of this second solution is that during the stabilization program existing contracts in the labor, product and capital markets made in terms of the inflationary central bank currency can be enforced, reducing the negative effects of inflation inertia on output. The parallel currency approach would in principle allow a transition during which budget constraints can gradually harden while the currency of the currency board enables the public to protect itself from high inflation. "Soft" budgets will gradually turn into "hard" budgets but the braking process will not be as abrupt. The process of currency competition and currency substitution will thus be a gradual one, minimizing output losses. This second strategy has much in common with Leijonhufvud's bluebacking scheme.

A currency board introduced in this way requires no "preconditions" for monetary reform. Government finances, state enterprises, or trade need not already be reformed before the currency board can begin to issue its parallel currency. There are a few cases in history where a parallel currency has been a method to reduce high inflation. (See for example Rostowski and Shapiro [1992], Hanke, Jonung and Schuler [1993] and Siklos [1993] on Russia in the 1920s.)

In the case of a high inflation Latin American country, the currency board currency would preferably be tied to the U.S. dollar as is the case in Argentina. Such a currency would have a truly fixed exchange rate to the dollar and thus the same credibility as the U.S. dollar. Here one should think in terms of relative credibility. The Federal Reserve Board does not have a perfect inflationary record but the relative credibility of the U.S. dollar will in the foreseeable future be much stronger than that of the currency issued by the central bank of any Latin American country.

A number of additional steps may be taken to protect the currency board from political pressure and thus to foster the credibility of its currency. Possibly, the main office of its board could be set up in a foreign country and the majority of the boards' members be foreign citizens. Part of the profits of the board (its "seignorage") may be returned to the domestic economy in order to create public and political support for the new arrangement.¹¹

A currency board reform for Russia along these lines, has recently been proposed by Hanke, Jonung and Schuler (1993). Russia today is experiencing extreme inflation and the

Russian central bank has a history of high inflation. Hence any attempt to create credibility for the rouble will be extremely costly. Russia may have to live with high real interest rates for a long time before credibility is established for the present central bank rouble. Thus Russia today faces the problems typical of many high inflation economies in Latin America in the 1970s and 1980s.

In two countries, Estonia and Argentina, the central bank is presently mimicing currency boards. Estonia has tied its currency to the DM at the rate of eight Estonian Kroons for one DM. As discussed above, one Argentine peso since January 1992 is equivalent to one U.S. dollar.

These programs have initially met with success. Their main weakness, however, is that a central bank that tries to mimic a currency board does not have the same high credibility as a "pure" currency board. The political system may change the behavior of the Estonian or Argentine central bank such that it will not continue to behave as a fullfledged currency board, consequently starting the inflationary process anew. The future will show if these two central banks, ordered to operate as currency boards, represent a significant step towards less inflationary monetary regimes. If so, it will be a remarkable break with the past. It is our guess that if they fail a possible next step would be to move towards "true" currency boards.

4. Empirical Evidence

Axel Leijonhufvud's theoretical writings contain a number of predictions about the performance of key macro variables under alternative monetary regimes. His most important predictions concern the behavior of the inflation rate under convertible and discretionary (RWMS) regimes; specifically, the inflation rate should be higher, more variable and more uncertain under discretionary monetary policy regimes than under convertible regimes. Moreover, the forecast error of inflation should be increasing with the time horizon under the RWMS regime. Also, inflation variability and uncertainty should be greater under high RWMS regimes than low ones. Presumably, other nominal variables such as the exchange rate (Leijonhufvud, 1984b) and nominal interest rates should be more variable under the RWMS type regimes than under convertible regimes.

As a consequence of greater inflation uncertainty, he argues that other things equal, real output will be more variable under RWMS regimes than under convertible regimes. At the same

time real variables may be more subject to both real and nominal shocks under convertible regimes than under discretion (Leijonhufvud, 1990). Other real variables, such as the real exchange rate and real interest rates may respond in a similar manner.

Leijonhufvud's insights on the behavior of alternative monetary regimes pertains specifically to the performance of individual countries or, if a number of countries are part of a similar regime -- of the whole system. His insights also can be related to the relationship between countries under alternative monetary regimes or to put it another way, to the issues raised by the debate over fixed versus flexible exchange rates.

According to the traditional view, adherence to a (commodity based) fixed-exchange rate regime, such as the gold standard, ensured long-run price stability for the world as a whole because the fixed price of gold provided a nominal anchor to the world money supply. Individual nations, by pegging their currencies to gold, fixed their price levels to that of the world.¹² A fixed-rate system based on fiat money however, may not provide a stable nominal anchor unless a credible commitment mechanism constrains the growth of the world's money supply (Giovannani, 1993). The disadvantage of fixed rates is that individual nations are exposed to both monetary and real shocks transmitted from the rest of the world via the balance of payments and other channels of transmission (Bordo and Schwartz 1989a). The advantage of floating exchange rates is to provide insulation from foreign shocks. The disadvantage is the absence of the discipline of the fixed-exchange-rate-rule, since monetary authorities might adopt inflationary policies.

Theoretical developments in recent years have complicated the simple distinction between fixed and floating rates. In the presence of capital mobility, currency substitution, policy reactions, and policy interdependence, floating rates no longer necessarily provide insulation from either real or monetary shocks (Bordo and Schwartz, 1989a). Moreover, according to recent real business cycle approaches, there may be no relationship between the international monetary regime and the transmission of real shocks (Baxter and Stockman, 1989). Nevertheless, the empirical comparison between regimes may shed light on these issues.

To make the case for one monetary regime over another empirical and historical evidence on their performance is crucial. In this section we present some evidence on different aspects of the macro performance of alternative international monetary regimes over the past 110 years.¹³ The comparison for 11 (the G-10 plus Switzerland) industrialized countries (the United States, United Kingdom, Germany, France, Japan, Canada, Italy, Belgium, the Netherlands, Sweden and Switzerland) is based on annual data for the classical gold standard (1881-1913), the interwar period (1919-1939), Bretton Woods (1946-1970), and the present regime of floating rates between the principal currencies (1971-1989). The Bretton Woods period (1946-1970) is divided into two subperiods: the preconvertible phase (1946-1958) and the convertible phase (1959-1970).¹⁴ This classification of regimes corresponds roughly to Leijonhufvud's distinction between convertibility based regimes (the gold standard and Bretton Woods convertible); loose convertibility (Interwar, Bretton Woods preconvertible) and discretion or RWMS (the floating regime).

In addition, to reflect Leijonhufvud's interest in the performance of high inflation economies we also examine the behavior of a number of macro variables for four traditionally high inflation economies (Argentina, Brazil, Chile, Israel). Although these countries did not strictly adhere to convertible regimes, there is considerable evidence that the prevalence of these regimes in the rest of the world influenced their macro performance.¹⁵

One important caveat is that the historical regimes presented here do not represent clear examples of fixed and floating rate regimes or alternatively of convertibility rules versus discretion. The interwar period is composed of three regimes: general floating from 1919 to 1925; the gold exchange standard from 1926 to 1931; and a managed float to 1939.¹⁶ The Bretton Woods regime cannot be characterized as a fixed exchange rate regime throughout its history: the preconvertibility period was close to the adjustable peg envisioned by its architects; the convertible period was close to a de facto fixed dollar standard.¹⁷ Finally, although the period since 1973 has been characterized as a floating exchange rate regime, at various times it has experienced varying degrees of management.

4.1 Stability and Convergence

Table 1 presents descriptive statistics on ten macro variables for each of the G-11 countries; the data for each variable are converted to a continuous annual series from 1880 to

1989. Table 2 presents similar data for a smaller set of data for the four high inflation countries. The ten variables are: the rate of inflation, real per capita growth, money growth, short-term and long-term nominal interest rates, short-term and long-term real interest rates, the absolute rates of change of nominal and real exchange rates, and the ratio of the government deficit (government expenditures less tax revenues) to GDP. The definition of the variable used, e.g., M_1 versus M_2 was dictated by the availability of data over the entire period. For each variable and each country we present two summary statistics: the mean and standard deviation. For all the countries taken as a group, we show two summary statistics: the grand mean and a simple measure of convergence defined as the mean of the absolute differences between each country's summary statistic and the grand means of the group of countries.¹⁸ We comment on the statistical results for each variable.

4.1.1 Inflation (Panel a). The classical gold standard had the lowest rate of inflation of any monetary regime for all 15 countries and the interwar period displayed mild deflation for all except Brazil. The rate of inflation during the Bretton Woods period was on average and for every country except Japan lower than during the subsequent floating exchange rate period. The average rate of inflation in the two Bretton Woods subperiods was virtually the same for the G-11 countries. However, this comparison conceals the importance of two periods of rapid inflation in the 1940s and 1950s and in the late 1960s. For the high inflation countries in Table 2, inflation increased substantially between the preconvertible and Bretton Woods convertible periods. See Figure 1.¹⁹ Thus the evidence based on country and period averages of very low inflation in the gold standard period and of a lower inflation rate during Bretton Woods than the subsequent floating period is consistent with the traditional view on price behavior under fixed (commodity based) and flexible exchange rates.

In addition, the inflation rates show the highest degree of convergence between the G-11 countries during the classical gold standard and to a lesser extent during the Bretton Woods convertible subperiod compared to the floating rate period and the mixed interwar regime. This evidence also is consistent with the traditional view of the operation of the classical price specie-flow mechanism and commodity arbitrage under fixed rates and insulation and greater monetary independence under floating rates.²⁰ For the high inflation countries for the post war period (for

which we have complete data) although the inflation rates are considerably higher than the G-11, we also observe greater convergence under Bretton Woods than during the float. This suggests that although these countries did not directly follow convertibility rules, the fact that the G-11 did, may have influenced regime performance.²¹

The Bretton Woods convertible subperiod had the most stable inflation rate of any regime for the G-11 judged by the standard deviation. By contrast, for the G-11 the preconvertible Bretton Woods period exhibited greater inflation variability than either the gold standard or the recent float. The evidence of a high degree of price stability in the convertible phase of Bretton Woods is also consistent with Leijonhufvud's writing and the traditional view that convertible fixed rate (commodity based) regimes provide a stable nominal anchor; however, the remarkable price stability during this period may also reflect the absence of major shocks.

For the high inflation countries (for which we have complete data) inflation variability does not differ much between the gold standard and Bretton Woods Regimes. It is considerably higher than in the G-11 for those periods. As with the G-11, inflation variability was much greater in the floating rate period than under Bretton Woods. The dramatic increase in inflation variability likely reflects the operation of a RWMS regime.

4.1.2 Real per capita GNP (Panel b). Generally, the Bretton Woods period, especially the convertible period, exhibited the most rapid output growth of any monetary regime for the G-11 countries, and not surprisingly the interwar period the lowest (see Figure 2). Like the G-11, for the high inflation countries the Bretton Woods convertible period displayed the most rapid growth, but for Argentina, Brazil, and Israel the floating period was the lowest. For these countries, as Heymann and Leijonhufvud suggest, the shift from a loosely convertible to a purely discretionary regime may have been related to deteriorating economic performance. Output variability was also lowest in the convertible subperiod of Bretton Woods for the G-11, but because of higher variability in the preconvertible period, the Bretton Woods system as a whole was more variable than the floating period. Both pre-World War II regimes exhibit higher variability than their post-World War II counterparts.²² For the high inflation countries (for which we have data) the convertible Bretton Woods period also emerges as the least variable.

For the G-11, the Bretton Woods regime also exhibited the lowest divergence of output variability between countries of any regime, with the interwar regime the highest.²³ For the high inflation countries, like the G-11, the Bretton Woods convertible regime exhibited the lowest degree of divergence along with the gold standard. The preconvertible Bretton Woods regime and the Interwar was the highest. The greater convergence of output variability under Bretton Woods may reflect conformity between countries' business fluctuations, created by the operation of the fixed-exchange rate regime (Bordo and Schwartz, 1989a, and Darby and Lothian, 1989).

4.1.3 Money growth (M_2) (Panel c). It was considerably more rapid across all countries post-World War II than before the war (see Figure 3). For the G-11 there is not much difference between Bretton Woods and the subsequent floating regime. Within the Bretton Woods regime, money growth was more rapid in the preconvertibility period than in the convertibility period. For the high inflation countries money growth rates accelerated over the entire postwar period reaching their highest levels under the float. To the extent that the world adhered to convertibility rules they seem to have been more effective in constraining money growth in these countries before 1959. However the comparison between the total Bretton Woods period and the subsequent float (for all except Chile) suggests that the convertibility regime in the rest of the world still may have had some influence.

Money growth rates showed the least divergence between G-11 countries during the fixed-exchange-rate gold standard and the convertible Bretton Woods regime with the greatest divergence in the preconvertible Bretton Woods period and the interwar period. For the high inflation countries, divergence in money growth rates increased as the twentieth century progressed, reaching its peak with the recent float.

Like inflation and real output variability, for the G-11, money growth variability was lowest in the convertible Bretton Woods period. This, however, was not the case for the preconvertible period which was the most variable of any regime. It also exhibited the greatest divergence in variability between countries. To the extent that one of the properties of adherence to a fixed-exchange-rate regime is conformity of monetary growth rates between countries, these results are sympathetic to the view that the Bretton Woods system really began in 1959. For the high inflation countries, money growth variability did not increase significantly

between the earlier periods and the Bretton Woods period but did so dramatically between Bretton Woods and the float. This could be viewed as strong evidence for the operation of a RWMS monetary regime. Divergence of money growth variability also increased dramatically for those countries between the Bretton Woods and floating regimes.

4.1.4 Short-term and long-term interest rates (Panels d and e). The underlying data can be seen in figures 4 and 5. The absence of reliable data precluded us from presenting this data for the high inflation countries. As in other nominal series for the G-11, the degree of convergence of mean short-term interest rates is highest in the convertible Bretton Woods period. Long-term rates are most closely related in the classical gold standard with the convertible Bretton Woods period not far behind. These findings are similar to these of McKinnon (1988), who views them as evidence of capital market integration under fixed exchange rates. The lack of convergence in the preconvertibility Bretton Woods period reflects the presence of pervasive capital controls. Convergence of nominal interest rates would not be expected under floating exchange rates. Convergence of standard deviations is also highest in the gold standard period followed by Bretton Woods. Long-term rates were most stable and least divergent under the classical gold standard, followed by the two Bretton Woods subperiods, with floating exchange rates the least stable. The evidence that nominal interest rates are more stable and convergent between countries under fixed exchange rate (commodity based) regimes is consistent with the traditional view.

4.1.5 Real short-term and real long-term interest rates (Panels f and g). For the underlying data see figures 6 and 7. The real interest rates are ex post rates calculated using the rate of change of a consumer price index.²⁴ Unlike the nominal series for the G-11, the degree of convergence in means between real short-term interest rates is lowest in the floating exchange rate period, next lowest in the Bretton Woods convertible period, and highest in the preconvertible period. For long-term real rates, as in the case of nominal rates, convergence is highest under the gold standard followed by the Bretton Woods convertible regime. It is lowest under preconvertible Bretton Woods. The real short-term interest rate is most stable across countries during the Bretton Woods convertible period. It also shows the least amount of divergence in standard deviations. The same holds for real long-term interest rates.

The behavior of real interest rates across regimes is consistent with McKinnon's (1988) explanation. He argued that fixed exchange rates encourage capital market integration by eliminating devaluation risk. This reduces variability in short-term real interest rates. Similarly, real long-term interest rates are stabilized by pooling across markets, which reduces capital market risk.

4.1.6 Nominal and real exchange rates (Panels h and i). For the underlying data see figures 8 and 9. For the G-11 countries the lowest mean rate of change of the nominal exchange rate and the least divergence between rates of change occurred during the Bretton Woods convertible and gold standard periods, with the former exhibiting the lowest degree of divergence. Exchange rates during the preconvertibility Bretton Woods regime changed almost as much as during the floating period. This mainly reflected the major devaluations of 1949 (see Figure 8 and Bordo (1992) Table 2). Nominal exchange rates were least variable in the gold standard and convertible Bretton Woods periods and the most variable and most divergent in the Bretton Woods preconvertible period. For the high inflation countries both the average rate of change of the nominal exchange rate and its standard deviation were a multiple of the G-11 for all regimes. Both statistics increased between the pre and post World War II periods reaching a peak with the recent float. Divergence of both measures also increased as the century progressed.

As with the nominal exchange rate the lowest mean rate of change in the real exchange rate across G-11 countries and the least divergence between countries was in the Bretton Woods convertible period with the gold standard period next in size of these measures (see Figure 9). The highest rate of change was in the floating period. Similarly the lowest standard deviation across countries and the least divergence between standard deviations was the Bretton Woods convertible period with the gold standard again next in these rankings. The other regimes were characterized by much greater variability and divergence. For the high inflation countries, although the orders of magnitude are somewhat greater than the G-11, the same pattern emerges across regimes.

These results shed light on the relationship between the nominal exchange rate regime and the behavior of real exchange rates. Mussa (1986) presented evidence for ten industrialized countries in the post-World War II period showing the similarity between nominal and real

exchange rate variability under floating rate. His explanation for greater real exchange rate variability under floating rates than under fixed rates is nominal price rigidity.²⁵ The explanation may be questioned, for example, fixed nominal exchange rates may produce greater trade stability that will be reflected in the real exchange rate, as is evident for both the Bretton Woods and gold standard periods. Yet as Eichengreen (1991) points out and as can be seen in Table 5 below, these results could be explained by the fact that both periods were characterized by few shocks.²⁶

Finally, based on monthly data 1880-1986 for the U.K. and the U.S., Grilli and Kaminsky (1991), show that, with the exception of the post-World War II period, no clear connection exists between the nominal exchange rate regime and the variability of real exchange rates. Our results for the G-11 show a clear correlation between nominal exchange rate rigidity and lower real exchange rate variability for the gold standard and Bretton Woods convertible regime. For the preconvertible Bretton Woods period - de jure a type of fixed exchange rate regime - the correlation is not evident. We do not distinguish between fixed and flexible periods in the interwar segment as do Grilli and Kaminsky, hence that period cannot be used in the comparison.²⁷

4.1.7 Government Deficit (Panel j). For the underlying data see Figure 10. For the G-11 countries the average ratio of the government deficit to GNP is lowest on average during the Bretton Woods convertible period, followed by the Gold Standard. The highest ratio is for the recent float. The ratios did not differ much between most of the countries across the regimes, with the key exception of Italy and Belgium which ran considerably higher deficits than the others under the preconvertible Bretton Woods period and the recent float. The standard deviations in fiscal policy followed a pattern similar to the means. As in the case of monetary policy, fiscal policy converged most closely in both means and standard deviations between countries during the Bretton Woods convertible regime and the gold standard. Thus adherence to constitutional regimes may have constrained fiscal policy in the same way as it did monetary policy. On the other hand, more limited fiscal needs during those regimes may have made it easier to adhere to the convertibility rule. Finally, except for the recent float, the correlation between the fiscal deficit and inflation is weak. As Heymann and Leijonhufvud (1992) point out, under convertible as well as low inflation RWMS regimes, fiscal authorities possess sufficient

credibility to have liberal access to bond markets -- hence fiscal and monetary policy can be quite independent.

For the high inflation countries, (Table 2, panel f) the fiscal deficit as a share of GNP increases dramatically between the pre World War II and post World War II periods. In the postwar period it increases between regimes, reaching a peak with the float. In contrast to the G-11, the fiscal deficit is quite significant in the Bretton Woods convertible period. A closer correlation between the fiscal deficit, money growth and inflation can be observed across regimes for the high inflation countries, than is the case for the G-11. As Heymann and Leijonhufvud and others have argued, a close connection between fiscal deficits and inflationary finance is a hallmark of the absence of credibility of high inflation random walk monetary regimes.

In summary, the gold standard and convertible Bretton Woods regime exhibited the most stability and closest convergences of financial variables for the G-11 countries. In addition the Bretton Woods convertible regime exhibited the best overall macro performance of any regime. As the summary statistics in Table 1 show, both nominal and real variables were most stable in this period. However, the floating rate regime on most criteria, was not far behind the Bretton Woods convertible regime. On all criteria the Interwar period performed the worst.

These results agree with the views of Leijonhufvud and others that convertibility rules in the past have been associated with superior performance of nominal variables. However, there is little evidence that adherence to such rules has been associated with better real performance as can be seen in a comparison for the G-11, between the recent float and the gold standard.

For the high inflation countries, there is strong evidence linking poor nominal performance with the absence of a link to a convertible regime. Also for at least three countries, real performance deteriorated markedly after the world shifted from Bretton Woods to a floating regime. This suggests, in agreement with Leijonhufvud, that a high inflation Random Walk Money Supply Regime has serious real consequences.

4.2 Inflation Persistence

A second piece of evidence on regime performance is the persistence of inflation. Evidence of persistence in the inflation rate suggests that market agents expect the monetary authorities to continually follow an inflationary policy or alternatively a RWMS regime; its

absence would be consistent with the belief that the authorities are following a stable monetary rule such as the gold standard's convertibility rule. Barsky (1987) presented evidence for the UK and US based on both autocorrelations and time series models that inflation under the gold standard was very nearly a white-noise process, whereas in the post-World War II period, the inflation rate exhibited considerable persistence. Alogoskoufis and Smith (1991) also show, based on AR(1) regressions of the inflation rate, that inflation persistence in the two countries increased between the classical gold standard period and the interwar period and between the interwar period and the post World War II period.²⁸

Table 3 presents the inflation-rate coefficient (from the type of AR(1) regressions on CPI inflation estimated by Alogoskoufis and Smith (1991)), for all 15 countries over successive regimes since 1880,²⁹

as well as the standard errors and the Dickey-Fuller tests for a unit root.³⁰ The results, as in Alogoskoufis and Smith, show an increase in inflation persistence for most G-11 countries between the classical gold standard and the interwar period, and also between the interwar period and the post-World War II period as a whole. Within the post-World War II period, inflation persistence is generally lower, with the exceptions of France, Japan, and Sweden, in the preconvertible Bretton Woods than the convertible period. This suggests that though the immediate post-World War II period was characterized by rapid inflation, market agents may have expected a return to a stable price regime. The higher degree of persistence in the convertible regime suggests this expectation lost credence. Finally, the evidence that persistence was generally highest during the float may imply the public's realization that there was no longer a stable nominal anchor.

For the high inflation countries, the pattern is quite similar to the G-11, with inflation persistence increasing over time and reaching its peak under the post 1973 float. In sum, the evidence on inflation persistence in Table 3 is consistent with Leijonhufvud's (1987a) description of the gradual evolution away from convertible and towards RWMS regimes.

4.3 Forecast Errors in Inflation and Growth

A third piece of evidence relates to the forecast errors of inflation and real output growth. According to Meltzer and Robinson (1989) "a welfare maximizing monetary rule would reduce

variability to the minimum inherent in nature and institutional arrangements." (p. 179). They measure variability by the mean absolute error (MAE) of a one period forecast based on the univariate multi-state Kalman Filter (MSKF). Following their approach, Table 4 presents the MAE's for inflation and real growth for the G-11 countries over successive regimes. The MSKF forecasts incorporate both transitory and permanent shocks to the rate of change series.³¹ According to Leijonhufvud (1984a), inflation forecast errors should increase with time under a RWMS regime. Accordingly, we present the forecast errors for both variables at one, five, and ten year horizons.

The lowest forecast errors at the one year horizon for inflation on average, for the G-11 countries, were for the Bretton Woods convertible period, followed by the gold standard and the floating rate period. The highest were for the interwar period, followed by the preconvertible Bretton Woods period. The most notable exception to the pattern was for the U.K., where the floating rate period exhibited the largest variability. For the high inflation countries, inflation forecast errors were considerably lower in all periods compared to the recent float.

For the G-11 the inflation forecast error increases with time across all regimes but much more so under the recent float -- a pattern predicted by Leijonhufvud's RWMS regime. For the high inflation countries, forecast errors increasing dramatically with time in the postwar period, especially since 1973.

For real growth, as for the inflation rate, the lowest MAE, at the one year horizon on average, for the G-11 occurred in the convertible Bretton Woods period. An exception to this pattern was Japan. The highest MAE was again in the interwar and the preconvertible Bretton Woods period. The floating period, though more variable than the convertible Bretton Woods period was slightly less variable than the gold standard. Like inflation, forecast errors increase with time across all regimes but the most variable regime was the preconvertible Bretton Woods period. For the high inflation countries, like the G-11, real growth forecast errors at the one year horizon were lowest in the Bretton Woods convertible period. At longer time horizons the errors increased but not dramatically as in the case of inflation.

The results for inflation forecast errors are highly consistent with Leijonhufvud's theory. They increase with time at a much greater rate for non convertible monetary regimes. This

pattern is most dramatic for high inflation countries. Although forecast errors in real growth tend to be lowest at the one year horizon during the Bretton Woods convertible regime, there does not appear to be a clear pattern linking real growth uncertainty to the monetary regime.

4.4 Demand and Supply Disturbances

An important issue is the extent to which the performance of alternative monetary regimes as revealed by the data in the preceding tables, reflects the operation of the monetary regime in constraining policy actions or the presence or absence of shocks to the underlying environment. One way to shed light on this issue, following earlier work by Bayoumi and Eichengreen (1992a) (1992b) (1992c) (1992d), is to identify underlying shocks to aggregate supply and demand. According to them, aggregate supply shocks reflect shocks to the environment and are independent of the regime, but aggregate demand shocks likely reflect policy actions and are specific to the regime.

The approach used to calculate aggregate supply and demand shocks is an extension of the bivariate structural vector autoregression (VAR) methodology developed by Blanchard and Quah (1989). Following Bayoumi and Eichengreen (1992a), we estimated a two-variable VAR in the rate of change of the price level and output.³² Restrictions on the VAR identify an aggregate demand disturbance, which is assumed to have only a temporary impact on output and a permanent impact on the price level, and an aggregate supply disturbance, which is assumed to have a permanent impact on both prices and output.³³ Overidentifying restrictions, namely, that demand shocks are positively correlated and supply shocks are negatively correlated with prices, can be tested by examining the impulse response functions to the shocks.

The methodology has important limitations which suggest that the results should be viewed with caution. The key limitation is that one can easily imagine frameworks in which demand shocks have permanent effects on output while supply shocks have only temporary effects.³⁴

We estimated supply (permanent) and demand (temporary) shocks, using annual data for each of the 15 countries, over alternative regimes in the period 1880-1989. The VAR's are based on three separate sets of data (to the extent available): 1880-1913, 1919-1939, and 1946-1989, omitting the war years because complete data on them was only available for a few of the

countries.³⁵ The VARS have two lags. We also did the estimation for aggregated price and output data for the G-11 and the high inflation countries.

Figures 11 and 12 show the impulse responses to a one standard deviation shock in aggregate demand and aggregate supply, on output and prices for the G-11 aggregate and the high inflation countries aggregate, by regime.³⁶ The overidentifying restrictions that demand shocks be positively correlated and supply shocks negatively correlated with the price level are satisfied for the two country grouping aggregates for the post-World War Regimes. But for the period before World War II, for most countries, as reflected in the aggregates shown in figures 11 and 12, they are not. Supply shocks were positively correlated with prices.

Keating and Nye (1991) attempted to explain this result for the earlier periods by possible hysteresis effects. Bayoumi and Eichengreen (1992a) argue that the positive response to favorable aggregate supply shocks may be, in part, due to the operation of the classical gold standard -- as the price level rises, it reduces the relative price of gold and its flow supply. It may also reflect the temporary nature of agricultural supply shocks being treated as demand shocks. These results may also reflect a limitation of the Blanchard-Quah methodology.

Table 5 presents the standard deviations of supply and demand shocks for the 15 countries by regimes. We also present the aggregate of shocks for the G-11 countries and for the four high inflation countries. In addition we show, following Bayoumi and Eichengreen (1992a), the weighted average of the individual country shocks. Figures 13 and 14 show the shocks for the G-11 aggregate, for the high inflation aggregate and for each of the 15 countries.

Table 5 shows for the G-11 aggregate that the convertible Bretton Woods regime was the most tranquil of all the regimes -- neither supply nor demand shocks dominated. However, it was not that much less turbulent than the succeeding float. The interwar period, unsurprisingly, shows the largest supply and demand shocks.³⁷ Sizeable supply and demand shocks which are two or three times greater than the post World War II period also characterize the classical gold standard.³⁸

For individual G-11 countries, the Bretton Woods convertible period was the most stable in eight countries and flexible rates in three. However, the difference between the convertible Bretton Woods period and the float was not great in any country. The interwar period as

expected was the most volatile. Both types of shocks were the largest in every country except the U. K. Finally, in the majority of countries, with the principal exceptions of the U. K., Germany, and the Netherlands both supply, and to a lesser extent demand shocks, were greater in the gold standard period than in the post-World War II period.

For the high inflation countries Argentina is the only one with complete data. For that country in marked contrast to the G-11, demand shocks exceeded supply shocks in all regimes. In the post World War II period, demand shocks vastly exceeded supply shocks, especially under the float. This evidence, to the extent demand shocks capture discretionary policy actions, provides strong support for Leijonhufvud's views on the RWMS regime. For the other high inflation countries in the postwar period, a similar but muted pattern is observed.

The dispersion of demand shocks across countries, as measured by the GNP weighted standard deviation of the individual country shocks around the G-11 aggregate, reveals very little difference between the gold standard and the post World War II regimes, with the convertible Bretton Woods regime displaying the highest degree of convergence. Dispersion is much greater in the interwar period. The dispersion of supply shocks is considerably greater during the gold standard and the interwar periods than in any of the post World War II regimes.

In sum, the evidence on demand and supply shocks complements the preceding evidence on stability, persistence and forecast errors. For the G-11 countries, the gold standard was characterized by higher demand and especially higher supply shocks than the post World War II regimes, and within that period both the convertible Bretton Woods regime and the float are relatively stable.³⁹ By contrast, for the high inflation countries demand shocks greatly exceeded supply shocks across all regimes, and especially under the postwar float. For these countries the constraints of the convertible regime appear to be much weaker than for the G-11, although one could argue that the much greater incidence of supply shocks in those countries may in part account for the greater use of discretionary policy.

4.5 Summary

Leijonhufvud emphasizes important differences between convertible and discretionary monetary regimes. Under convertible regimes the existence of a credible nominal anchor constrains the money supply process, under discretion no such constraint exists. Under a

discretionary regime, inflation uncertainly has serious effects on economic welfare. In this section we present some empirical evidence on the performance of alternative monetary regimes in history. In many aspects the evidence is consistent with Leijonhufvud's views.

First, under two convertible regimes, the classical gold standard and the convertible Bretton Woods regime, we observe, for both industrialized and less developed high inflation countries, greater stability of nominal variables -- the inflation rate, nominal interest rates and nominal exchange rates -- than under regimes characterized by loose convertibility or outright discretion.

Second, we observe lower inflation persistence under convertible regimes -- evidence for the credibility of commitment to maintain the nominal anchor.

Third, the forecast errors of inflation and of real growth tend to be lowest during the convertible Bretton Woods regime. Also, forecast errors of inflation increase with time at a much greater rate under discretionary than under convertible regimes, as Leijonhufvud predicted. This result is most evident for the high inflation countries since World War II.

Fourth, the evidence on real variables is less transparent. There is no clear pattern for the G-11 countries showing that real variables perform worse under discretion or loose convertibility than under tight convertibility. For the high inflation countries, however, this is not the case since 1973. (See Heymann and Leijonhufvud, 1992).

Fifth, the evidence on demand and supply shocks for the G-11 countries suggests that it is unlikely that the convertible regimes prevailed because of the absence of supply shocks, since the size of demand and supply shocks were quite similar across both types of regimes. The durability or fragility of past convertible regimes likely had more to do with regime design (Bordo, 1993b). For the high inflation countries demand shocks far exceeded supply shocks across all regimes -- evidence for the operation of a discretionary regime, although supply shocks for these countries also were much larger than for the G-11. Greater supply shocks, in addition to traditionally higher fiscal deficits, may account for the greater prevalence in those countries of Random Walk Money Supply Regimes.

5. Conclusion

Axel Leijonhufvud has made important contributions to our understanding of the relationship between the money supply process and inflation. These include his emphasis on the concept of a monetary regime as incorporating both monetary institutions and their link to the public's expectations; a reassessment of the costs of inflation; and new proposals for monetary reform.

Understanding the monetary regime for Leijonhufvud is crucial to understanding how alternative monetary strategies will impinge on both nominal and real activity. His analysis, by emphasizing expectations, expands on the earlier concept of a monetary standard, which referred simply to the institutions and arrangements governing the money supply. The distinction made between constitutional and discretionary regimes represents a useful way of dichotomizing monetary regimes in history. The world evolved from a tight convertibility based constitutional regime to a looser regime and then ultimately to a regime of pure discretion -- the Random Walk Monetary Standard (RWMS). The distinction between constitutional regimes and (RWMS) operationalizes the earlier distinction made by Kydland and Prescott (1977) between rules and discretion which emphasizes the importance of credible rules in preventing monetary authorities from following time inconsistent policies.

The concept of RWMS also adds insights to our understanding of the costs of inflation. The essence of the RWMS regime, because it is based on purely discretionary actions, is that it creates inflation uncertainty. Inflation uncertainty -- which under the RWMS increases with time -- in turn has the serious real consequence of distorting resource allocation. These costs, under conditions of high inflation, far outweigh the traditional neoclassical welfare losses of expected inflation.

Finally, to restore price stability and eliminate the RWMS, Leijonhufvud has advocated a number of proposals for reform. For low to moderate inflation he has suggested two schemes: a possible return to a commodity based convertibility rule; and the Peel-Friedman rule. The latter would combine the rule characteristics of a constant monetary growth rate with some flexibility to allow monetary authorities to deal with unexpected contingencies, without disturbing the expectations of the constitutional regime. For high inflation countries, he proposed the Blueback Scheme -- issuing a parallel currency to appreciate in step with the expected depreciation of the

existing currency -- as a way of easing the transition to price stability. This scheme would operate in combination with an orthodox reform package of restoring budget balance and nominal exchange rate anchoring. Argentina incorporated bluebacking in its short-lived 1985 Austral Plan. Had it also followed the other prescriptions for reform and been part of a true regime shift as may have occurred with the convertibility plan of 1991, Leijonhufvud's proposal would have likely been successful. We suggest that the use of monetary institutions that are sharply isolated from domestic political pressure such as a currency board, would be more successful than a central bank in reducing high inflation in the short run and maintaining in the long run, a low rate in countries with inflationary histories. Inflation is a political phenomenon. To eliminate inflation after long periods of rapidly rising prices it is most promising to make fundamental changes in the monetary institutional framework, that is to create a new monetary regime.

In Section 4 of the paper we present a body of empirical evidence on regime performance in history which is very sympathetic to the distinctions made in Leijonhufvud's writings between types of regimes and their characteristics. We examine annual data for over a century for 15 countries divided into industrial and high inflation economies. Our classification of historical regimes: the gold standard; interwar; Bretton Woods pre-convertible; Bretton Woods convertible and floating; corresponds roughly to his distinction between convertibility based regimes (the gold standard and Bretton Woods convertible); loose convertibility (Interwar, Bretton Woods preconvertible) and discretion or RWMS (the floating regime).

We find, as Leijonhufvud predicted, that inflation and other nominal variables (interest rates and nominal exchange rates) are more variable in loose convertible and discretionary regimes than under tight convertibility regimes. Also they are more tightly integrated across countries, as predicted by traditional open economy macro theory. In addition, inflation persistence is lower under the gold standard than subsequent looser regimes -- evidence consistent with Leijonhufvud's classification of regimes. Moreover, in strong support of Leijonhufvud, inflation forecast errors are greater under loose convertibility and discretion than tight convertibility and they increase most rapidly with the time horizon under the recent float. Also, in line with Leijonhufvud's work, we find little correlation between the budget deficit and inflation for the G-11 countries but a visible one for the high inflation countries. Finally, for the

industrialized countries, since little difference between demand (policy induced) and supply (environment induced) shocks were detected, regime performance can not be accounted for by the presence or absence of supply shocks. However, for the high inflation countries, the response to larger supply shocks than in the G-11 may, along with higher fiscal deficits, explain the very high demand shocks which were detected in all regimes.

Finally, with respect to real performance, little evidence was detected for the G-11, linking it to the nature of the regime. But for high inflation countries, as Leijonhufvud predicted, we observe the shift from a convertibility influenced regime to high inflation in the 1970s to be associated with a decline in economic growth.

In summary, Leijonhufvud's writings on monetary regimes provide a highly useful perspective for students of economics and economic history; his views on inflation suggest fruitful topics for empirical research and his proposals for monetary reform are of great value to policy makers.

Endnotes

* For excellent research assistance we would like to thank Jakob Koenes, Joe Santos and Alex Hohmann. Helpful comments on an earlier draft were provided by conference participants, Barry Eichengreen and Julio Santaella.

1. Also see Leijonhufvud (1986, 1987a, 1987b).
2. Also see Grossman and Van Huyck, (1988); Flood and Isard, (1989); DeKock and Grilli, (1993); Bordo and Kydland, (1992).
3. See Redish (1993) for a discussion of the tension between maintaining the credibility of the gold convertibility nominal anchor and national monetary sovereignty.
4. For a discussion of the history and the problems of the Bretton Woods system see Bordo (1993a).
5. For a discussion of the 'rules of the game' of the Bretton Woods system see McKinnon (1993).
6. For a recent defense of the neoclassical theory see Lucas (1993).
7. Both of these proposals were actually adopted as guidelines for Swedish monetary policy. See Jonung (1979).
8. However it is still possible to get inflation under a currency board system in the case of rapid growth in the volume of foreign reserves backing the currency board. But the constitution of the currency board could be written as to minimize the risk of inflation in the volume of reserves. See Hanke, Jonung and Schuler (1993).
9. See also Bruno (1993).
10. See for example the surveys by Bruno (1993), Paldam (1993) and Vegh (1992). As a rule the output loss of a stabilization program to eliminate a hyperinflation is smaller than the loss of reducing chronic or even rapid inflation.
11. See Hanke, Jonung and Schuler (1993) and Hanke and Schuler (forthcoming) on various techniques to insulate a currency board from external pressure.
12. However, the common world price level under the gold standard exhibited secular periods of deflation and inflation reflecting shocks to the demand for and supply of gold (Bordo, 1981; Rockoff, 1984). A well-designed monetary rule, it is argued, could have avoided the long-run swings that characterized the price level under the gold standard (Cagan, 1984).

13. The approach taken below follows that taken in Bordo (1993a and 1993b) which focuses on regime performance for the G-7 countries.

14. We also examined the period (1946-1973) which includes the three years of transition from the Bretton Woods adjustable peg to the present floating regime. The results are similar to those of the 1946-1970 period.

15. For the performance of Latin American countries during the classical gold standard see Fishlow (1987) and Eichengreen (1992a) and for the performance of all four countries during Bretton Woods see Edwards and Santaella (1993).

16. To be more exact, the U.S. stayed on gold until 1933 and France until 1936. For a detailed comparison of the performances of these three regimes in the interwar period, see Eichengreen (1992a).

17. Within the G-11 Canada floated from 1950 to 1961.

18. This is a very crude measure of convergence or divergence between the different countries' summary statistics. Because it is based on the average for the whole period, it suppresses unusual movements within particular subperiods. Bayoumi and Eichengreen (1992d) presented an alternative measure of convergence of dispersion--the GDP-weight standard deviation of the individual country series around the G-7 aggregate. Bordo (1993a) calculated this alternative measure of convergence for the G-7 countries. The results are very close to those reported here for virtually every variable.

19. The data sources for Figure 1 and all subsequent figures are listed in the Data Appendix.

20. For similar evidence see Bordo (1981), Darby, Lothian et.al. (1983) and Darby, Lothian (1989).

21. According to Edwards and Santaella (1993), the IMF had limited success during the Bretton Woods period in using access to its reserves as a weapon to constrain inflationary excesses in a number of developing countries.

22. Baxter and Stockman (1989) and Eichengreen (1992b) use residuals from a linear trend to the logarithm of real output as a detrending filter rather than the logarithmic first difference used here. According to their results, real output variability is not greater in the floating than in the fixed period.

23. However, using their alternative measure of convergence -- the GDP-weighted standard deviation of the individual country series around the G-7 aggregate -- Bayoumi and Eichengreen (1992a) report that the lowest degree of dispersion of real GDP growth was in the floating rate period, followed by the Bretton Woods convertible period. Similar results hold for the real GNP per capita data in Table 1. For Bayoumi and Eichengreen (1992a) the decline in the dispersion of real growth and the rise in the dispersion of inflation rates between the Bretton Woods convertible period and the float have the following explanations: the move to flexible rates allowed

countries to stabilize their relative growth rates in the face of asymmetric supply shocks at the expense of their relative inflation rates. They also report that, when they apply the linear trend filter of Baxter and Stockman (1989), evidence of a rise in the cross country correlation between output movements after 1970 is considerably reduced.

24. Define the real interest rate as $r_t = i_t - \Delta \log P_t$; where i_t is the nominal interest rate and $\Delta \log P_t = \log P_t - \log P_{t-1}$ is the percentage change in the consumer price index.

25. Also see Dornbusch (1976).

26. Stockman (1983, 1988) argues that greater variability in real exchange rates under floating rates than under fixed rates reflects the response of real exchange rates to productivity shocks, with changes in the real exchange rate producing nominal exchange rate volatility. This volatility is offset under fixed rates by exchange market intervention.

27. Meltzer (1990) in a comparison of EMS and non-EMS countries in the floating rate period also finds a strong correlation between changes in nominal and real exchange rates.

28. Also see Alogoskoufis (1992), who attributes the increase in persistence to the accommodation by the monetary authorities of shocks. This evidence is also consistent with the results of Klein (1975).

29. Regression run was $\Delta \log P_t = B_0 + B_1 \Delta \log P_{t-1} + \epsilon_t$. We ran the same regression for the GNP deflators, with similar results.

30. Eichengreen (1992b) also presents these statistics for four of the countries.

31. Meltzer and Robinson (1989) present their results for levels, growth rates, and permanent growth rates of the series. We present only growth rates to make the results comparable to those in Table 1.

32. Both variables were rendered stationary by first differencing.

33. Specifically, four restrictions are placed on the matrix of the shocks: two are simple normalizations, which define the variances of the shocks to aggregate demand and aggregate supply; the third assumes that demand and supply shocks are orthogonal; the fourth is that demand shocks have only temporary effects on output, i.e., that the cumulative effect of demand shocks on the rate of change in output must be zero.

34. See Keating and Nye (1991).

35. We omit entries for Brazil in the floating period because for that country it was not possible to find a stable solution to the impulse response function needed to calculate the shocks.

36. The impulse response functions were calculated from VAR's run for the separate regime periods. Because the number of observations was limited, the Bretton Woods regime could not be split into the two subperiods shown in preceding tables.

37. The results for the G-11 in the interwar period figures are similar to those reported for the U.S. by Cecchetti and Karras (1992), who estimate a three-variable VAR with monthly data. The late 1920's and early 1930's reveal a major negative demand shock consistent with Friedman and Schwartz's (1963) attribution of the onset of the Great Depression to monetary forces. After 1931, negative supply shocks predominate, consistent with Bernanke's (1983) and Bernanke and James (1991) explanation for the severity of the Great Depression that stresses the collapse of the financial system.

38. Though the shocks are smaller, the rankings by regime for the weighted average of individual country shocks are similar to the G-11 aggregate.

39. These results are very similar to those presented for the G-7 in Bordo (1993b) and by Eichengreen and Bayoumi (1992a).

References

- Alogoskoufis, George S. and Ronald Smith. 1991. "The Phillips Curve, the Persistence of Inflation and the Lucas Critique: Evidence from Exchange-Rate Regimes." *American Economic Review*, Vol. 81, No. 2, pp. 1254-1273.
- Alogoskoufis, George S. 1992. "Monetary Accommodation, Exchange Rate Regimes and Inflation Persistence." *Economic Journal* 2 May. pp. 461-480.
- Barro, Robert J. and David B. Gordon. 1983. "Rules, Discretion and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics* 12, pp. 101-121.
- Barsky, Robert B. 1987. "The Fisher Hypothesis and the Forecastability and Persistence of Inflation." *Journal of Monetary Economics* 19, No.1 January. pp. 3-24.
- Baxter, Marianne and Alan C. Stockman. 1989. "Business Cycles and the Exchange-Rate Regime: Some International Evidence." *Journal of Monetary Economics* 23 May, pp. 377-400.
- Bayoumi, Tamin and Barry Eichengreen. 1992a. "Economic Performance Under Alternative Exchange Rate Regimes: Some Historical Evidence." University of California at Berkeley. (Mimeo) July.
- Bayoumi, Tamin and Barry Eichengreen. 1992b. "Shocking Aspects of European Monetary Unification." NBER Working Paper No. 3949. January.
- Bayoumi, Tamin and Barry Eichengreen. 1992c. "Is There a Conflict Between EC Enlargement and European Monetary Unification?" NBER Working Paper No. 3950. January.
- Bayoumi, Tamin and Barry Eichengreen. 1992d. "Monetary and Exchange Rate Arrangements for NAFTA." University of California at Berkeley. Mimeo. April.
- Bernanke, Benjamin. 1983. "Non Monetary Effects of the Financial Crisis in the Propagation of the Great Depression." *American Economic Review*. 73, pp. 259-76.
- Bernanke, Benjamin and Harold James. 1991. "The Gold Standard, Deflation and Financial Crisis in the Great Depression: An International Comparison" In *Financial Markets and Financial Crisis* ed. R. Glenn Hubbard, Chicago: University of Chicago Press. pp. 33-68.

- Blanchard, Olivier and Danny Quah. 1989. "The Dynamic Effects of Aggregate Demand and Aggregate Supply Disturbances." *American Economic Review*. 1979. September, pp. 655-73.
- Bordo, Michael D. 1981. "The Classical Gold Standard: Some Lessons for Today." *Federal Reserve Bank of St. Louis Review*. 63 May, pp. 2-17.
- Bordo, Michael D. 1984. "The Gold Standard: The Traditional Approach." In Michael D. Bordo and Anna J. Schwartz (eds) *A Retrospective on the Classical Gold Standard, 1821-1931*. Chicago: University of Chicago Press.
- Bordo, Michael D. and Anna J. Schwartz. 1989a. "Transmission of Real and Monetary Disturbances Under Fixed and Floating Rates." *Dollars, Deficits and Trade*. (eds) James A. Dorn and William A. Niskanen. 237-258. Boston: Kluwer Academic Publishers.
- Bordo, Michael D. and Finn E. Kydland. 1992. "The Gold Standard As a Rule." Federal Reserve Bank of Cleveland. Working Paper No. 9205. March.
- Bordo, Michael D. 1993a. "The Bretton Woods International Monetary System: A Historical Overview." In Michael D. Bordo and Barry Eichengreen (eds) *A Retrospective on the Bretton Woods System: Lessons for International Monetary Reform*. Chicago: University of Chicago Press.
- Bordo, Michael D. 1993b. "The Gold Standard, Bretton Woods and Other Monetary Regimes: A Historical Appraisal." *Federal Reserve Bank of St. Louis Review*, Vol. 75, No. 2, March/April, pp. 123-191.
- Bruno, Michael. 1993. *Crisis, Stabilization and Economic Reform*. Oxford University Press. London.
- Cagan, Philip. 1984. On the "Report of the Gold Commission 1982 and Convertible Monetary Systems." *Carnegie Rochester Conference Series on Public Policy*. 21 Autumn.
- Cecchetti, Stephen G. and Georgios Karras. 1992. "Sources of Output Fluctuations During the Interwar Period: Further Evidence on the Causes of the Great Depression." NBER Working Paper No. 4049. April.
- Cukierman, Alex. 1992. *Central Bank Strategy, Credibility, and Independence: Theory and Evidence*. Cambridge: Massachusetts Institute of Technology Press.

- Darby, Michael R. and James R. Lothian et. al. 1983. *The International Transmission of Inflation*. Chicago: University of Chicago Press.
- Darby, Michael R. and James R. Lothian. 1989. "The International Transmission of Inflation Afloat." In *Monetary, History, and International Finance: Essays in Honor of Anna J. Schwartz*. (ed) Michael D. Bordo. Chicago: University of Chicago Press. pp. 203-236.
- DeKock, Gabriel and Vittorio Grilli. 1992. "Fiscal Policies and the Choice of Exchange Rate Regime." CEPR Discussion Paper No. 631. March.
- Dornbusch, Rudiger. 1976. "Expectations and Exchange Rate Dynamics." *Journal of Political Economy*. 84, pp. 1161-76.
- Eichengreen, Barry. 1992. "Trends and Cycles in Foreign Lending." In Horst Siebert ed. *Capital Flows in the World Economy*. Kiel: *World Institute of World Economics*, pp.3-28.
- Eichengreen, Barry. 1992a. "The Gold Standard Since Alex Ford." In S.N. Broadberry and N.F.R. Crafts. (eds) *Britain in the International Economy 1870-1939*. Cambridge: Cambridge University Press. pp. 49-79.
- Eichengreen, Barry. 1992b. "History of the International Monetary System: Implications for Research in International Macroeconomics and Finance." In Frederick van der Ploeg. (ed) *Handbook of International Macroeconomics*. Oxford: Blackwell (forthcoming).
- Eichengreen, Barry. 1993. "Three Perspectives on the Bretton Woods System." In *A Retrospective on the Bretton Woods System*. eds. Michael. D. Bordo and Barry Eichengreen. Chicago. University of Chicago Press and NBER (forthcoming).
- Edwards, Sebastian and Julio Santaella. 1993. "Devaluation Controversies in the Developing Countries: Lessons from the Bretton Woods Era." In Michael D. Bordo and Barry Eichengreen (eds) *A Retrospective on the Bretton Woods System: Lessons for International Monetary Reforms*. Chicago: University of Chicago Press. pp. 405-455.
- Fishlow, Albert. 1987. "Market Forces or Group Interests: Inconvertible Currency in Pre-1914 Latin America." University of California at Berkeley.
- Flood, Robert P. and Peter Isard. 1989. "Monetary Policy Strategies." *IMF Staff Papers* 36:612-632.

- Friedman, Milton. 1960. *A Program for Monetary Stability*. New York. Fordham University Press.
- Friedman, Milton and Schwartz, Anna J. 1963. *A Monetary History of the United States, 1867-1960*. Princeton: Princeton University Press.
- Giavazzi, Francesco and Marc Pagano. 1988. "The Advantage of Tying One's Hands: EMS Discipline and Central Bank Credibility." *European Economic Review*. 32, pp. 1055-1082.
- Giovannini, Alberto. 1993. "Bretton Woods and Its Precursors: Rules Versus Discretion in the History of International Monetary Regimes." In *A Retrospective on the Bretton Woods System*. (eds.) Michael D. Bordo and Barry Eichengreen. Chicago. University of Chicago Press.
- Grossman, Herschel J. and John B. Van Huyck. (1988). "Sovereign Debt as a Contingent Claim: Excusable Default, Repudiation, and Reputation." *American Economic Review*. 78: 1088-1097.
- Grilli, Vittorio and Graciella Kaminsky. 1991. "Nominal Exchange Rate Regimes and the Real Exchange Rate: Evidence from the United States and Great Britain, 1885-1986." *Journal of Monetary Economics*. 29 April:191-212.
- Hall, Robert E. 1982. "Explorations in the Gold Standard and Related Policies for Stabilizing the Dollar." In Robert E. Hall (ed) *Inflation: Causes and Effects*. Chicago: University of Chicago Press. pp. 111-122.
- Hanke, Steve H. and Schuler, Kurt. 1991. *Banco Central o Caja de Conversión?*, Fundacion Republica, Buenos Aires.
- Hanke, Steve H., Jonung, Lars and Schuler, Kurt. 1992. *Monetary Reform for a Free Estonia*, SNS, Stockholm.
- Hanke, Steve H., Jonung, Lars and Schuler, Kurt. 1993. *Russian Currency and Finance. A Currency Board Approach to Finance*. Routledge: London and New York.
- Heymann, Daniel. 1987. "The Austral Plan." *American Economic Review*, Vol. 77, No. 2, pp. 284-287.

- Heymann, Daniel. 1991. "From Sharp Disinflation to Hyperinflation, Twice: The Argentine Experience, 1985-1989." In Michael Bruno, Stanley Fischer, Elhanon Helpman, and Nissan Liviatan (eds) *Lessons of Economic Stabilization and its Aftermath*. Cambridge: Massachusetts Institute of Technology Press.
- Heymann, Daniel and Leijonhufvud, Axel. 1992. "High Inflation." UCLA. Mimeo. September.
- Jonung, Lars. 1979. "Knut Wicksell's Norm of Monetary Policy in the 1930s." *Journal of Monetary Economics*, Vol. 5, No. 4, October, pp. 459-496.
- Keating, John W. and John V. Nye. 1991. "Permanent and Transitory Shocks in Real Output: Estimates from Nineteenth Century and Postwar Economies." St. Louis: Washington University Working Paper No. 160. July.
- Klein, Benjamin. 1975. "Our New Monetary Standard: Measurement and Effects of Price Uncertainty, 1880-1973." *Economic Inquiry*. 13, pp. 461-484.
- Kydland, Finn E. and Prescott, Edward. 1977. "Rules Rather than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy*. 85, pp. 473-491.
- Leijonhufvud, Axel. 1984a. "Constitutional Constraints on the Monetary Powers of Government." In Richard B. McKenzie (ed) *Constitutional Economics*. Lexington, Mass: Lexington Books, pp. 95-107.
- Leijonhufvud, Axel. 1984b. "Inflation and Economic Performance." In Barry N. Siegel (ed) *Money in Crisis: The Federal Reserve, the Economy and Monetary Reform*. Cambridge, Massachusetts. Ballinger Publishing Company. pp. 19-36.
- Leijonhufvud, Axel. 1986. "Rules With Some Discretion." In Colin D. Campbell and William R. Dougan (eds) *Alternative Monetary Regimes*. Baltimore: Johns Hopkins Press. pp. 38-43.
- Leijonhufvud, Axel. 1987a. "Rational Expectations and Monetary Institutions." In *Monetary Theory and Economic Institutions: Proceedings of a Conference held by the International Economic Association at Fiesole, Florence, Italy*. New York. St. Martin's Press, pp. 44-65.

- Leijonhufvud, Axel. 1987b. "Constitutional Constraints on the Monetary Powers of Government." In James A. Dorn and Anna J. Schwartz. (eds.) *The Search for Stable Money: Essays on Monetary Reform*. Chicago: University of Chicago Press. pp. 129-142.
- Leijonhufvud, Axel. 1988. "Foreword" to Thomas D. Willet. (ed). *Political Business Cycles: The Political Economy of Money, Inflation and Unemployment*, Pacific Research Institute for Public Policy. Durham. Duke University Press. pp. xv-xxii.
- Leijonhufvud, Axel. 1990. "Monetary Policy and the Business Cycle Under Loose Convertibility." *Greek Economic Review*. Vol. 12, Supplement, pp. 133-151.
- Leijonhufvud, Axel. 1992. "High Inflation and Contemporary Monetary Theory." *Economic Notes by Monte dei Paschi di Siena*. Vol. 21, No. 2, pp. 211-224.
- Levin, Andrew. 1993. "Exchange Rate Convertibility and Relative Price Adjustment in Argentina, 1991-1993." International Finance Division. Federal Reserve Board of Governors. Washington, DC. Mimeo. May.
- Lucas, Robert E., Jr. 1993. "On the Welfare Cost of Inflation." University of Chicago. Mimeo.
- McKinnon, Ronald I. 1988. "An International Gold Standard Without Gold." *Cato Journal*. 8 Fall, pp. 351-373.
- McKinnon, Ronald I. 1993. "International Money in Historical Perspective". *Journal of Economic Literature*. Vol. xxxi, No. 1, March, pp. 1-44.
- Meltzer, Allan H. 1990. "Some Empirical Findings on Differences Between EMS and non-EMS Regimes: Implications for Currency Blocs." *Cato Journal*. 10 November, pp. 455-483.
- Meltzer, Allan H. and Saranna Robinson. 1989. "Stability Under the Gold Standard in Practice." In *Monetary, History and International Finance: Essays in Honor of Anna J. Schwartz*. (ed) Michael D. Bordo. Chicago: University of Chicago Press. pp.163-195.
- Mussa, Michael. 1986. "Nominal Exchange Rates and the Behavior of Real Exchange Rates: Evidence and Implications." *Carnegie Rochester Conference Series on Public Policy*. 25, pp. 117-214.
- Osband, K. and Villanueva. 1992. "Independent Currency Authorities: An Analytic Primer," IMF Working Paper. July.

- Paldam, M. 1993. "The Political Economy of Stopping High Inflation." Mimeo. Institute of Economics, Århus, Denmark.
- Redish, Angela. 1993. "Anchors Away: The Transition from Commodity Money to Fiat Money in Western Economies." Innis Lecture at the Canadian Economics Association Annual Meetings. Ottawa. June.
- Rockoff, Hugh. 1984. "Some Evidence on the Real Price of Gold, Its Cost of Production, and Commodity Prices." In Michael D. Bordo and Anna J. Schwartz eds. *A Retrospective on the Classical Gold Standard, 1821-1931*. Chicago: University of Chicago Press.
- Rostowski, J. and Shapiro, J. 1992. "Secondary Currencies in the Russian Hyperinflation and Stabilization of 1921-1924." Discussion Paper No. 59. Centre for Economic Performance, London.
- Santaella, J.A. 1993. "Stabilization Programs and External Enforcement: Experience from the 1920s," IMF Working Paper. January.
- Sargent, Thomas J. 1982. "The Ends of Four Big Inflations." In Robert E. Hall (ed) *Inflation: Causes and Effects*. Chicago: University of Chicago Press. pp. 41-97.
- Schwartz, Anna J. 1984. Introduction. In Michael D. Bordo and Anna J. Schwartz eds. *A Retrospective on the Classical Gold Standard, 1821-1931*. Chicago: University of Chicago Press.
- Schwartz, Anna J. 1993. "Currency Boards - Their Past, Present, and Possible Future Role." *Carnegie-Rochester Conference Series on Public Policy* Vol 39, December: pp. 147-187.
- Siklos, Pierre. 1993. "Tales of Parallel Currencies: The Early Soviet Experience." (Mimeo) Wilfred Laurier University. May.
- Stockman, Alan C. 1983. "Real Exchange Rates Under Alternative Nominal Exchange Rate System." *Journal of International Money and Finance*. 2 August, pp. 147-166.
- Stockman, Alan C. 1988. "Real Exchange-Rate Variability Under Pegged and Floating Nominal Exchange-Rate Systems: An Equilibrium Theory." *Carnegie Rochester Conference Series on Public Policy*. 29 Autumn, pp. 259-294.
- Svensson, Lars. 1993. "The Simplest Test of Inflation Target Credibility." NBER Working Paper No. 4604. December.

Vegh, Carlos. 1992. "Stopping High Inflation: An Analytical Overview." *IMF Staff Papers*, Vol. 39, No. 3, September, pp. 621-695.

Wood, Geoffrey. 1994. "Central Bank Independence in New Zealand: Analytical, Empirical and Institutional Aspects." City University of London Business School (Mimeo).