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

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9 Monetary Regimes, Inflation and Monetary Reform:

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INTRODUCTION

Since the late 1970s Axel Leijonhufvud has written extensively on monetary regimes and their connection with 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 policy 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.

A number of useful taxonomies for the study of different monetary regimes in history have been created by Leijonhufvud, based on their ability to conform to constitutional rules; by their form of monetary control – monetary aggregate control versus the convertibility principle; and by their 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 characterised 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

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costs elucidated include: excessive relative price variability with 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.

Leijonhufvud has made a number of proposals for monetary reform to restore inflationary monetary regimes to price stability. For the low to moderate inflation regimes that have characterised the industrialised 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; and 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 stabilisation 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 programme in its 1991 stabilisation.

This paper discusses Leijonhufvud's writings on monetary regimes and inflation in the second section. The third section considers his various proposals for monetary reform and compares them to alternatives, including recent proposals for currency boards. A brief discussion of the recent stabilisation experiences of a number of countries highlights the main points. The fourth section examines evidence for fifteen countries (G-10 plus Switzerland and four high-inflation countries) since 1880, with respect to their 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. In conclusion, the last section presents a brief appraisal of Leijonhufvud's contribution to the analysis of monetary regimes and inflation.

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 of 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 incorporating expectations, a 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 policy-makers' underlying model and likely policies consistent with that model. Policy-makers 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 and 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 choice 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 stabilisation policies, to produce an inflationary outcome. In the discretionary regime, once the monetary authority has announced a given rate of money growth, which the public expects it to validate, the authority then has an incentive to create a monetary surprise either to reduce unemployment or to reduce 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, for example, 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 suspend temporarily the rule (gold convertibility) and use seigniorage to finance its expenditure. The rule is contingent in the sense that the public understands that the suspension will only last for the duration of the emer-

gency 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, for example, 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 on the quantity principle and the convertibility principle respectively (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 the national 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 level 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 influence temporarily *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 characterised 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 inflation 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 raise revenues successfully 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 (Heymann and Leijonhufvud, 1995, ch. 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 where economic activity is affected seriously. At this point the regime becomes unreliable. Only a drastic monetary reform returning the system to a more transparent, rules-based regime can prevent it from drifting towards the chaos of hyperinflation.

The History of Monetary Regimes

The history of monetary regimes since the 1880s 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, 1987b, pp. 60–2; 1990, pp. 142–4). 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 of 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 was the consequence of a number of financial developments including the substitution of fiduciary money for coin by the private sector to economise 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 twentieth 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 First World War 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 used the pound and the dollar extensively as international reserves. The system only lasted for six years, from 1925 to 1931. It foundered because holdings of reserve currencies had expanded relative to the stock of monetary gold, so the convertibility commitment lost credibility. Gold maldistribution and perverse sterilisation 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 regime requiring quality control. The Bretton Wood system (1946–71) he views as a regime based on control of the quantity of high-powered dollars, but one that the US monetary authorities operated for some twenty years to mimic a system 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 USA 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 USA, as key reserve centre, the balance of payments was not a binding constraint on money issue. According to Leijonhufvud, although the USA 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 stabilisation 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.

The Real Effects of Alternative Monetary Regimes

Leijonhufvud (1987a and b, 1988); Heymann and Leijonhufvud (1995) criticises the standard neoclassical theory of expected inflation for trivalising 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 per cent inflation rate for ever is the loss of consumer surplus under the demand for money. Against this cost is 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 expectation-generating mechanism can lead to a clearer understanding of the causes of inflation. Under the RWMS 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, and this, in turn, 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 dollarised; rents and wages are indexed; and wholesale and retail markets for consumer goods use domestic currency (Leijonhufvud, 1992, p. 217; Heymann and Leijonhufvud, 1995, ch. 5). 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.

PROPOSALS FOR MONETARY REFORMS

Axel Leijonhufvud has made a number of proposals to reform the monetary regimes of both low- and high-inflation countries. In addition, we compare his proposals with some alternatives and then examine actual experience with stabilisation programmes.

Low Inflation

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

The Peel's Act–Friedman rule

Leijonhufvud's suggestion for a constitutional amendment to move the USA 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 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 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 stabilisation 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 stabilisation department would act like the banking department of the Bank of England. It would engage in short-run stabilisation policy. The reserves required for the stabilisation department to conduct its policies would be provided by setting the base initially some 10/15/20 per cent higher than the actual base before putting into practice 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 would be anchored by the Friedman rule, market agents would follow mean-reverting price expectations and not view the policies of the stabilisation department as a form of RWMS.

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 Hall (1982)) and then let the private sector determine the monetary aggregate endogenously.

Bluebacking

Leijonhufvud has proposed a method for abrupt disinflation that avoids both the traditional output and employment costs and the usual redistributions and bankruptcies resulting from 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; Heymann and Leijonhufvud, 1995, ch. 3). For example, if the anticipated rate of inflation in greenbacks is 15 per cent per year and we start with the two types of currency trading at par, from then onwards 'bluebacks grow constantly in their legal capacity to extinguish debts contracted in greenbacks' (Leijonhufvud, 1984b, p. 21), and after one year 85 blueback cents would pay off a one greenback dollar debt; after two years it would take 71 blueback cents, and so on.

If expectations are rational, zero inflation would be achieved quickly 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.

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 1980s for the exchange rate mechanism (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 been demonstrated most recently by the breakdown in 1992–3 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*-per cent rule, and various proposals to target GNP growth as well as recommendations to stabilise the growth of the monetary base. In an earlier era, two proposals made were: Knut Wicksell's norm of price stabilisation of 1898, and David Davidson's norm where the price level should fall in proportion to the increase in productivity.[7]

Judging from the historical record, a fundamental weakness with all these plans to create low and stable inflation, including Leijonhufvud's proposals, is that they do not contain a mechanism that creates sufficient credibility. As long as money is produced by a government-controlled monopolist, 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 (Cukierman, 1992), and this has seemingly been successful in New Zealand (Svensson (1993), 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 on demand into the reserve currency at a fixed exchange rate. 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.

Currency boards were common from the nineteenth century until the post-Second World War period. About 50–60 boards were operating in various European colonies in Africa, Asia and the Caribbean (Schwartz (1993), Hanke *et al.* (1993)). When these former colonies obtained independence, commonly one of their first steps was to set up a central bank. Eventually, most of these former colonies experienced high inflation, with the principal exception of those such as 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 likely to remain so in the foreseeable future. However, because currency

boards require a country to give up its monetary sovereignty completely and because they do not have a provision for a lender of last resort, a country seeking an anti-inflation plan may not find this to be a palatable solution.

HIGH INFLATION

To extricate economies from high inflation RWMS regimes, Heymann and Leijonhufvud (1995, ch. 6) 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 rationalising the budgetary process will remove the imperative for monetisation 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.

Recent Stabilisation Plans

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

The Austral Plan

Argentina has instituted five plans since the 1970s to deal with an extremely serious high inflation problem – from 1980 to 1990 consumer prices increased on average by 300 per cent 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 cent per month and the fiscal deficit at above 15 per cent of GDP. The plan aimed at rapid disinflation to break inflationary expectations (Heymann, 1987 and 1991).

The plan contained three elements. First, the central bank would no longer finance the fiscal deficit. It was hoped that the reduction in inflation (through the Tanzi effect), 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 austral appreciate relative to the peso.

Initially, the plan was successful. Inflation fell to 3 per cent 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 cent 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 plan was introduced. In other words, the monetary regime remained unchanged. Hence there was little reason for the Argentina public to revise its expectations about the future long-run behaviour of inflation. Inflation was expected to return to a high chronic level and eventually it did so.

The Convertibility Law of April 1991

The Menem Administration, which entered office in June 1989, faced a legacy of hyperinflation (greater than 20 per cent per month), a high fiscal deficit (11 per cent of GDP) and declining real output. In the following year, it enacted a number of important reforms to reduce the fiscal deficit. These included: simplification of the tax structure; reduced government expenditure; and privatisation of state-owned enterprises. These initiatives succeeded in reducing the deficit to 1.8 per cent 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 1 April 1991. The Convertibility Law established full convertibility of the Argentine currency at the rate of 10 000 australs per US dollar. It required the monetary base to 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 1 January 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.

Initially, the plan was highly successful. Within a year, inflation was reduced to less than 20 per cent. This plan is regarded by observers as more credible than earlier stabilisation plans because of 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 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 domestically-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 rebuffed successfully in November 1992. Given Argentina's history of hyperinflation, devaluation may harm seriously 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.

Other Stabilisation Experiences

A number of countries have suffered from extremely high inflation in recent decades and as a consequence experimented with various stabilisation programmes. Vegh (1992) surveys the experience of ten stabilisation programs in six high inflation countries (Argentina, Brazil, Chile, Israel, Mexico and Uruguay) since the 1960s, as well as stabilisation programs in hyperinflation countries.[8] Two types of programmes in high inflation countries are distinguished: heterodox stabilisations that rely on nominal exchange rate anchoring and incomes policies; and 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 inflationary consequences described above.

By comparison, stabilisation in a hyperinflation setting has had one outstanding success. In the case of Bolivian hyperinflation, the stabilisation of 1985 was successful in restoring price stability immediately. 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 stabilisation of 1991, successful so far, may, in addition to incorporating 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.

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 stabilisation programme 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 programme 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 stabilisation programmes to reduce high and chronic inflation shows, however, that it is extremely difficult to get instantaneous as well as lasting credibility.[9]

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. This commonly forces the domestic central bank to maintain high domestic real interest 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 organisation, such as the League of Nations or the International Monetary Fund (IMF), to enforce the commitment (see, for example, Santaella (1993)). Such foreign intervention, however, can 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 high credibility immediately relative to the existing currency. The currency board can then function as a binding commitment, both in the transition to a low rate of inflation and to the subsequent maintenance of permanent stable rate. To create credibility it relies on an external arrangement, but here the commitment is much stronger than with a pegged exchange rate plus 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 stabilisation programme, existing contracts in the labour, 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' ones, but the braking process will not be as abrupt. The process of currency competition and currency substitution will thus be gradual minimising 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 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 *et al.* (1993) and Siklos (1993) on two such cases in Russia in the 1920s).

If a high inflation Latin-American country were to establish a currency board, the currency board currency would presumably be tied to the US 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 US

dollar. The Federal Reserve Board does not have a perfect inflationary record, but the relative credibility of the US dollar will in the foreseeable future be much stronger than that of the currency issued by the central bank of any Latin-American country.

To protect the currency board from political pressure and thus to foster the credibility of its currency, the main office of its board could be set up in a foreign country and the majority of the board's members be foreign citizens. Such an agreement, however, might engender resentment of foreign domination. To offset such concerns and to create public and political support for the new arrangement, part of the profits of the board from investment of its foreign currency reserves would be returned to the domestic government.[10]

A currency board reform for Russia, along these lines, has recently been proposed by Hanke *et al.* (1993). Russia in the 1990s 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 in the mid-1990s faces 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 mimicking currency boards. Estonia has tied its currency to the Deutschemark (DM) at the rate of eight Estonian kroons for one DM. As discussed above, one Argentine peso since January 1992 is equivalent to one US dollar.

Initially, these programmes have 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 traditional currency board. The political system may change the behaviour of the Estonian or Argentine central bank so that it will not continue to behave as a fully-fledged 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. If they fail, a possible next step would be to move towards traditional currency boards.

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 behaviour 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 convertibility 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 being 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 into the behaviour of alternative monetary regimes pertain 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 can also be applied 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.[11] 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 (Giovannini, 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, 1989). 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 1989). 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, empirical comparisons of 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 since 1881.[12] The comparison for eleven (the G-10 plus Switzerland) industrialised countries (the USA, UK, 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 (1919–39), Bretton Woods (1946–70), and the regime of floating rates between the principal currencies (1971–89). The Bretton Woods period is divided into two subperiods: the preconvertible phase (1946–58) and the convertible phase (1959–70).[13] 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 behaviour of a number of macro variables for four traditionally high inflation economies (Argentina, Brazil, Chile, Israel) for periods for which data is available. Although these countries did not strictly adhere to convertible regimes, there is considerable evidence that the prevalence of such regimes in the rest of the world influenced their macro performance.[14]

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.[15] The Bretton Woods regime cannot be characterised 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.[16] Finally, although the period since 1973 has been characterised as a floating exchange rate regime, at certain times it has experienced varying degrees of management.

Stability and Convergence

Table 9.1 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 9.2 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, for example, 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.[17] We comment on the statistical results for each variable.

Inflation (Panel a)

The classical gold standard had the lowest rate of inflation of any monetary regime for all fifteen countries, and the interwar period displayed mild deflation for all except Brazil. The rate of inflation during the Bretton Woods period was on average (for every country except Japan) lower than during the subsequent floating exchange rate period. The average rate of inflation in the two Bretton Woods sub-periods 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 9.2, inflation increased substantially between the preconvertible and Bretton Woods convertible periods – see Figure 9.1.[18] 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 behaviour 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 sub-period, compared to the floating rate period and the mixed interwar regime. This evidence is also consistent with the traditional view of the operation of the classical price specie–flow mechanism and commodity arbitrage under fixed rates and

Table 9.1 Descriptive statistics of selected open economy macro variables, the G-11 countries, 1881–1990, annual data: mean, standard deviation

	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–58)*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–90)*	
a Inflation PGNP[a]												
United States	0.3	3.1	−1.8	7.6	2.4	2.6	2.8	3.5	2.6	1.5	5.6	2.4
United Kingdom	0.3	3.1	−1.5	7.8	3.7	2.2	4.6	2.5	3.4	1.5	9.4	6.1
Germany	0.6	2.6	−2.1	4.7	2.7	4.0	2.1	6.2	3.2	1.8	3.3	1.2
France	0.0	4.9	2.2	9.1	5.6	4.1	5.6	5.1	5.5	3.6	8.8	3.2
Japan	4.6	5.5	−1.7	7.3	4.5	4.6	4.7	7.3	5.1	1.3	2.6	2.4
Canada	0.4	1.4	−1.9	6.1	2.7	3.0	3.9	3.9	2.9	1.5	7.3	2.6
Italy	0.6	3.2	−1.1	11.7	3.8	11.5	5.8	16.0	3.8	2.1	12.9	4.6
Belgium	0.2	4.9	3.8	4.4	2.4	3.2	2.4	4.4	3.3	1.5	4.9	2.5
Netherlands	1.0	2.2	−3.1	5.6	4.1	3.1	4.5	3.2	4.9	3.1	3.6	2.9
Sweden	0.4	3.1	−2.3	6.1	3.9	4.0	4.1	5.4	4.2	1.7	8.4	3.0
Switzerland	n.a.		−2.2	4.3	2.8	1.9	1.8	1.9	4.2	1.0	3.5	1.8
Mean	0.8	3.4	−1.1	6.8	3.5	4.0	3.8	5.4	3.9	1.9	6.4	3.0
Convergence	0.8	1.0	1.4	1.6	0.8	1.4	1.1	2.2	0.9	0.6	2.4	0.9
b Real per capita growth[a]												
United States	1.8	5.1	0.0	8.1	2.0	2.8	1.8	3.4	2.9	1.9	2.1	2.7
United Kingdom	1.1	2.4	1.2	4.5	2.1	1.8	2.1	2.2	2.3	1.4	1.5	4.2
Germany	1.7	2.9	2.6	8.5	5.0	3.3	7.3	3.9	3.5	2.6	2.1	1.9
France	1.5	4.6	1.3	7.2	3.9	2.1	4.6	2.7	3.9	1.3	1.7	1.5
Japan	1.4	3.8	2.0	6.1	8.1	2.7	5.7	1.1	8.9	2.5	3.5	1.1

Table 9.1 *Continued*

	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–58)*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–90)*	
Canada	2.3	2.8	0.2	8.8	2.5	2.6	2.4	3.3	3.5	1.7	1.3	2.4
Italy	1.0	4.0	0.9	4.7	5.6	3.3	5.2	4.4	5.8	1.9	2.5	2.2
Belgium	n.a.		3.8	6.4	3.1	2.2	2.4	2.4	4.1	1.3	1.8	2.0
Netherlands	0.9	2.4	0.9	3.8	3.6	3.3	4.1	4.0	4.2	2.7	1.1	1.8
Sweden	2.4	4.3	2.6	6.8	3.3	1.5	3.1	1.7	3.6	1.5	1.6	2.3
Switzerland	n.a.		0.1	2.6	3.0	3.1	2.7	4.1	2.9	1.7	1.5	2.5
Mean	1.6	3.6	1.4	6.1	3.8	2.6	3.8	3.0	4.1	1.9	1.9	2.2
Convergence	0.4	0.9	0.9	1.4	1.3	0.5	1.4	0.8	1.1	0.5	0.5	0.6
c Money growth[a]												
United States	6.1	4.1	0.6	8.6	6.3	5.8	6.4	8.3	7.0	1.5	8.6	2.4
United Kingdom	2.1	1.7	0.8	4.7	3.2	3.2	1.7	2.9	5.5	2.9	13.5	5.5
Germany	5.7	4.7	1.3	10.1	12.8	5.9	17.6	5.6	10.9	4.7	5.7	4.5
France	2.1	4.7	6.4	8.5	11.5	7.5	14.7	7.2	8.6	6.5	8.8	3.4
Japan	7.2	14.5	0.5	9.7	16.2	16.2	20.1	21.8	14.9	7.0	5.8	6.3
Canada	7.4	5.3	1.1	4.7	6.0	4.0	5.1	3.2	8.3	3.9	10.6	3.9
Italy	3.2	3.1	3.6	6.2	13.3	7.8	15.9	10.5	12.4	2.0	13.4	4.9
Belgium	n.a.		6.3	9.8	4.5	3.2	3.8	2.2	5.5	4.2	4.4	3.7
Netherlands	4.2	3.5	–1.0	8.1	5.5	4.9	3.2	5.8	8.1	1.7	6.6	4.6
Sweden	5.9	3.7	–0.8	4.9	7.1	3.5	6.7	3.0	8.0	3.8	8.6	4.8
Switzerland	n.a.		8.1	7.9	5.8	4.2	3.3	3.7	7.9	3.3	3.4	7.0
Mean	4.9	5.0	2.4	7.6	8.4	6.0	9.0	6.7	8.8	3.8	8.1	4.6
Convergence	1.8	2.2	2.0	1.6	3.5	2.2	5.3	3.3	2.1	1.4	2.3	0.9

Table 9.1 *Continued*

	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–58)*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–90)*	
d Short-term interest rate												
United States	4.8	0.9	3.5	2.0	3.4	1.9	2.0	0.9	4.8	1.6	8.9	2.6
United Kingdom	2.8	0.8	3.0	1.8	4.0	2.5	2.3	1.8	5.8	1.6	11.2	2.1
Germany	3.2	0.9	4.6	1.6	4.0	1.5	4.1	1.1	4.0	1.7	5.9	2.4
France	2.5	0.6	3.1	1.4	4.1	1.9	3.2	1.5	5.1	1.9	10.3	2.6
Japan	2.4	0.5	2.0	0.5	6.5	0.8	6.9	1.0	6.3	0.6	5.2	2.0
Canada	n.a.		0.9	0.4	2.9	2.0	1.4	1.1	4.6	1.3	10.3	2.8
Italy	n.a.		n.a.		n.a.		n.a.		n.a.		n.a.	
Belgium	2.8	0.7	3.4	1.4	3.0	2.0	1.5	0.6	4.6	1.6	9.8	2.8
Netherlands	2.8	0.8	2.6	1.5	2.5	1.6	1.6	1.0	3.5	1.6	6.7	1.9
Sweden	n.a.		n.a.		5.9	1.4	n.a.		5.9	1.4	10.2	2.7
Switzerland	3.6	0.6	2.5	1.1	1.9	0.7	1.6	0.4	2.3	0.9	2.5	2.1
Mean	3.1	0.7	2.8	1.3	3.8	1.6	2.7	1.0	4.7	1.4	8.1	2.4
Convergence	0.6	0.1	0.8	0.4	0.9	0.4	1.3	0.3	0.7	0.3	1.9	0.3
e Long-term interest rest												
United States	3.8	0.3	4.2	0.6	3.9	1.3	3.0	0.4	5.0	1.1	10.4	2.1
United Kingdom	2.9	0.2	4.1	0.7	5.2	1.8	3.9	0.8	6.6	1.3	12.1	2.8
Germany	3.7	0.2	6.8	1.6	6.3	0.7	5.9	0.5	6.7	0.7	7.8	1.5
France	3.2	0.3	4.6	0.8	5.7	0.8	5.8	0.5	5.7	1.0	10.9	2.4
Japan	n.a.		n.a.		7.0	0.1	n.a.		7.0	0.1	7.1	1.8
Canada	3.5	0.4	4.7	0.8	4.5	1.5	3.3	0.5	5.8	1.1	11.0	2.0
Italy	4.2	0.5	5.9	0.6	6.0	0.7	6.3	0.4	5.7	0.7	13.7	3.3

Table 9.1 *Continued*

	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–58)*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–90)*	
Belgium	3.2	0.3	4.7	0.8	5.2	1.1	4.4	0.2	6.1	0.9	9.9	2.0
Netherlands	3.3	0.3	4.1	0.7	4.3	1.3	3.3	0.4	5.3	1.3	8.4	1.5
Sweden	3.8	0.3	4.5	0.4	4.3	1.6	2.9	0.3	5.7	1.2	11.1	1.7
Switzerland	3.8	0.2	4.7	0.9	3.5	0.8	3.0	0.3	3.9	0.9	4.9	1.1
Mean	3.5	0.3	4.8	0.8	5.1	1.1	4.2	0.4	5.8	0.9	9.8	2.0
Convergence	0.3	0.1	0.6	0.2	0.8	0.4	1.1	0.1	0.5	0.3	1.5	0.5
f Real short-term interest rate[b]												
United States	4.8	2.0	3.8	6.7	0.3	3.9	–1.6	4.7	2.4	0.4	2.5	2.8
United Kingdom	2.9	2.3	4.2	7.1	–0.1	3.4	–2.4	3.2	2.3	1.1	1.3	5.1
Germany	2.4	2.3	5.1	5.2	2.2	2.6	3.0	3.6	1.6	1.5	2.5	1.9
France	2.8	6.4	1.2	14.7	–0.9	5.2	–3.3	6.9	1.2	1.4	2.1	2.8
Japan	–1.5	5.5	1.4	8.8	1.9	2.5	3.4	3.5	1.1	1.6	1.4	3.5
Canada	n.a.		–0.8	1.3	–0.3	4.2	–2.6	4.8	2.2	0.8	3.1	3.2
Italy	n.a.		n.a.		n.a.		n.a.		n.a.		n.a.	
Belgium	2.8	4.8	0.6	9.6	0.4	3.8	–1.1	4.8	2.0	1.4	3.9	3.5
Netherlands	2.2	2.8	4.3	5.8	–1.7	3.0	–3.1	3.5	–0.3	1.4	2.5	3.3
Sweden	n.a.		n.a.		1.8	1.5	n.a.		1.8	1.5	1.9	3.6
Switzerland	n.a.		4.4	5.3	–0.1	1.8	0.3	2.0	–0.5	1.5	–1.1	2.7
Mean	2.3	3.7	2.7	7.2	0.4	3.2	–0.8	4.1	1.4	1.3	2.0	3.2
Convergence	1.1	1.6	1.9	2.6	1.0	0.8	2.0	1.1	0.7	0.3	0.6	0.5

Table 9.1 *Continued*

	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–58)*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–90)*	
g Real long-term interest rate[b]												
United States	3.7	2.2	4.6	6.8	0.8	3.6	–0.7	4.4	2.5	0.7	3.9	3.8
United Kingdom	3.0	2.5	5.4	7.1	1.1	2.8	–0.8	2.6	3.2	1.0	2.2	3.7
Germany	2.9	2.4	6.9	6.0	4.3	2.8	4.3	4.4	4.3	0.9	4.4	0.9
France	3.5	6.5	1.0	15.1	0.4	4.4	–1.2	6.2	1.8	1.0	2.7	3.1
Japan	n.a.		n.a.		1.7	1.3	n.a.		1.7	1.3	2.0	4.2
Canada	2.9	4.1	5.4	6.5	1.3	3.8	–0.7	4.4	3.4	0.7	3.8	3.1
Italy	4.2	2.4	3.4	9.3	0.3	9.4	–1.5	12.9	2.3	2.2	1.4	4.8
Belgium	3.2	5.0	1.8	9.8	2.7	3.4	1.8	4.6	3.5	1.1	4.1	3.3
Netherlands	2.4	2.6	5.8	5.6	0.1	3.1	–1.3	3.5	1.6	1.7	4.2	2.4
Sweden	3.4	3.3	6.1	7.0	0.5	3.3	–0.9	3.9	2.0	1.4	2.8	3.0
Switzerland	n.a.		6.6	5.5	1.4	1.7	1.7	1.8	1.1	1.4	1.3	1.6
Mean	3.2	3.4	4.7	7.9	1.3	3.6	0.1	4.9	2.5	1.2	3.0	3.1
Convergence	0.4	1.2	1.5	1.9	0.9	1.2	1.4	1.6	0.8	0.4	0.9	0.8
h Nominal exchange rate[d]												
United States[c]					0.7	0.8			0.7	0.8	5.0	4.7
United Kingdom	0.2	0.2	6.8	7.9	2.4	6.2	3.3	7.9	1.5	4.0	10.0	4.7
Germany	0.2	0.1	3.9	9.5	1.8	3.8	2.4	5.3	1.3	2.1	9.3	8.2
France	0.0	0.0	18.4	15.6	2.5	7.7	4.4	11.3	1.1	3.3	10.7	7.8
Japan	2.9	4.5	6.8	9.0	15.9	37.2	30.5	47.9	0.2	0.2	8.8	9.5
Canada	0.0	0.0	2.7	3.4	1.6	1.9	1.8	1.9	1.4	2.0	3.7	2.4

Table 9.1 *Continued*

	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–58)*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–90)*	
Italy	1.4	1.5	13.6	20.1	7.4	20.6	14.1	27.4	0.2	0.2	10.9	9.0
Belgium	2.6	3.1	13.2	16.5	0.8	2.0	1.3	2.8	0.3	0.2	10.6	8.5
Netherlands	0.2	0.3	6.5	8.8	1.8	5.6	3.0	7.7	0.6	1.0	9.9	7.9
Sweden	0.2	0.2	7.7	10.0	2.2	7.3	4.0	9.9	0.2	0.2	8.4	7.0
Switzerland	0.3	0.2	7.7	9.6	0.2	0.3	0.2	0.3	0.2	0.2	10.8	9.3
Mean	0.8	1.0	8.7	11.0	3.4	8.5	6.5	12.2	0.7	1.3	8.9	7.2
Convergence	0.9	1.2	3.7	3.7	2.7	6.7	5.7	9.0	0.5	1.1	1.7	1.7
i Real exchange rate[cd]												
United States					1.7	1.0			1.7	1.0	7.4	6.5
United Kingdom	1.7	1.5	8.5	10.0	4.2	6.5	5.9	8.2	2.5	3.9	12.3	6.1
Germany	2.4	1.2	5.8	9.2	2.8	5.1	3.9	7.3	1.9	1.8	8.8	8.2
France	4.3	5.0	9.0	6.9	4.1	5.6	6.2	7.7	2.5	2.9	9.2	7.7
Japan	6.6	5.5	7.8	7.2	3.5	2.9	4.8	4.1	2.7	1.5	9.6	8.9
Canada	2.6	2.2	3.2	2.8	2.4	2.3	3.3	2.5	1.5	1.7	3.8	2.0
Italy	2.1	1.7	13.3	16.9	8.0	18.7	13.1	25.2	2.4	1.6	8.6	7.8
Belgium	5.4	3.9	9.0	9.8	2.3	2.9	3.4	3.8	1.3	0.9	10.0	8.4
Netherlands	3.6	2.6	8.6	8.9	2.9	4.0	3.7	5.4	2.1	1.4	9.4	8.0
Sweden	2.8	1.5	7.9	10.1	4.1	6.6	6.0	8.8	2.0	1.1	7.5	7.2
Switzerland	n.a.		6.7	8.5	2.3	2.3	2.8	3.0	1.8	0.8	10.2	9.0
Mean	3.5	2.8	8.0	9.0	3.5	3.6	5.3	7.6	0.2	1.7	8.8	7.3
Convergence	1.3	1.3	1.6	2.2	1.1	1.4	1.8	3.5	0.5	0.6	1.3	1.3

Table 9.1 *Continued*

	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–70)*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–90)*	
j Government budget deficit as a percentage of nominal GNP												
United States	–0.3	0.6	1.9	4.4	–0.1	2.1	–0.5	2.9	0.4	0.6	3.0	1.5
United Kingdom	0.1	0.8	–0.7	1.7	–2.3	2.8	–2.2	3.6	–2.4	1.6	2.2	1.6
Germany	2.8	1.0	1.4	1.1	0.1	1.8	–0.2	2.6	0.4	0.8	1.5	0.8
France	0.6	1.1	3.8	3.8	2.2	2.3	3.5	2.8	1.0	0.9	1.5	1.3
Japan	–3.1	3.3	–5.1	3.3	–1.0	3.2	–2.7	3.7	0.8	0.8	4.5	1.9
Canada	0.5	1.1	1.5	2.5	–1.1	1.7	–1.7	1.9	–0.4	1.1	2.9	2.0
Italy	0.9	1.1	8.6	9.7	3.2	4.0	5.0	4.9	1.2	1.0	9.5	2.2
Belgium	n.a.		3.9	1.2	4.8	4.8	6.8	6.1	2.7	0.9	7.3	2.7
Netherlands	2.1	0.3	5.6	3.2	0.6	5.2	1.7	7.1	–0.6	0.7	3.8	2.4
Sweden	0.0	0.6	1.6	1.2	–0.2	2.6	1.8	1.6	–2.4	1.6	1.1	3.8
Switzerland	n.a.		–0.0	0.5	–0.2	1.1	0.2	1.4	–0.5	0.6	0.1	0.7
Mean	0.4	1.1	2.1	3.0	0.6	2.9	1.1	3.5	0.0	1.0	3.4	1.9
Convergence	1.1	0.5	2.4	1.5	1.6	1.0	2.4	1.2	1.0	0.3	1.7	0.5

Notes:
[a]Mean growth rate calculated as the time coefficient from a regression of the natural logarithm of the variable on a constant and a time trend.
[b]Calculated as the nominal interest rate minus the annual rate of change of the CPI.
[c]Calculated as the nominal exchange rate divided by the ratio of foreign to the US CPI.
[d]Absolute rate of change.
[e]Trade-weighted nominal and real exchange rate starting in 1960.
Date sources: See data appendix.

Table 9.2 Descriptive statistics of selected open economy macro variables, four high inflation countries, 1881–1989, annual data: mean, standard deviation

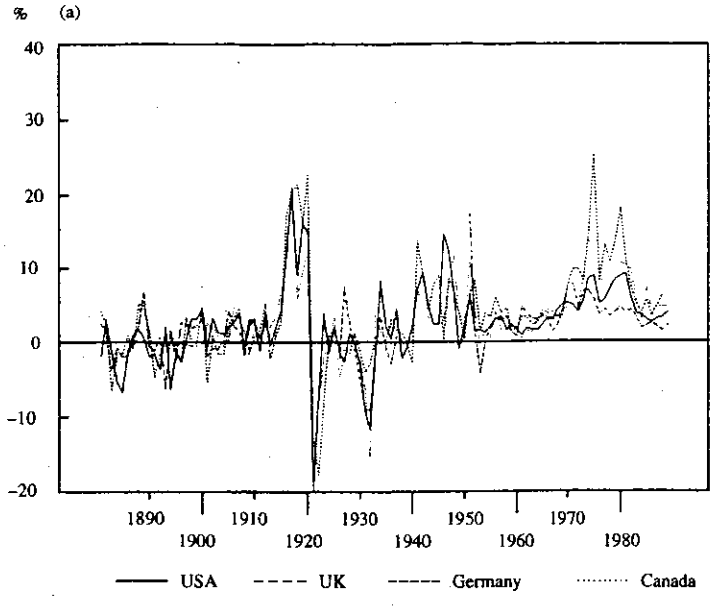
	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–58*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–89*	
a Inflation PGN[a]												
Argentina	2.6	14.2	–1.7	6.3	22.9	14.7	18.4	9.8	19.9	7.2	122.9	77.0
Brazil	4.3	17.5	3.0	6.3	24.3	14.8	13.2	6.1	35.7	15.1	94.5	87.0
Chile	5.2	9.1	5.5	7.3	27.7	13.0	29.0	15.7	26.6	10.5	30.9	41.2
Israel					7.9	9.3	14.9	12.3	5.7	3.2	69.3	42.9
Mean	4.0	13.6	2.3	6.6	20.7	13.0	18.9	11.0	2.2	9.0	79.4	62.0
Convergence	1.0	3.0	2.6	0.4	6.4	1.8	5.1	3.0	9.2	3.8	29.3	20.0
b Real per capita growth[a]												
Argentina	1.4	6.3	0.6	4.6	1.5	4.7	0.8	4.3	2.7	4.2	–1.4	4.2
Brazil	1.2	8.0	1.7	8.7	4.8	4.2	3.5	2.1	6.4	5.6	0.9	4.3
Chile	3.3	4.7	1.2	12.0	0.7	5.9	1.5	7.0	1.6	5.0	1.6	7.4
Israel					5.1	5.1	4.3	7.2	5.0	3.3	1.8	8.9
Mean	2.0	6.3	1.2	8.4	3.0	5.0	2.5	5.2	3.9	4.5	0.7	6.2
Convergence	0.9	1.1	0.4	2.6	1.9	0.5	1.4	2.0	1.8	0.8	1.1	2.0
c Money growth[a]												
Argentina	6.7	12.1	1.8	8.9	22.2	10.1	19.0	7.4	25.1	12.3	124.6	82.6
Brazil	6.9	25.8	9.2	12.4	32.6	21.5	17.9	8.9	48.4	19.9	91.5	79.8
Chile	–3.7	9.7	5.1	15.1	29.7	12.8	28.3	11.3	32.5	14.8	32.2	39.3
Israel					15.4	8.9	17.9	9.3	13.9	8.4	66.1	39.3
Mean	3.3	15.9	5.4	12.1	25.0	13.3	20.8	9.2	30.0	13.9	78.6	60.3
Convergence	4.7	6.6	2.6	2.2	6.2	4.1	3.8	1.1	10.5	3.5	29.5	21.0

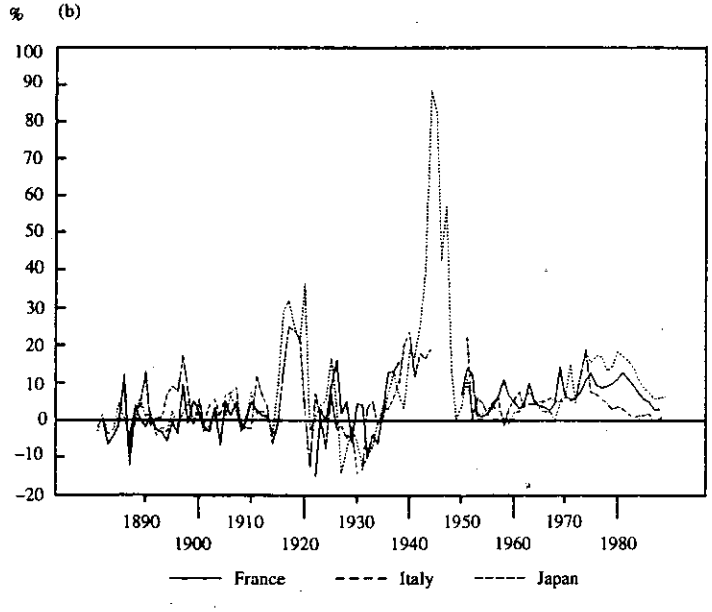
Table 9.2 *Continued*

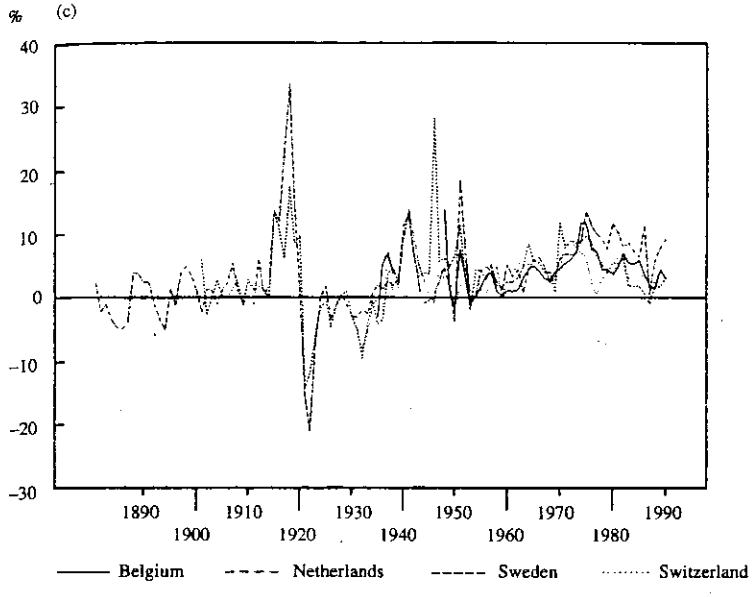
	Gold standard (1881–1913)		*Inter-War (1919–38)*		*Bretton Woods (total) (1946–70)*		*Bretton Woods (preconvertible) (1946–58)*		*Bretton Woods (convertible) (1959–70)*		*Floating exchange (1974–89)*	
d Nominal exchange rate[d]												
Argentina	7.6	10.9	9.7	7.6	18.8	16.7	20.2	16.6	17.3	17.5	130.5	85.4
Brazil	9.6	12.6	13.8	14.7	22.5	22.3	11.6	17.8	34.3	21.0	95.5	84.6
Chile	9.5	8.9	13.3	19.4	24.3	17.9	27.4	21.6	21.0	12.9	40.3	49.0
Israel	n.a.		n.a.		12.0	26.3	19.7	35.5	5.5	13.8	46.9	47.4
Mean	8.9	10.8	12.3	13.9	19.4	20.8	19.7	22.9	19.5	16.3	78.3	66.6
Convergence	0.9	1.3	1.7	4.2	4.0	3.5	4.1	6.3	8.1	3.0	34.7	18.4
e Real exchange rate[cd]												
Argentina	6.0	5.0	12.6	10.9	13.1	10.2	13.2	11.7	12.9	8.7	32.6	23.3
Brazil	6.4	5.7	15.1	10.3	10.7	8.7	11.2	8.9	10.1	8.9	9.8	8.5
Chile	13.9	6.6	14.6	16.3	15.7	13.9	19.4	15.3	11.7	11.5	12.1	14.1
Israel	n.a.		n.a.		14.2	20.3	22.6	26.0	7.2	10.8	8.2	5.5
Mean	8.8	5.8	14.1	12.5	13.4	13.3	16.6	15.5	10.5	10.0	15.7	12.9
Convergence	3.4	0.6	1.0	2.5	1.6	3.8	4.4	5.3	1.8	1.2	8.5	5.9
f Government budget deficit as a percentage of nominal GNP												
Argentina	2.5	2.4	1.7	1.8	6.0	3.7	8.7	3.0	3.0	1.1	9.3	6.8
Brazil	2.0	2.4	1.9	1.6	1.5	1.3	1.1	1.3	2.0	1.3	5.5	5.8
Chile	2.4	4.4	1.8	1.7	1.9	1.6	1.3	1.4	2.5	1.7	1.1	2.9
Israel	n.a.		n.a.		5.1	6.5	0.8	1.3	8.3	6.9	17.6	7.1
Mean	2.3	3.1	1.8	1.7	3.6	3.3	3.0	1.8	4.0	2.8	8.4	5.7
Convergence	0.2	0.9	0.1	0.1	1.9	1.8	2.9	0.6	2.2	2.1	5.1	1.4

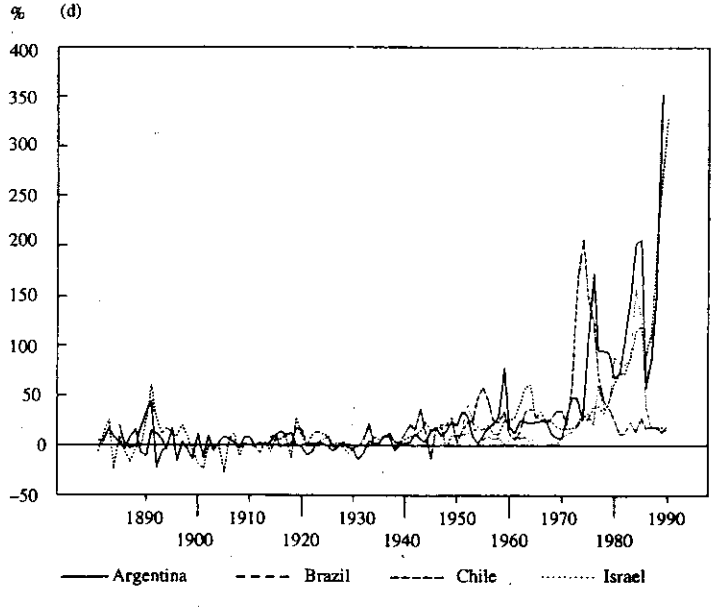
Notes: As Table 9.1.
Date sources: See data appendix.

Figure 9.1 Inflation rates, 1880–1989









insulation and greater monetary independence under floating rates.[19] For the high inflation countries for the post-war period, although the inflation rates are considerably higher than for the G-11, we also observe greater convergence under Bretton Woods than during the float. This suggests that although these countries did not follow convertibility rules directly, the fact that the G-11 *did*, may have influenced regime performance.[20]

The Bretton Woods convertible sub-period 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.

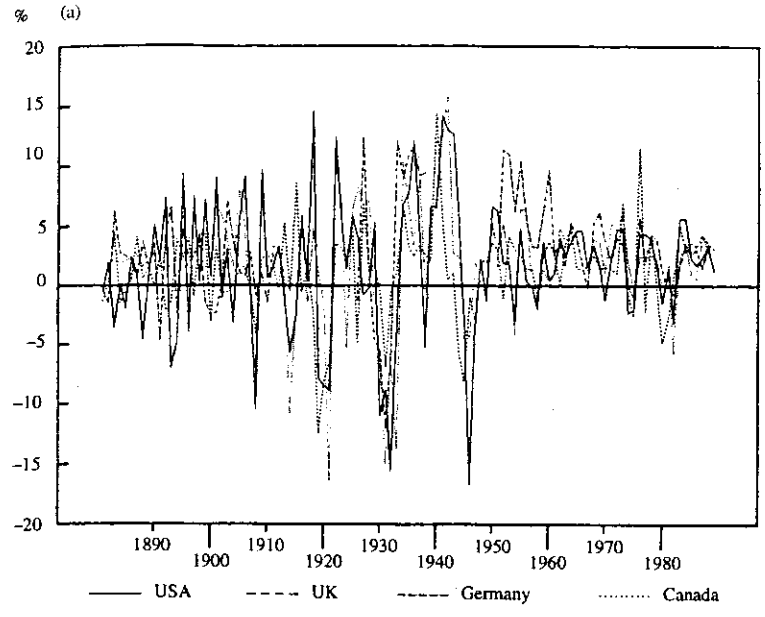
For the high inflation countries, inflation variability does not differ much between the gold standard and Bretton Woods Regimes. It is considerably higher than in the G-11 for those periods. As with the G-11, inflation variability was much greater in the floating rate period than under Bretton Woods.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

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 9.2). 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 convertibility sub-period 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-Second World War regimes exhibit higher variability than their post Second World War counterparts.[21] 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

Figure 9.2 Per capita income growth rates, 1880–1989



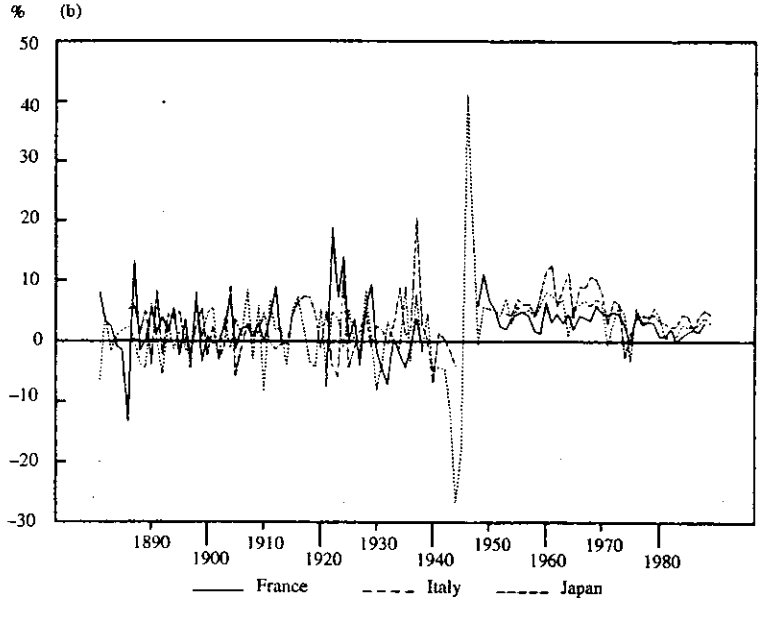
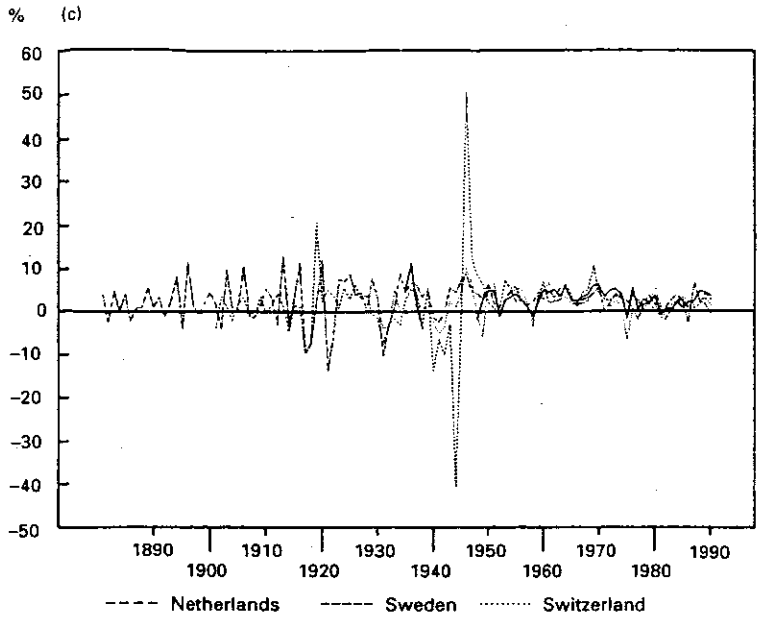
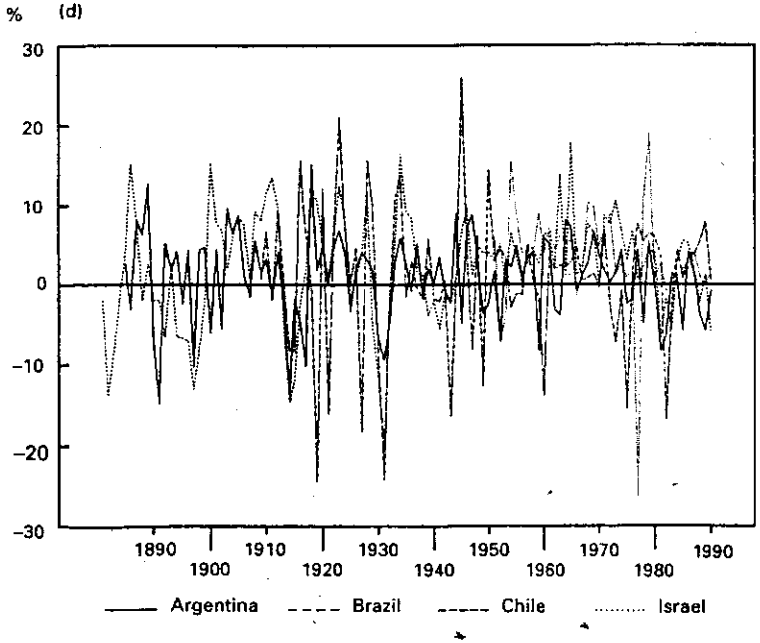


Figure 9.2 *Continued*





inter-war regime the highest.[22] For the high inflation countries, such as the G-11, the Bretton Woods convertible regime exhibited the lowest degree of divergence, along with the gold standard. The inter-war showed 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, (1989) and Darby and Lothian (1989)).

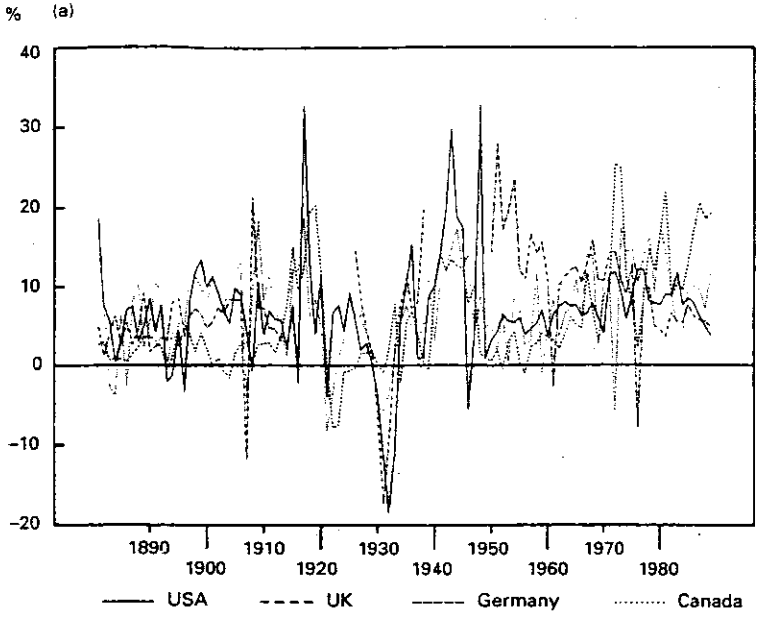
Money growth (M_2) (Panel c)

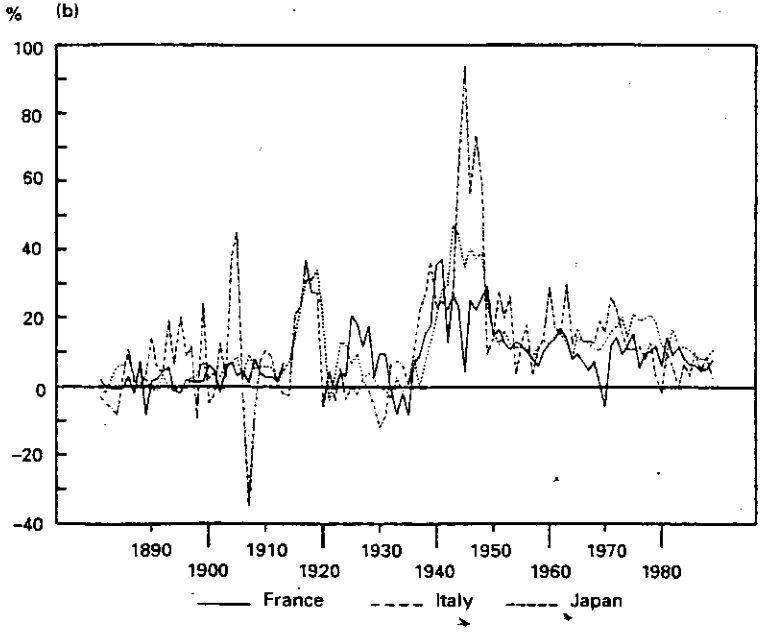
It was considerably more rapid across all countries post-Second World War than before the war (see Figure 9.3). For the G-11 there is not much difference between Bretton Woods and the subsequent floating regime. Within the Bretton Woods regime, money growth was more rapid in the preconvertibility period than in the convertibility period. For the high inflation countries, money growth rates accelerated over the entire post-war 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.

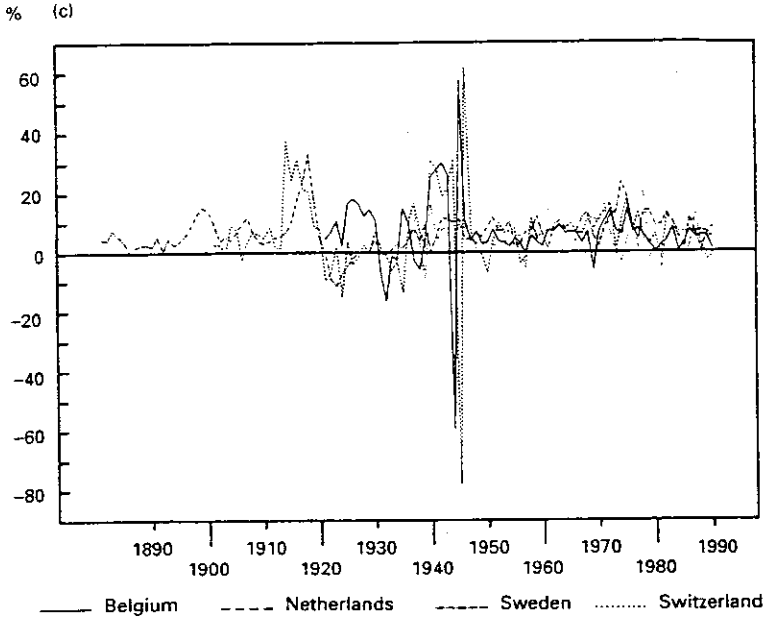
Money growth rates showed the least divergence between G-11 countries during the fixed-exchange-rate gold standard and the convertible Bretton Woods regime, with the greatest divergence in the preconvertible Bretton Woods period and the inter-war period. For the high inflation countries, divergence in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

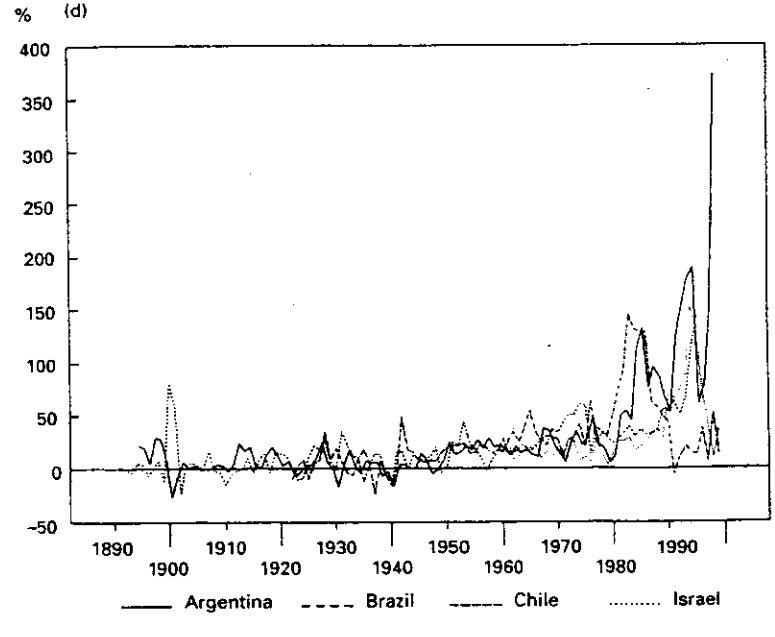
Like inflation and real output variability, for the G-11, money growth variability was lowest in the convertible Bretton Woods period. This, however, was not the case for the preconvertible period, which was the most variable of any regime. It also exhibited the great divergence in variability between 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.

Figure 9.3 Money growth rates, 1880–1989





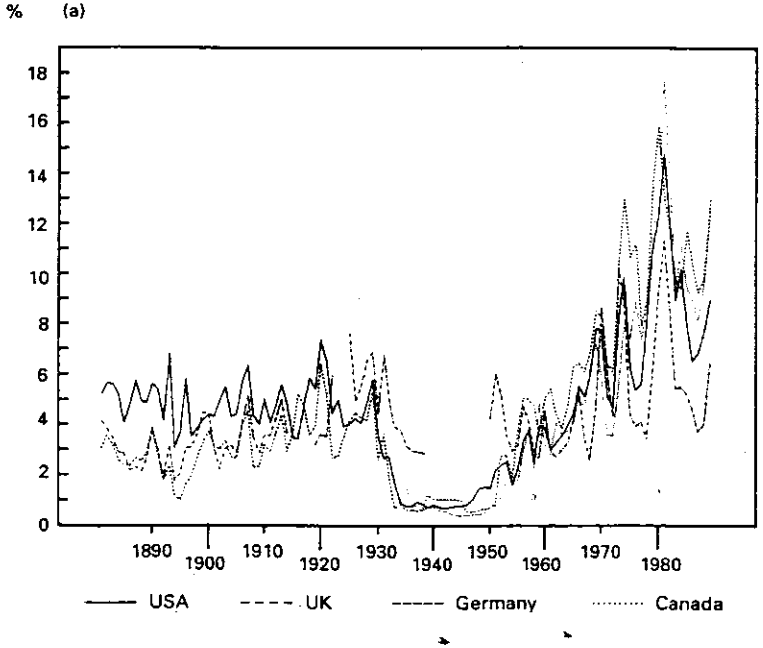


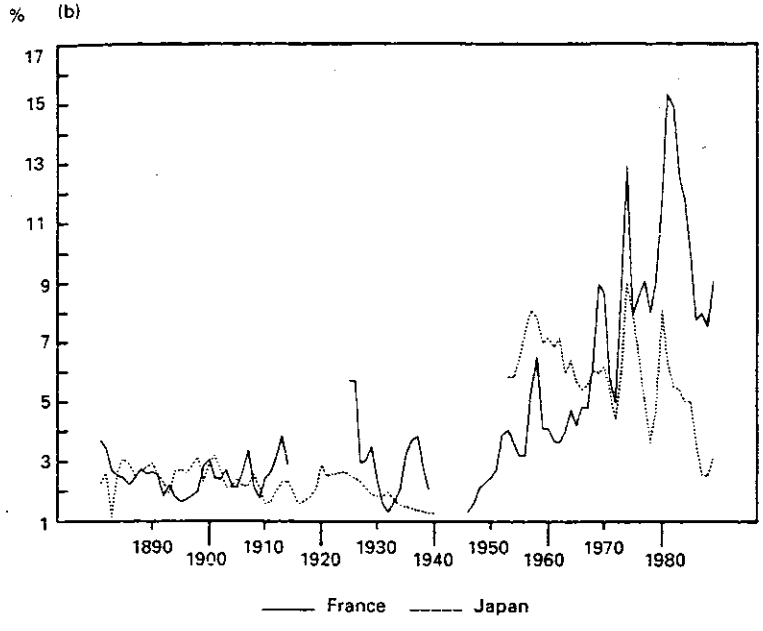


Short-term and long-term interest rates (Panels d and e)

The underlying data can be seen in Figures 9.4 and 9.5. Reliable data are absent 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 sub-periods, 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.

Figure 9.4 Short-term interest rates, 1880–1989





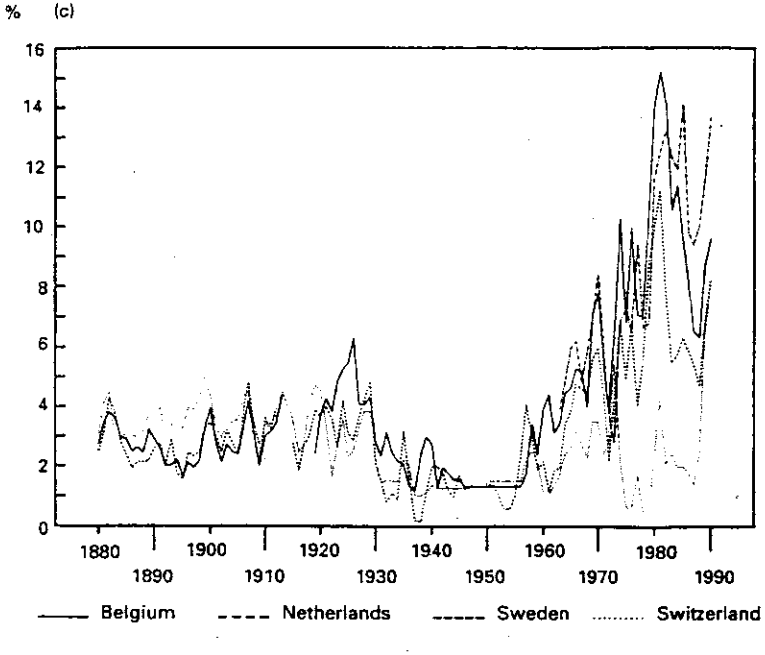
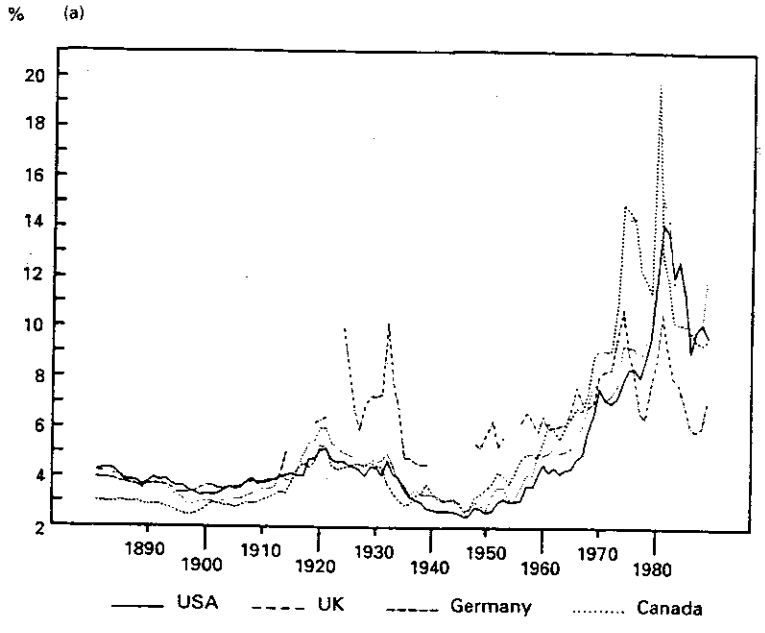
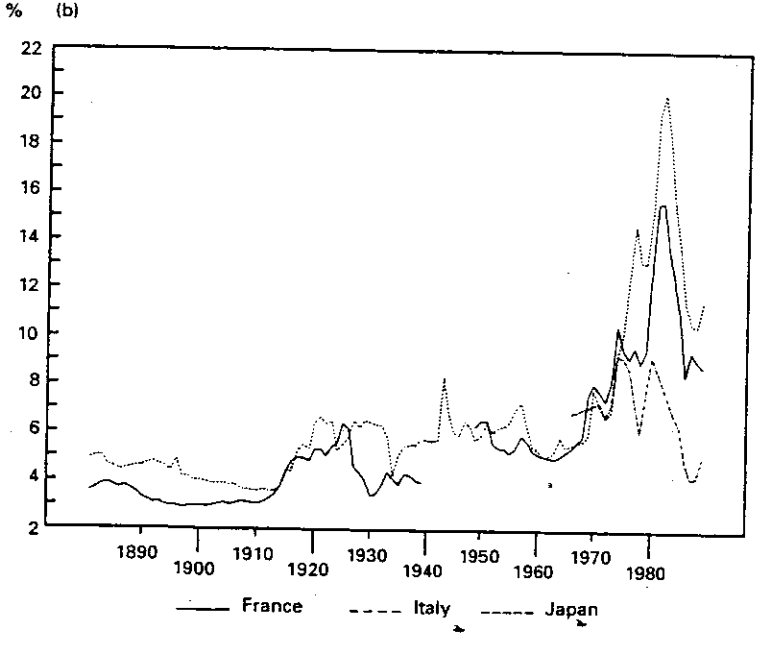
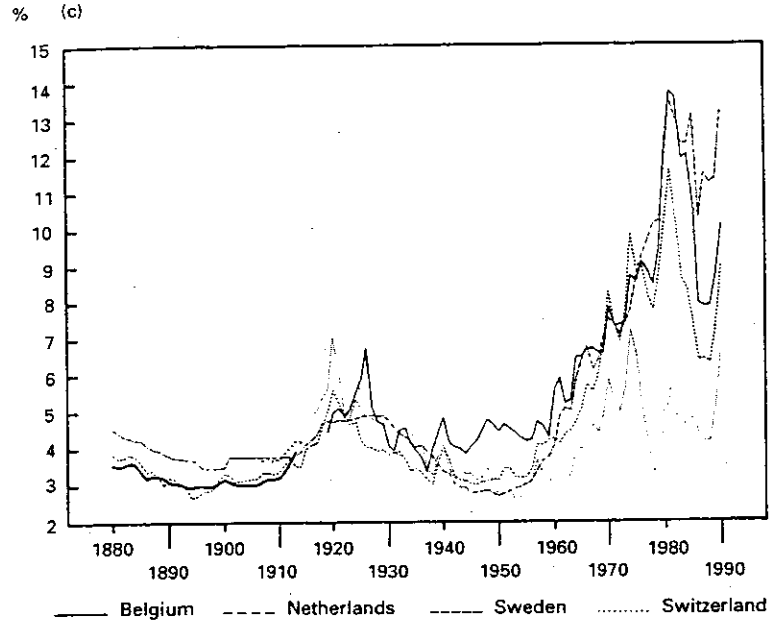


Figure 9.5 Long-term interest rates, 1880–1989





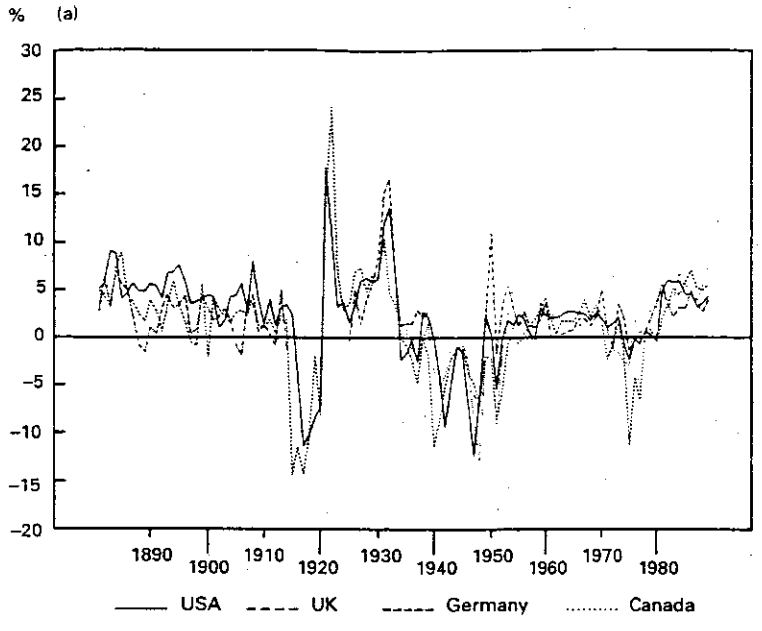


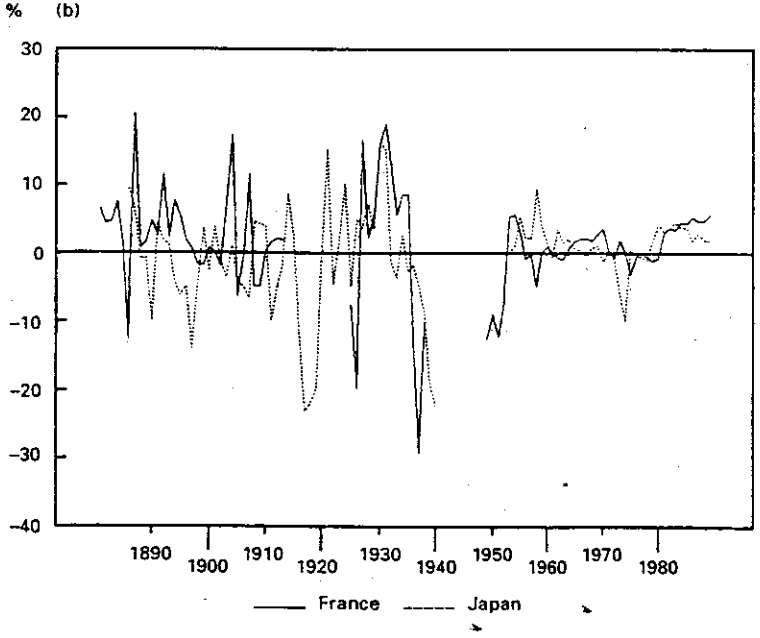
Real short-term and real long-term interest rates (Panels f and g)

For the underlying data see Figures 9.6 and 9.7. The real interest rates are *ex-post* rates calculated using the rate of change of a consumer price index.[23] 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 the 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 behaviour 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 stabilised by pooling across markets, which reduces capital market risk.

Figure 9.6 Real short-term interest rates, 1880–1989





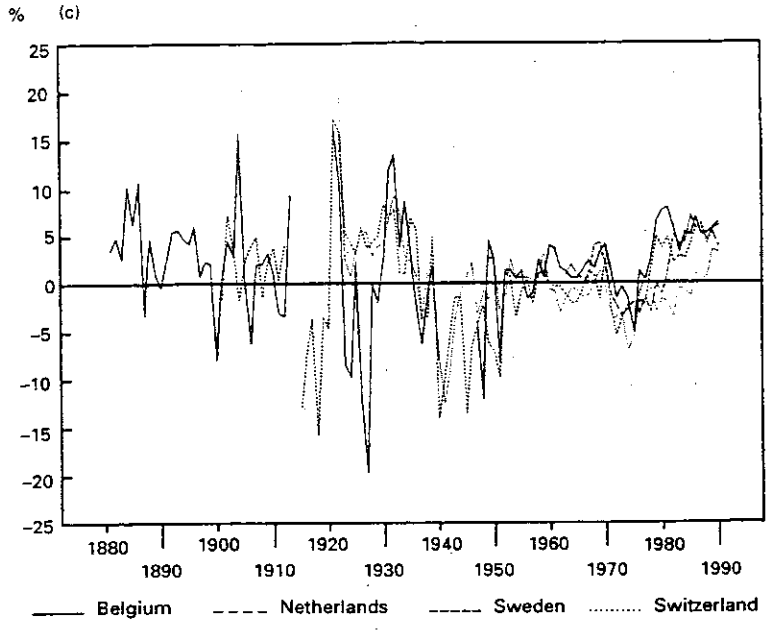


Figure 9.7 Real long-term interest rates, 1880–1989

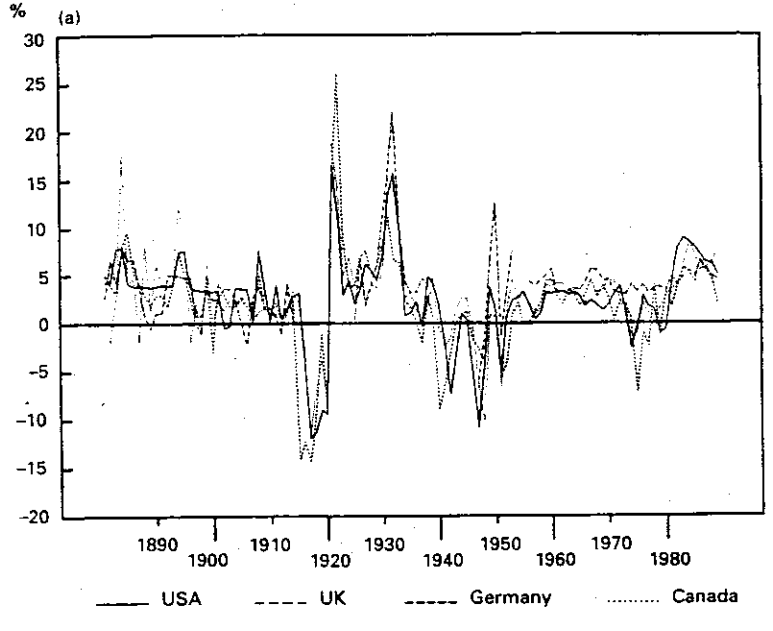
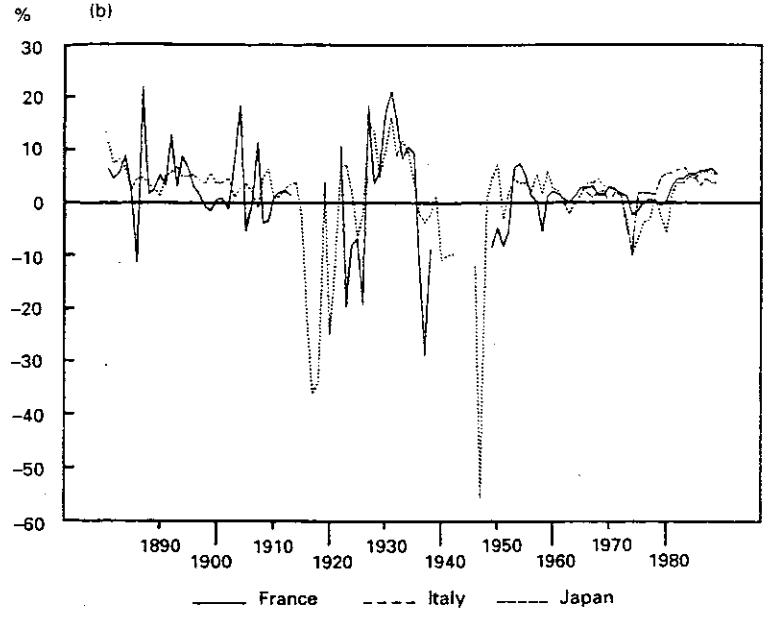
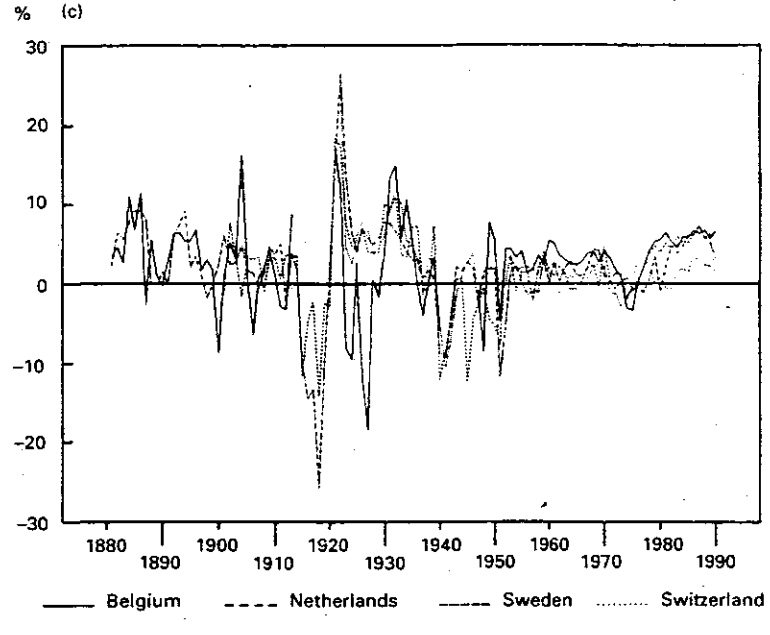


Figure 9.7 *Continued*





Nominal and real exchange rates (Panels h and i)

For the underlying data see Figures 9.8 and 9.9. 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 9.8 and Bordo (1993a) 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 measures increased between the pre- and post-Second World War 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

Figure 9.8 Absolute change in nominal exchange rates, 1880–1989

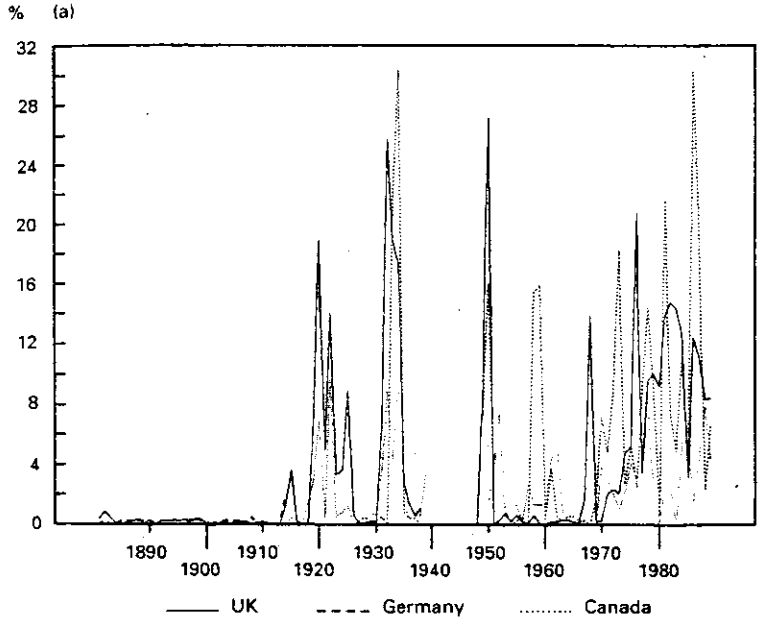
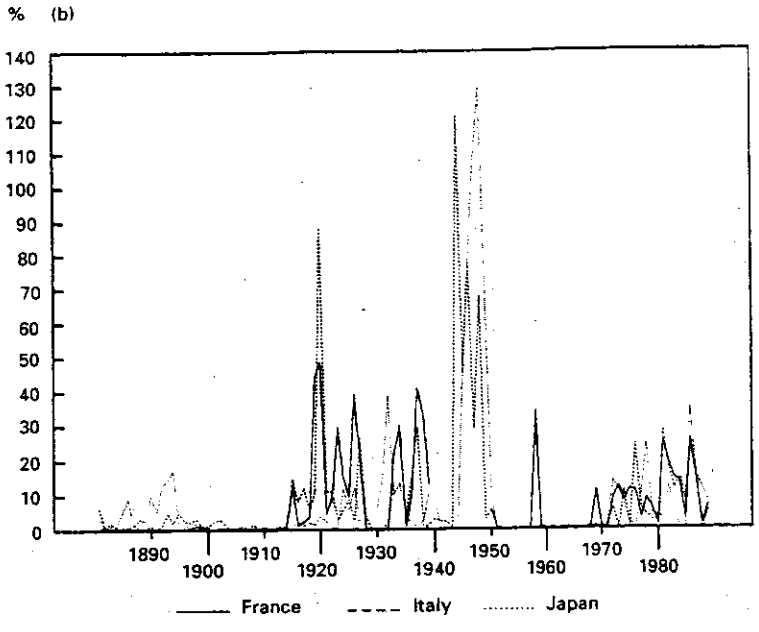
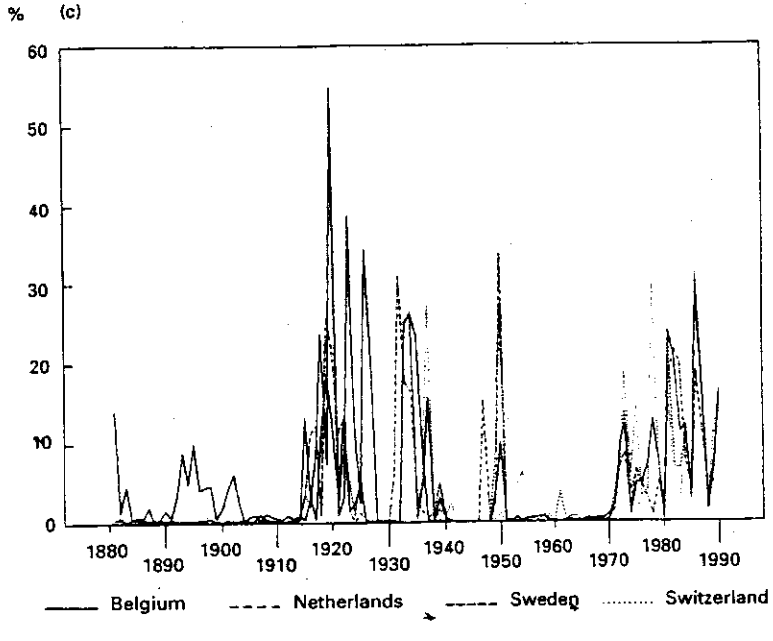


Figure 9.8 *Continued*





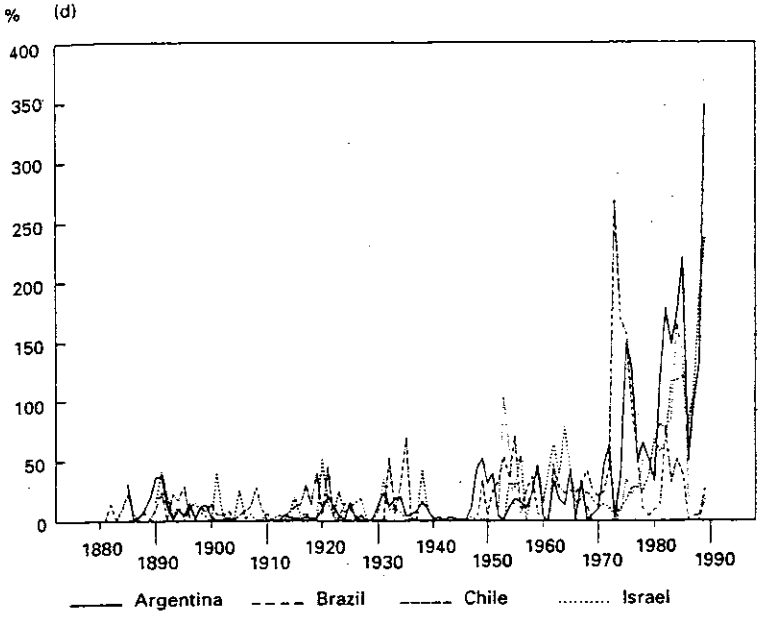
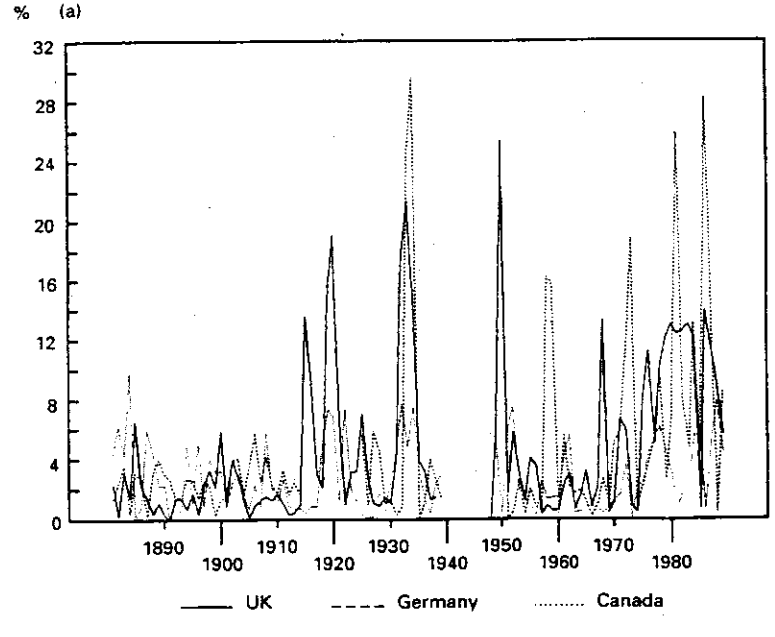


Figure 9.9 Absolute change in real exchange rates, 1880–1989



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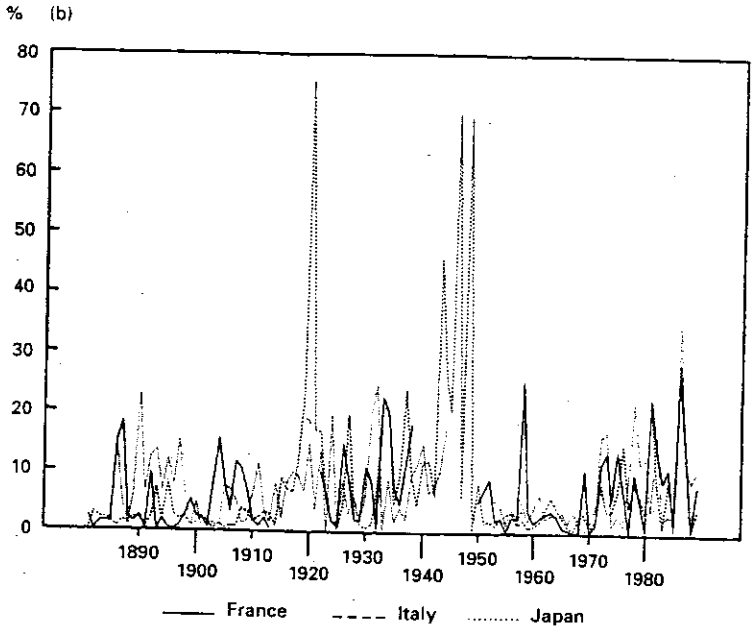
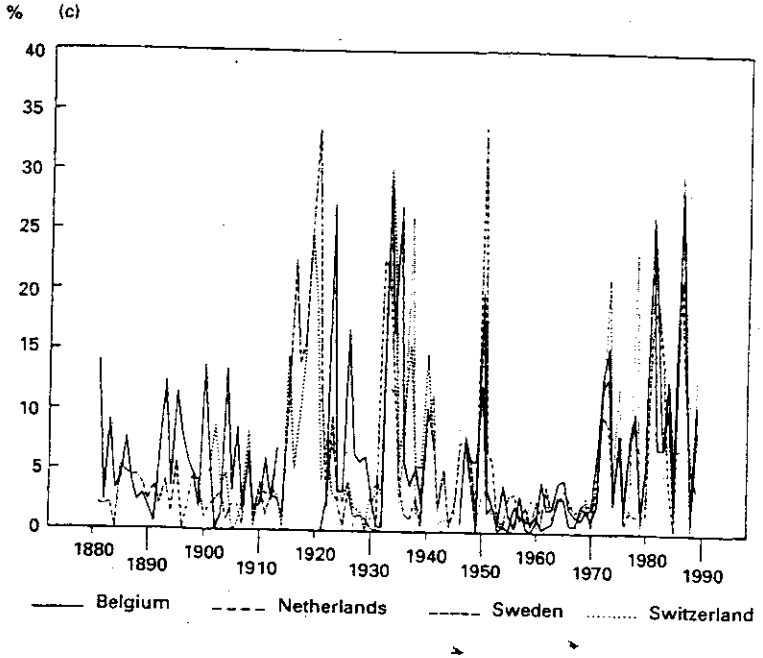
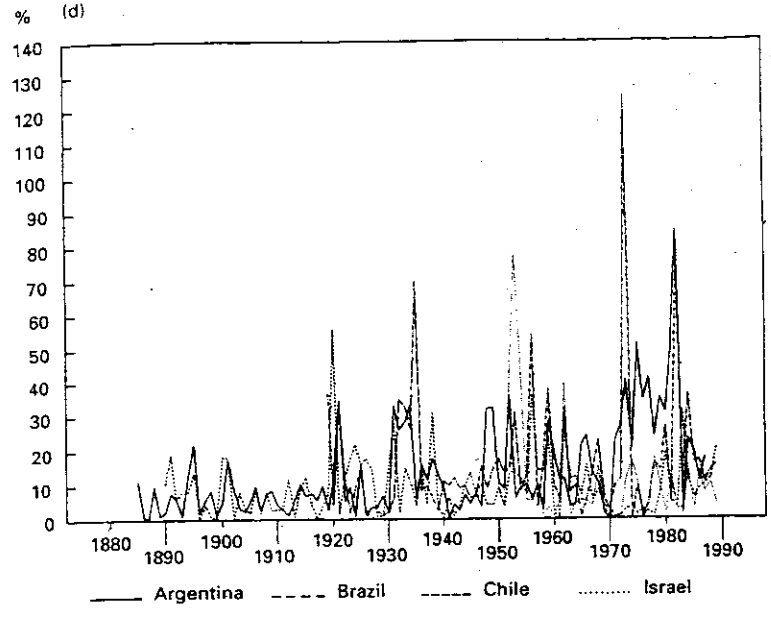






gold standard period next in size of these measures (see Figure 9.9). The highest rate of change was in the floating period. Similarly, the lowest standard deviation across countries, and the least divergence between standard deviations, was the Bretton Woods convertible period, with the gold standard again next in these rankings. The other regimes were characterised 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 behaviour of real exchange rates. Mussa (1986) presented evidence for ten industrialised countries in the post-Second World War 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.[24] 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 (1992a) points out and as can be seen in Table 9.5 here, these results could be explained by the fact that both periods were characterised by few shocks.[25]

Table 9.3 Persistence of CPI inflation: G-11 countries and four high inflation countries, 1880–1990, annual data: coefficient of AR1 regression; (standard error); t-statistic for unit root test

	United States			*United Kingdom*			*Germany*			*France*		
Gold standard	0.27	(0.18)	4.05	0.30	(0.17)	4.03	0.51	(0.16)	3.06	- 0.22	(0.18)	6.78
Interwar	0.45	(0.17)	3.18	0.35	(0.19)	3.37	0.51	(0.21)	2.33	0.42	(0.24)	2.42
Bretton Woods (total)	0.49	(0.19)	2.68	0.33	(0.20)	3.38	- 0.03	(0.21)	4.90	0.56	(0.16)	2.75
Bretton Woods (preconvertible)	0.41	(0.27)	2.15	0.15	(0.29)	2.96	- 0.07	(0.31)	3.45	0.60	(0.27)	1.48
Bretton Woods (convertible)	1.07	(0.20)	- 0.33	0.57	(0.34)	1.27	0.44	(0.31)	1.81	0.12	(0.14)	6.29
Floating exchange	0.68	(0.18)	1.76	0.69	(0.19)	1.67	0.83	(0.14)	1.21	0.85	(0.16)	0.94
Post-Second World War	0.65	(0.12)	2.92	0.75	(0.10)	2.50	0.31	(0.15)	4.60	0.69	(0.11)	2.82
	Japan			*Canada*			*Italy*					
Gold standard	0.22	(0.18)	4.33[a]	0.08	(0.18)	5.11	0.28	(0.14)	5.14			
Interwar	0.70	(0.25)	1.20	0.35	(0.20)	3.25	0.28	(0.18)	4.00			
Bretton Woods (total)	0.52	(0.18)	2.67	0.39	(0.19)	3.21	0.21	(0.12)	6.58			
Bretton Woods (preconvertible)	0.47	(0.07)	1.96	0.32	(0.28)	2.43	0.18	(0.18)	4.56			
Bretton Woods (convertible)	0.18	(0.31)	2.64	0.81	(0.20)	0.95	0.38	(0.29)	2.14			
Floating exchange	0.70	(0.19)	1.58	0.75	(0.17)	1.47	0.75	(0.17)	1.47			
Post-Second World War	0.54	(0.13)	3.54	0.65	(0.11)	3.18	0.28	(0.10)	7.20			

Table 9.3 *Continued*

	Belgium			*Netherlands*			*Sweden*			*Switzerland*		
Gold standard	0.11	(0.18)	4.83	–0.36	(0.26)	5.14	0.42	(0.17)	3.53	n.a.		
Interwar	0.49	(0.20)	2.57	0.34	(0.16)	4.14	0.50	(0.11)	4.44	0.16	(0.15)	5.77
Bretton Woods (total)	–0.09	(0.22)	5.07	0.31	(0.15)	4.58	0.13	(0.21)	4.26	0.24	(0.20)	3.75
Bretton Woods (preconvertible)	–0.16	(0.33)	3.58	0.26	(0.22)	3.33	0.17	(0.29)	2.89	–0.07	(0.30)	3.56
Bretton Woods (convertible)	0.72	(0.21)	1.32	0.50	(0.26)	1.91	–0.19	(0.35)	3.38	0.40	(0.29)	2.07
Floating exchange	0.78	(0.16)	1.40	0.88	(0.11)	1.05	0.53	(0.21)	2.25	0.69	(0.18)	1.80
Post-Second World War	0.41	(0.14)	4.13	0.52	(0.11)	4.41	0.54	(0.13)	3.62	0.60	(0.12)	3.28
	Argentina			*Brazil*			*Chile*			*Israel*		
Gold standard	0.29	(0.30)	2.37	(0.47)	(0.17)	3.11	0.23	(0.31)	2.48	n.a.		
Interwar	–0.17	(0.19)	6.14	0.53	(0.19)	2.53	0.16	(0.23)	3.68	n.a.		
Bretton Woods (total)	0.27	(0.20)	3.61	0.81	(0.12)	1.58	0.56	(0.16)	2.66	0.46	(0.20)	2.66
Bretton Woods (preconvertible)	0.41	(0.29)	2.04	0.49	(0.26)	1.95	0.63	(0.21)	1.77	0.40	(0.35)	1.74
Bretton Woods (convertible)	0.16	(0.32)	2.63	0.68	(0.22)	1.49	0.33	(0.30)	2.20	0.31	(0.30)	2.31
Floating exchange	0.74	(0.22)	1.18	1.29	(0.08)	–3.62	0.85	(0.14)	1.11	0.72	(0.17)	1.63
Post-Second World War	0.93	(0.10)	0.70	1.28	(0.05)	–5.91	0.83	(0.08)	2.04	0.82	(0.09)	2.00

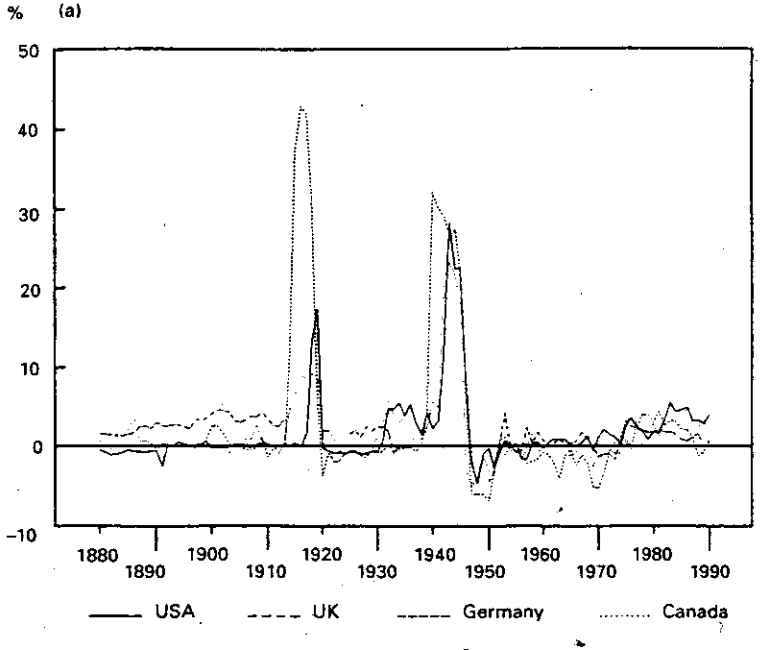
Notes: 5% significant level for unit root test with 25 observations is 3.00.
[a] GNP deflator was used because of unavailability of CPI data.
Data sources: As Table 9.1.

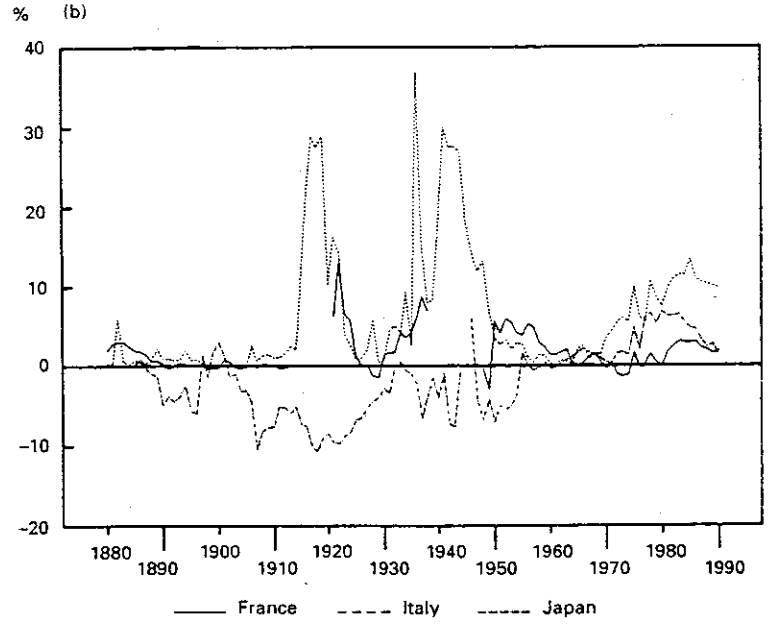
Finally, based on monthly data for 1880–1986 for the UK, and the USA, Grilli and Kaminsky (1991) show that, with the exception of the post-Second World War period, no clear connection exists between the nominal exchange rate regime and the variability of real exchange rates. Our results for the G-11 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 inter-war segment (as do Grilli and Kaminsky), hence that period cannot be used in the comparison.[26]

Government deficit (Panel j)

For the underlying data see Figure 9.10. 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

Figure 9.10 Government deficit as a percentage of nominal GNP, 1880–1990





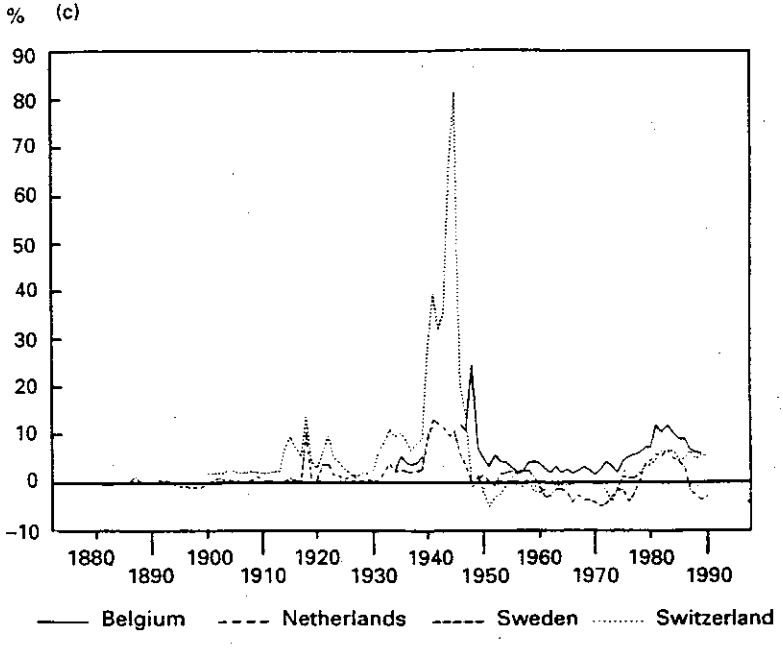
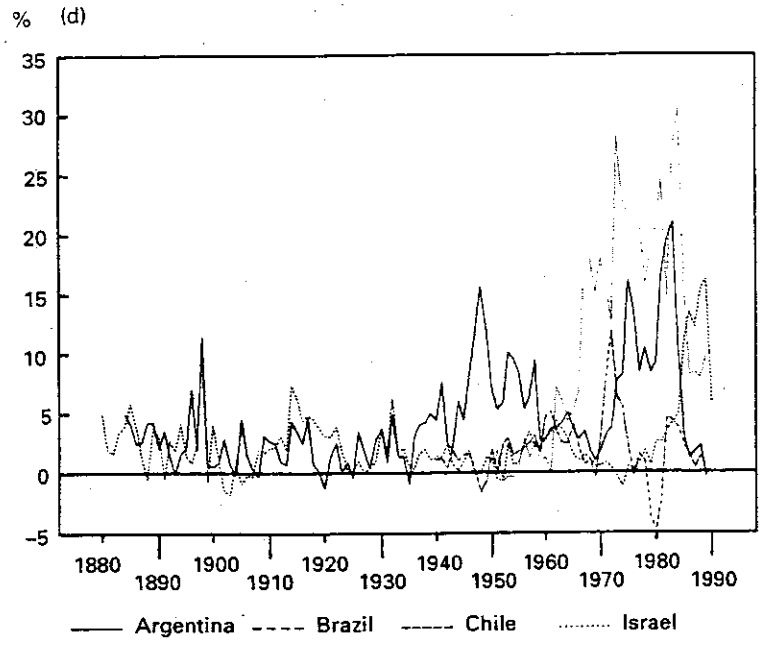


Figure 9.10 *Continued*



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, as both means and standard deviations show, fiscal policy converged most closely 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 (1995) 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 (see Table 9.2, Panel f) the deficit as a share of GNP increases dramatically between the pre- and post-Second World War periods. In the post-war 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 that 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 variable 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 9.1 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 inter-war 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 RWMS regime has serious real consequences.

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 follow an inflationary policy continually, 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 USA, 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-Second World War 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 inter-war period and between the inter-war period and the post-Second World War period.[27]

Table 9.3 presented the inflation-rate coefficient (from the type of AR(1) regressions on CPI inflation estimated by Alogoskoufis and Smith (1991), for all fifteen countries over successive regimes since 1880,[28] as well as the standard errors and the Dickey–Fuller tests for a unit root.[29] 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 inter-war period, and also between the inter-war period and the post-Second World War period as a whole. Within the post-Second World War 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-Second World War period was characterised 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 that this expectation lost credence. Finally, the evidence that persistence was generally highest during the float may imply the public's realisation 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 9.3 is consistent with Leijonhufvud's (1987a) description of the gradual evolution away from convertible and towards RWMS regimes.

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 9.4 presents the MAEs 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.[30] 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.

Table 9.4 Forecast errors in inflation and real growth: G-11 and high inflation countries, 1880–1989, annual data: mean absolute errors using the multi-state Kalman filter

		Gold Standard 1880–1913		*Interwar 1919–39*		*Bretton Woods (total) 1946–70*		*Bretton Woods (preconvertible) 1946–58*		*Bretton Woods (convertible) 1959–70*		*Floating exchange 1973–89*	
		Growth	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*
United States													
	1	2.00	1.48	4.90	4.55	3.22	2.33	5.01	3.47	1.28	1.11	1.67	2.06
	5	7.16	6.31	22.26	30.82	20.54	13.51	33.24	22.23	6.79	4.08	5.46	13.03
	10	12.86	11.87	19.00	48.54	30.55	27.48	45.08	44.15	14.80	9.42	9.23	26.64
United Kingdom													
	1	1.42	2.10	4.11	4.41	1.41	1.47	1.82	1.76	0.97	1.15	2.71	4.61
	5	4.85	6.80	22.01	37.20	10.80	5.95	17.54	6.73	3.50	5.11	8.24	28.59
	10	9.39	10.28	29.66	70.02	20.52	23.39	31.70	31.21	8.40	14.92	7.54	61.10
Germany													
	1	1.69	1.69	8.07	3.97	2.77	2.59	3.24	5.00	2.49	1.18	1.45	1.30
	5	5.73	7.39	37.00	22.65	12.99	12.15	18.40	45.80	11.63	3.74	7.02	7.85
	10	7.45	9.44	31.21	40.05	29.44	31.92	n.a.		29.44	31.92	19.80	16.31
France													
	1	2.25	2.48	5.54	7.08	1.51	3.13	2.28	4.62	0.87	2.14	1.44	2.82
	5	9.48	8.55	31.40	34.08	7.35	9.47	15.76	25.78	3.15	4.03	7.93	13.61
	10	16.58	11.29	79.95	59.54	19.11	20.29	n.a.	n.a.	19.56	20.29	14.42	22.30
Japan													
	1	1.69	3.95	2.69	6.83	1.59	2.63	0.85	5.48	1.89	0.96	1.54	2.95
	5	5.31	16.95	12.57	39.21	8.03	14.53	n.a.	48.57	8.37	6.02	10.62	16.82
	10	12.71	37.64	20.40	61.50	26.50	37.10	n.a.	n.a.	26.50	37.10	26.01	30.06

Table 9.4 *Continued*

	1880–1913		*Interwar* *1919–39*		*Bretton Woods (total)* *1946–70*		*Bretton Woods (preconvertible)* *1946–58*		*Bretton Woods (convertible)* *1959–70*		*Floating exchange* *1973–89*	
	Growth	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*
Canada												
1	1.58	0.80	7.16	3.99	2.19	1.92	3.06	2.96	1.24	0.79	1.72	2.29
5	8.11	3.44	29.66	25.54	15.16	8.73	21.01	12.14	8.83	5.03	7.75	14.04
10	11.70	6.35	27.85	45.63	25.21	18.56	34.21	23.91	15.46	12.78	17.09	33.67
Italy												
1	2.08	2.01	2.08	7.58	4.21	6.35	7.04	10.54	1.15	1.81	1.14	3.83
5	6.72	6.62	8.44	56.11	21.00	74.57	36.60	135.02	4.10	9.10	7.62	26.55
10	14.26	11.39	9.06	123.71	40.53	194.17	70.48	352.43	8.07	22.73	17.99	57.08
Belgium												
1	n.a.	1.22	1.36	1.93	1.48	2.06	1.71	2.95	1.29	1.30	1.41	2.16
5	n.a.	6.74	7.41	8.21	5.34	10.60	6.38	20.26	4.82	5.77	7.53	12.75
10	n.a.	8.80	9.37	21.02	11.80	21.64	n.a.	n.a.	9.58	13.53	13.91	28.74
Netherlands												
1	1.59	1.36	3.23	3.09	4.48	2.87	7.34	3.84	1.38	1.82	1.48	1.93
5	5.42	5.66	14.44	26.35	27.64	10.54	47.44	13.73	6.19	7.08	9.29	14.68
10	17.20	21.07	24.23	43.99	53.94	33.80	83.14	49.54	22.31	16.74	19.48	29.18
Sweden												
1	1.86	2.24	3.79	5.80	1.33	2.28	1.63	3.08	1.01	1.40	1.58	2.72
5	4.48	9.57	16.70	43.53	7.84	10.20	11.55	15.70	3.81	4.24	6.14	14.41
10	8.84	14.08	17.31	83.53	12.42	21.90	15.28	29.35	9.32	13.83	14.66	33.46

Table 9.4 *Continued*

	1880–1913		*Interwar* *1919–39*		*Bretton Woods (total)* *1946–70*		*Bretton Woods (preconvertible)* *1946–58*		*Bretton Woods (convertible)* *1959–70*		*Floating exchange* *1973–89*	
	Growth	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*
Switzerland												
1	n.a.	n.a.	1.74	3.50	2.30	1.41	3.20	1.44	1.32	1.38	1.73	1.77
5	n.a.	n.a.	8.75	18.88	10.33	7.94	14.84	8.85	5.45	6.95	8.70	7.56
10	n.a.	n.a.	n.a.	n.a.	18.91	26.37	25.09	38.98	12.22	12.69	19.79	13.42
Average G-11												
1	1.80	1.93	4.06	4.79	2.41	2.64	3.38	4.10	1.35	1.37	1.62	2.59
5	6.36	7.80	19.15	31.14	13.37	16.20	22.28	32.26	6.06	5.56	7.85	15.44
10	12.33	14.22	26.80	59.75	26.27	41.51	43.57	81.37	15.97	18.72	16.36	32.00
Argentina												
1	3.52	8.16	3.26	5.40	3.27	11.29	2.94	12.19	3.63	10.32	3.28	53.99
5	11.09	33.69	15.98	25.04	7.31	54.82	9.42	56.19	5.03	53.34	10.84	209.39
10	23.82	65.62	34.14	36.36	7.53	126.59	8.12	125.98	6.89	127.25	21.75	405.75
Brazil												
1	5.66	10.64	6.41	6.15	2.89	11.27	2.32	5.48	3.50	17.54	3.57	27.21
5	30.91	56.59	26.33	30.51	11.85	62.39	10.73	31.51	13.06	95.83	14.72	139.19
10	60.82	124.21	47.78	52.63	28.03	120.78	30.35	70.68	25.52	175.05	24.70	284.69
Chile												
1	3.44	8.14	6.53	6.60	3.19	9.09	3.71	10.69	2.62	7.36	5.00	32.03
5	16.79	26.29	21.32	29.62	12.55	47.34	11.67	49.22	13.50	45.31	18.45	255.08
10	23.71	53.70	25.81	55.24	18.26	90.72	17.44	88.18	19.15	92.41	17.27	581.52

Table 9.4 Continued

	1880–1913		Interwar 1919–39		Bretton Woods (total) 1946–70		Bretton Woods (preconvertible) 1946–58		Bretton Woods (convertible) 1959–70		Floating exchange 1973–89	
	Growth	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*	*Growth*	*Inflation*
Israel												
1	n.a.	n.a.	n.a.	n.a.	3.94	6.87	7.13	12.15	2.09	3.78	4.47	24.67
5	n.a.	n.a.	n.a.	n.a.	12.48	42.49	42.24	67.76	5.04	36.17	16.98	169.49
10	n.a.	n.a.	n.a.	n.a.	29.75	119.62	n.a.	n.a.	29.75	119.62	32.97	289.91
Average high inflation countries												
1	4.21	8.98	5.40	6.05	3.32	9.63	4.03	10.13	2.96	9.75	4.08	34.48
5	19.60	38.86	21.21	28.39	11.05	51.76	18.52	51.17	9.16	57.66	15.25	193.29
10	36.12	81.18	35.91	48.08	20.89	114.43	18.64	94.95	20.33	128.58	24.17	390.47

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 inter-war period, followed by the preconvertible Bretton Woods period. The most notable exception to the pattern was for the UK, 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 increased dramatically with time in the post-war 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 inter-war 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, such as 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.

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 preceeding 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 (1992, 1993, 1994a and b) 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 probably 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 (1994a), we estimated a two-variable VAR in the rate of change of the price level and output.[31] 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.[32] 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.[33]

We estimated supply (permanent) and demand (temporary) shocks, using annual data for each of the fifteen countries, over alternative regimes, in the period 1880–1989. The VARs are based on three separate sets of data (to the extent available): 1880–1913, 1919–39 and 1946–89, omitting the war years because complete data on them was available for only a few of the countries. The VAR have two lags. We also did the estimation for aggregated price and output data for the G-11 and the high-inflation countries.

Figures 9.11 and 9.12 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.[34] 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-Second World War regimes. But for the period before the Second World War, for most countries, as reflected in the aggregates shown in Figures 9.11 and 9.12, 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 (1994a) argue that the positive response to favourable aggregate supply shocks

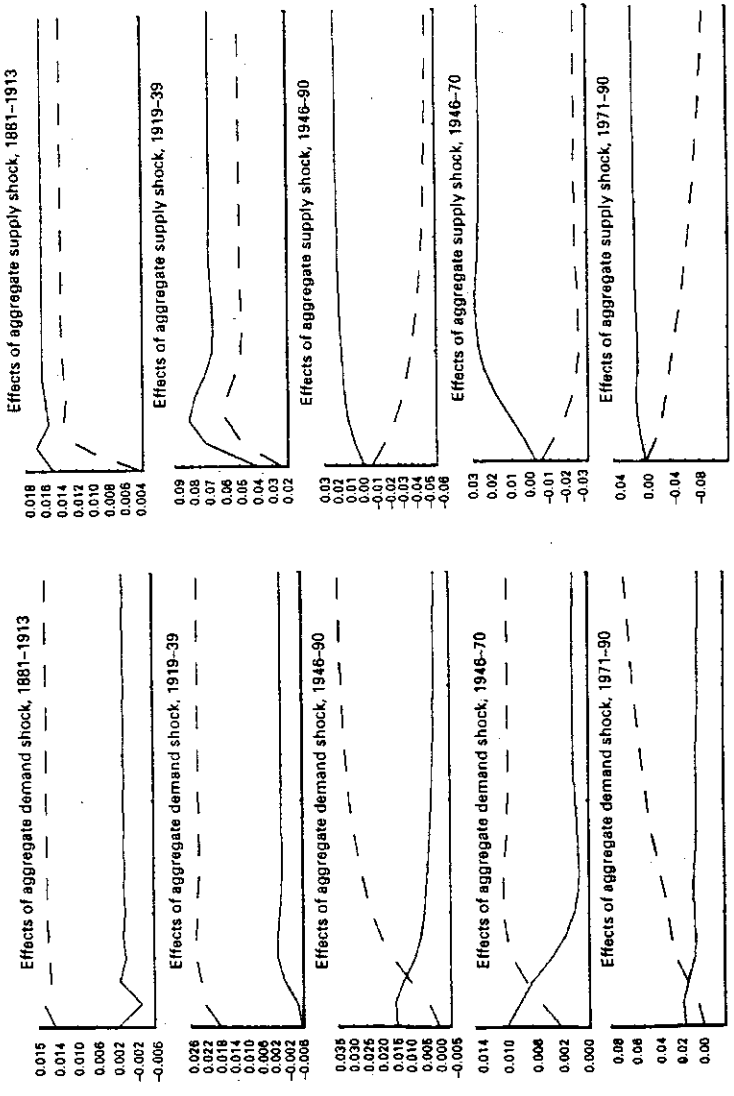


Figure 9.11 Impulse response functions of demand and supply shocks on prices (dotted lines) and output (solid lines), G-11 aggregate by regimes, 1881–1990, annual data.

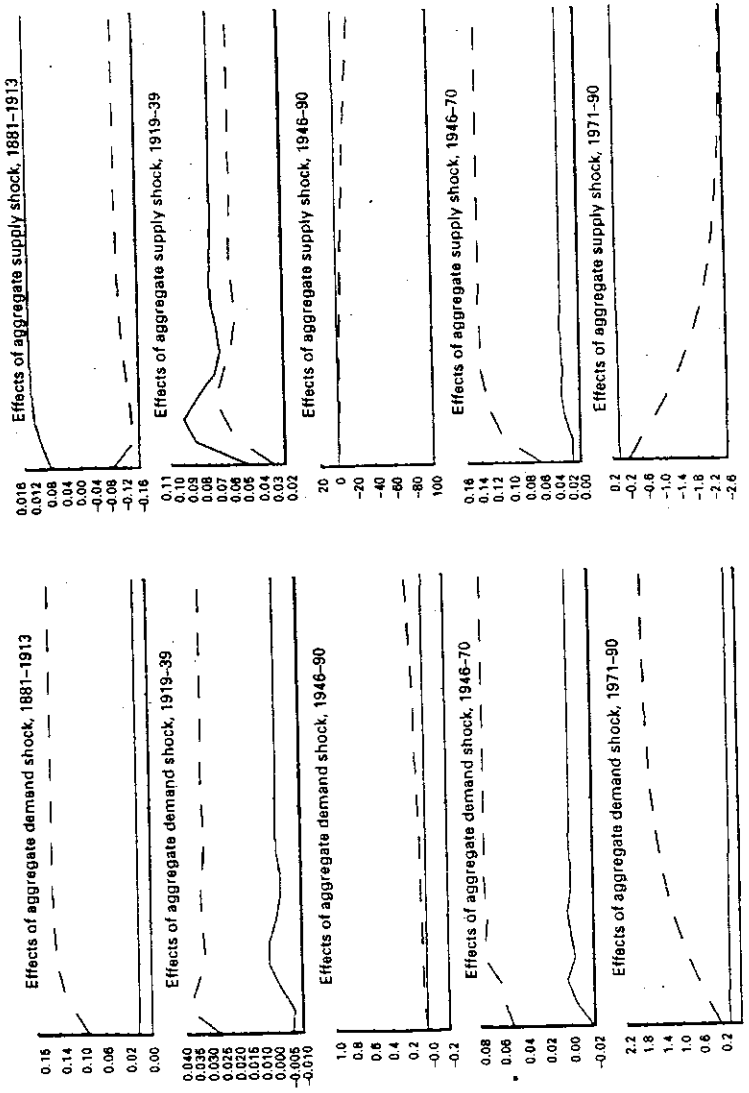


Figure 9.12 Impulse response functions of demand and supply shocks on prices (dotted lines) and output (solid lines), high inflation countries aggregate by regimes, 1881–1990, annual data

may be, in part, caused by 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 9.5 presents the standard deviations of supply and demand shocks for the fifteen 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 (1994a), the weighted average of the individual country shocks. Figures 9.13 and 9.14 show the shocks for the G-11 aggregate, for the high inflation aggregate and for each of the 15 countries.

Table 9.5 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 inter-war period, unsurprisingly, shows the largest supply and demand shocks.[35] Sizeable supply and demand shocks which are two or three times greater than the post- Second World War period also characterise the classical gold standard.[36]

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

For the high inflation countries, in marked contrast to the G-11, demand shocks exceeded supply shocks in all regimes except the inter-war. In the post-Second World War period, demand shocks considerably exceeded supply shocks, especially under the float. This evidence, to the extent that demand shocks capture discretionary policy actions, provides strong support for Leijonhufvud's views on the RWMS regime.

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-Second World War regimes, with floating regime displaying the highest degree of convergence. Dispersion is much greater in the inter-war period. The dispersion of supply shocks is considerably greater during the gold standard and the inter-war periods than in any of

Table 9.5 Supply (permanent) and demand (temporary) shocks, 1880–1990, annual data: standard deviations of shocks (%): dispersion of shocks across countries (%)

	Gold standard 1883–1913		*Inter-war 1921–39*		*Bretton Woods (total) 1948–70*		*Bretton Woods (preconvertible) 1948–58*		*Bretton Woods (convertible) 1959–70*		*Floating exchange 1973–89*		*Post Second World War 1948–89*	
	D	*S*	*D*	*S*	*D*	*S*	*D*	*S*	*D*	*S*	*D*	*S*	*D*	*S*
United States	2.03	3.81	4.46	6.74	2.33	1.54	3.11	1.99	1.37	1.07	1.72	1.94	2.08	1.69
United Kingdom	2.66	2.16	1.93	3.52	2.62	1.95	3.06	2.61	2.26	1.14	3.57	4.31	3.03	3.10
Germany	2.36	2.32	4.47	3.13	2.88	2.65	1.85	2.87	3.34	2.66	1.66	1.39	2.36	2.20
France	4.58	3.75	7.17	5.19	3.50	1.75	3.23	1.61	3.77	1.84	1.93	1.52	2.84	1.70
Japan	4.85	3.39	6.28	5.36	3.18	2.56	4.05	1.97	2.83	2.78	2.39	2.50	2.75	2.69
Canada	0.93	2.75	4.01	8.61	2.42	2.60	3.08	3.70	1.74	0.98	2.66	2.10	2.48	2.47
Italy	3.16	3.12	7.40	4.14	2.76	1.75	2.93	1.85	2.56	1.73	3.58	1.91	3.30	2.47
Belgium	n.a.		5.82	3.37	2.14	1.67	2.97	2.00	1.16	1.15	1.55	1.99	1.91	1.81
Netherlands	0.81	0.81	2.79	3.42	2.97	2.67	3.13	2.46	2.77	2.86	1.94	1.85	2.50	2.39
Sweden	2.57	3.03	3.08	5.10	3.89	2.96	5.37	4.18	1.97	1.26	2.32	2.40	3.44	2.86
Switzerland	n.a.		3.54	2.08	2.50	1.72	2.84	2.24	1.46	1.04	2.24	1.44	2.50	1.73

Table 9.5 *Continued*

	Gold standard 1883–1913		*Inter-war 1921–39*		*Bretton Woods (total) 1948–70*		*Bretton Woods (preconvertible) 1948–58*		*Bretton Woods (convertible) 1959–70*		*Floating exchange 1973–89*		*Post Second World War 1948–89*	
	D	*S*	*D*	*S*	*D*	*S*	*D*	*S*	*D*	*S*	*D*	*S*	*D*	*S*
G-11	1.55	2.27	3.61	3.82	1.10	0.85	1.79	1.19	0.65	0.77	1.63	0.89	1.41	0.86
G-11*	1.52	2.25	2.42	4.43	1.08	0.82	1.61	1.05	0.69	0.73	1.36	1.62	1.24	1.33
Dispersion	4.38	5.70	7.53	8.71	4.83	3.17	4.29	2.54	5.01	3.38	4.14	3.32	4.43	3.30

Notes:
G-11: G-11 aggregate data.
G-11: Weighted average of individual country shocks; the weights are calculated as the share of each country's national income in the total income in the G-11 countries in 1970, where the GNP/GDP data are converted to dollars using the actual exchange rate.
1880–1913: United States 53%, United Kingdom 6%, Germany 10%, France 8%, Japan 11%, Canada 4%, Italy 6%, Belgium 0%, Netherlands 0%, Sweden 2%, Switzerland 0%.
1919–38: United States 58%, United Kingdom 7%, Germany 0%, France 8%, Japan 12%, Canada 5%, Italy 6%, Belgium 0%, Netherlands 2%, Sweden 2%, Switzerland 0%.
1946–90: United States 51%, United Kingdom 7%, Germany 9%, France 8%, Japan 10%, Canada 4%, Italy 5%, Belgium 1%, Netherlands 2%, Sweden 2%, Switzerland 1%.
Dispersion: mean value of $\Sigma(\text{weight}_i\ (\text{shock}_i - \Sigma\ \text{weight}_j * \text{shock}_j)^{2/05}$, for i = United States, United Kingdom, Germany, France, Japan, Canada, Italy, Belgium, Netherlands, Sweden, Switzerland.

Table 9.5 Continued

	Gold standard 1883–1913 D	S	*Inter-war 1921–39* D	S	*Bretton Woods (total) 1948–70* D	S	*Bretton Woods (preconvertible) 1948–58* D	S	*Bretton Woods (convertible) 1959–70* D	S	*Floating exchange 1973–89* D	S	*Post Second World War 1948–89* D	S
Argentina	9.62	6.77	5.48	3.67	17.10	4.58	11.97	3.94	21.32	5.25	98.32	8.42	68.05	6.62
Brazil	15.91	6.69	5.76	6.15	16.67	5.54	12.46	4.00	17.97	5.42	18.16	7.50	18.47	5.78
Chile	8.55	6.90	9.98	9.41	12.73	5.62	14.46	6.91	11.56	4.20	27.00	8.06	20.86	6.79
Israel	n.a.		n.a.		5.94	3.16	6.47	3.50	5.95	2.99	28.06	12.29	20.12	9.28
High Inflation	11.32	5.19	5.93	5.98	10.36	5.99	12.44	4.01	17.13	6.01	26.89	10.02	20.11	9.04
High Inflation	9.32	5.81	4.86	4.72	11.91	5.23	10.76	4.52	19.67	6.37	30.72	9.86	23.23	8.69
Dispersion	7.40	4.95	4.27	4.23	20.01	6.14	18.12	5.20	21.31	6.79	50.28	13.51	32.68	9.51

High Inflation: High inflation countries – aggregate data.
High Inflation: Weighted average of individual country shocks; the weights are calculated as the share of each country's national income in the total income in the G-11 countries in 1970, where the GNP/GDP data are converted to dollars using the actual exchange rate.
1946–90: Argentina 31%, Brazil 53%, Chile 9%, Israel 7%.
1880–1939: Argentina 34%, Brazil 56%, Chile 10%.

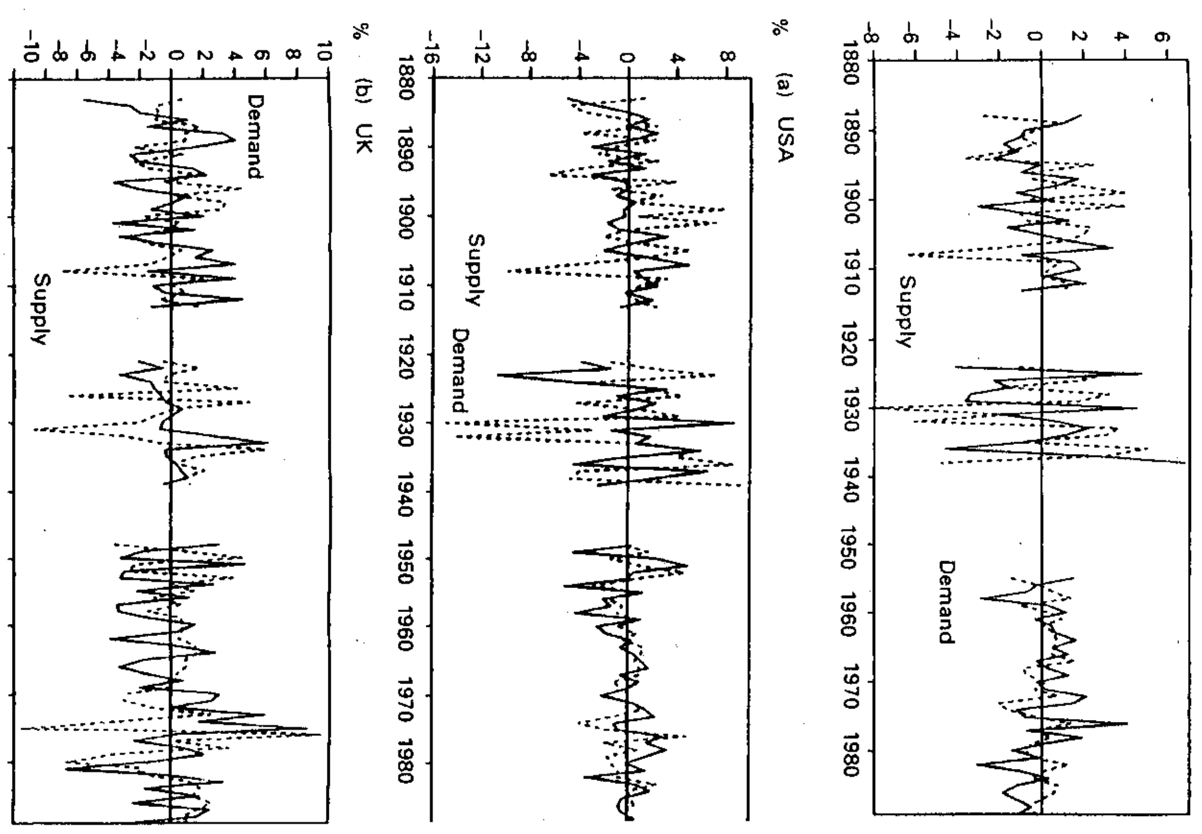
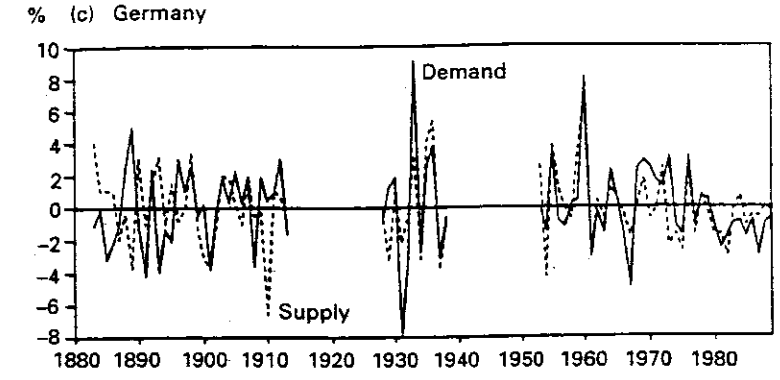
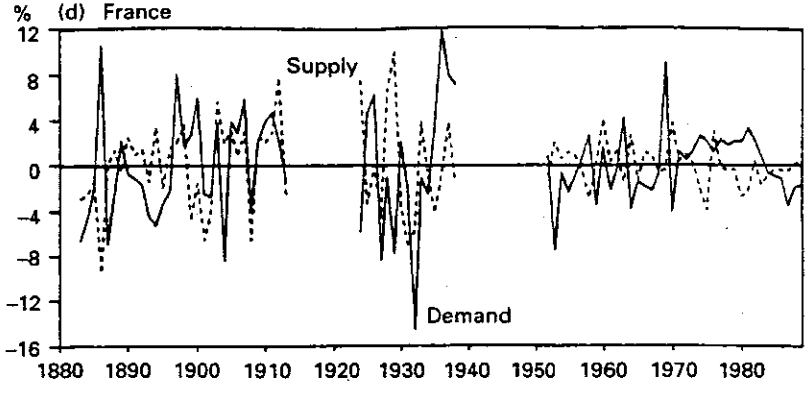


Figure 9.13 Supply and demand shocks: G-11 aggregate, 1880–1989, annual data

Figure 9.13 *Continued*





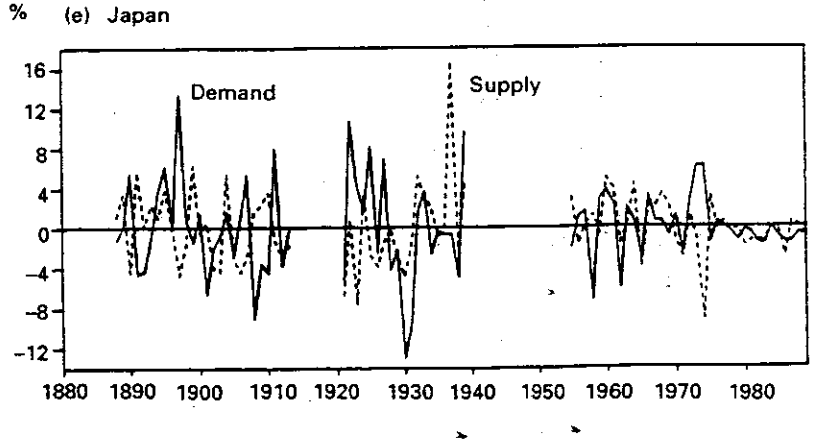
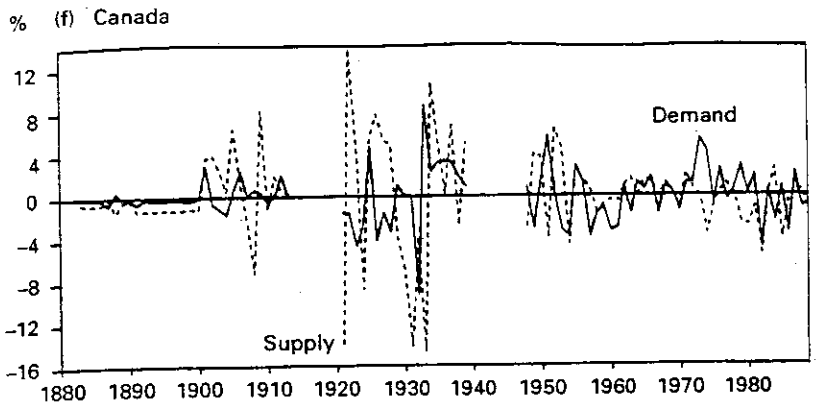
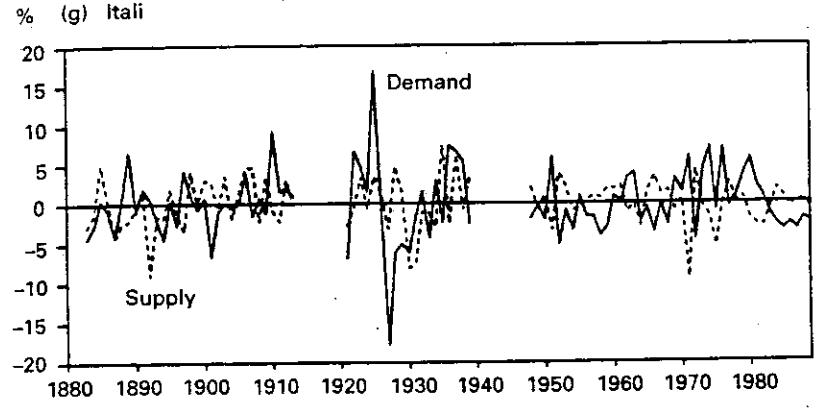


Figure 9.13 *Continued*





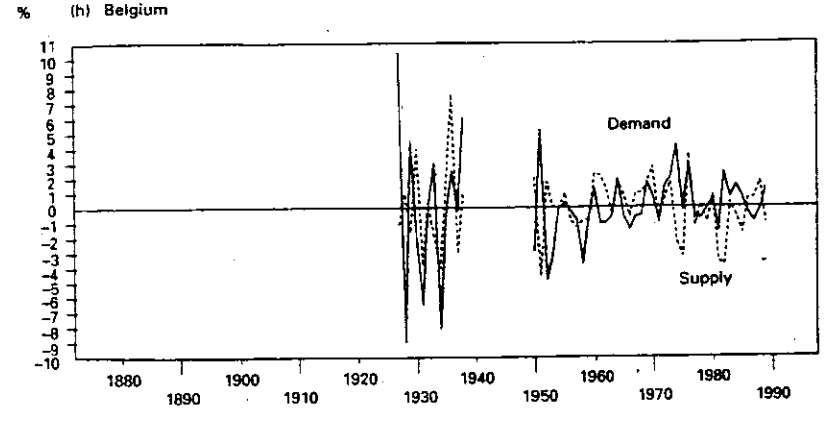
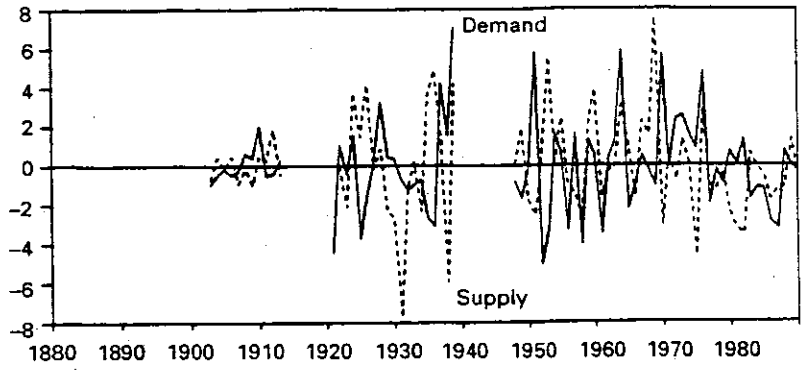
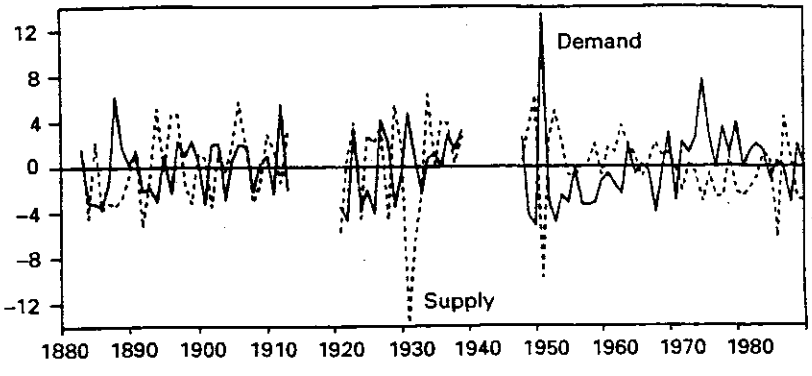


Figure 9.13 *Continued*

% (i) Netherlands



% (j) Sweden



% (k) Switzerland

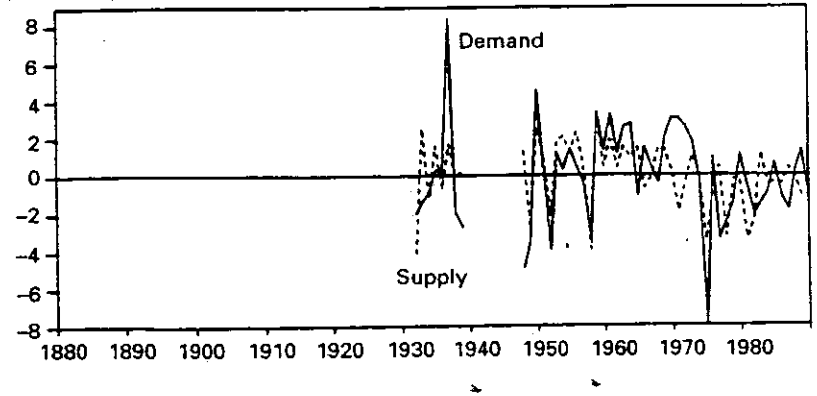


Figure 9.14 Supply and demand shocks: high inflation countries aggregate, 1880–1989, annual data

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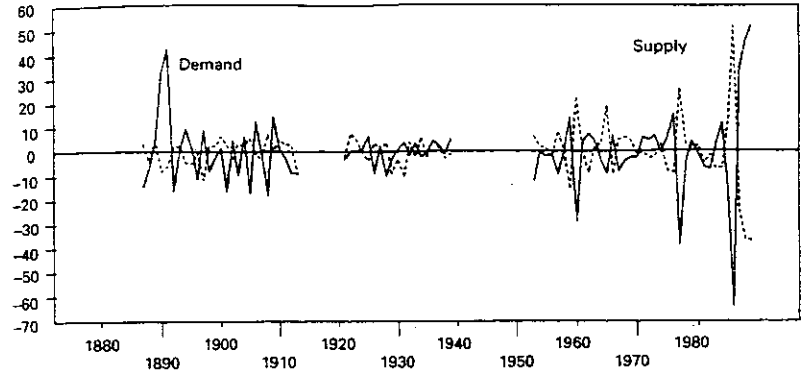
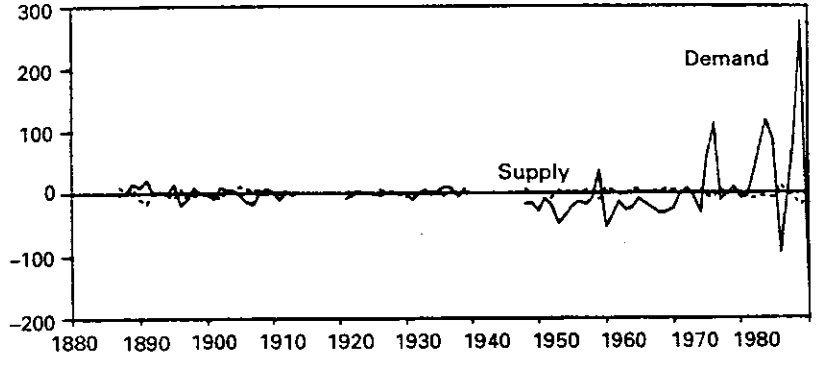


% (a) Argentina



% (b) Brazil

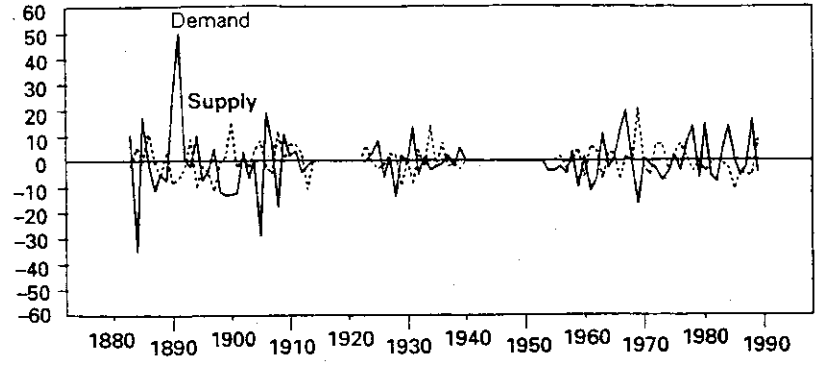
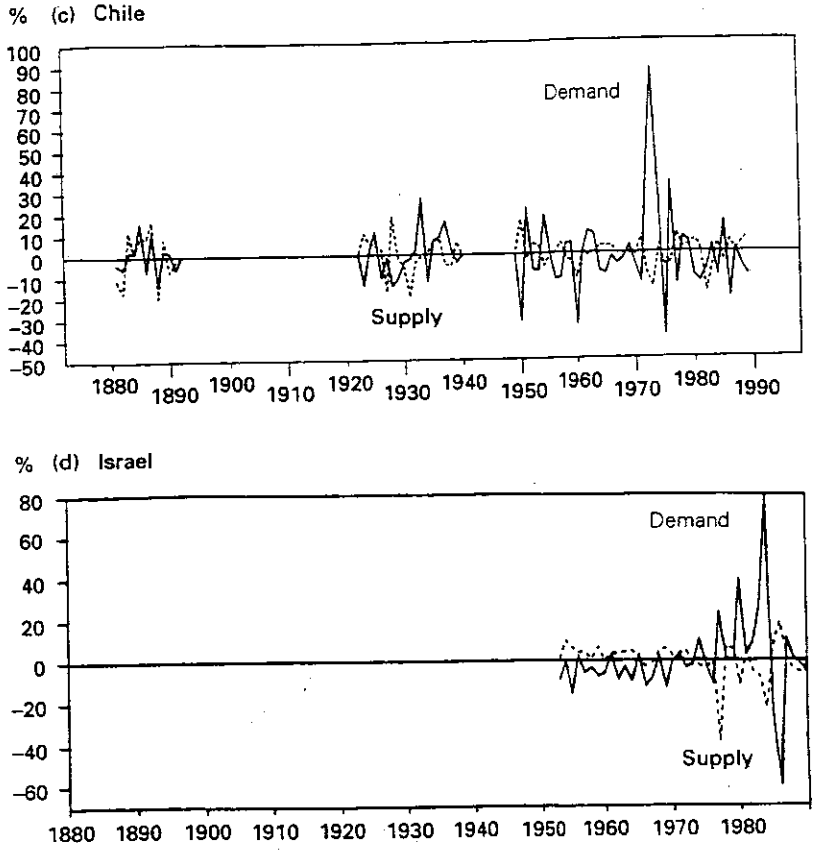


Figure 9.14 *Continued*



the post-Second World War regimes. For the high-inflation countries, the dispersion of both demand and supply shocks is considerably higher in the post-Second World War era compared to the pre-war period. Dispersion of both types of shocks also increases considerably between the Bretton Woods regime and the subsequent float.

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 characterised by higher demand – and especially higher supply – shocks than the post-Second World War regimes, and within that period both the convertible Bretton Woods regime and the float are relatively stable.[37] By contrast, for the high-

inflation countries, demand shocks exceeded supply shocks across all regimes, and especially under the post-war 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.

Summary

Leijonhufvud emphasises important difference 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 presented 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 industrialised and less-developed high-inflation countries, greater stability of nominal variables – the inflation rate, nominal interest rates and nominal exchange rates – than under regimes characterised 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 the Second World War.

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 has not been the case since 1973, (see Heymann and Leijonhufvud, 1995).

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 supply shocks, since the size of demand and supply shocks was quite similar across both types of regime. The durability or fragility of past convertible regimes probably 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 RWMS regimes.

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 emphasising 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 dichotomising monetary regimes in history. The world evolved over the century from 1881 from a tight, convertibility-based constitutional regime to a looser regime and then ultimately to a regime of pure discretion – the RWMS. The distinction between constitutional regimes and RWMS operationalises the earlier distinction made by Kydland and Prescott (1977) between rules and discretion, which emphasises 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 blue-back 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 incorporate bluebacking in its short-lived 1985 Austral Plan. Had it also followed the other prescriptions for reform and been a true regime shift as may have occurred with the convertibility plan of 1991, Leijonhufvud's proposal would have probably been successful. Historical experience suggests that the use of monetary institutions that are sharply isolated from domestic political pressure, such as a currency board, would be more successful in countries with inflationary histories than a central bank in reducing high inflation in the short run and maintaining a low rate in the long run. 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 the fourth section of this chapter we presented 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 fifteen countries divided into industrialised and high-inflation economies. Our classification of historical regimes were the gold standard; inter-war; Bretton Woods preconvertible; Bretton Woods convertible; and floating. These correspond roughly to Leijonhufvud's distinction between convertibility-based regimes (the gold standard and Bretton Woods convertible); loose convertibility (inter-war, Bretton Woods preconvertible) and discretion or RWMS (the floating regime).

We find, as Leijonhufvud predicted, that inflation and other nominal variable (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 in 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 under 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 marked one for the high-inflation countries. Finally, for the industrialised countries, since little difference between demand (policy induced) and supply (environment induced) shocks was detected, regime performance does not appear to 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 for the G-11, little evidence was detected linking it to the nature of the regime. But for high inflation countries, as Leijonhufvud predicted, the shift from a convertibility influenced regime to high inflation in the 1970s is 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.

Notes

1. See also Leijonhufvud (1986, 1987a, 1987b).
2. See also Grossman and Van Huyck (1988); Flood and Isard (1989); DeKock and Grilli (1992); Bordo and Kydland (1995).
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 defence of the neoclassical theory, see Lucas (1993).
7. Both of these proposals were infact adopted as guidelines for Swedish monetary policy. See Jonung (1979).
8. See also Bruno (1993).
9. See, for example, the surveys by Bruno (1993), Paldam (1993) and Vegh (1992). As a rule, the output loss of a stabilisation programme to eliminate hyperinflation is smaller than the loss of reducing chronic or even rapid inflation.
10. See Hanke *et al.* (1993) and Hanke and Schuler (1991) on various techniques to insulate a currency board from external pressure.

11. 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 characterised the price level under the gold standard (Cagan, 1984).
12. The approach taken below follows that taken in Bordo (1993a and b), which focuses on regime performance for the G-7 countries.
13. We also examined the period (1946–73) 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 1946–70 period.
14. For the performance of Latin-American countries during the classical standard, see Fishlow (1987) and Eichengreen (1992a); and for the performance of all four countries during Bretton Woods, see Edwards and Santaella (1993).
15. To be more exact, the USA stayed on gold until 1933 and France until 1936. For a detailed comparison of the performances of these three regimes in the inter-war period, see Eichengreen (1992a).
16. Within the G-11, Canada floated from 1950 to 1961.
17. This is a very crude measure of covergence 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 (1994b) presented an alternative measure of convergence GDP-weighted 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.
18. The data sources for Figure 9.1 and all subsequent figures are listed in the data appendix.
19. For similar evidence, see Bordo (1981); Darby *et al.* (1983); and Darby and Lothian (1989).
20. 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.
21. Baxter and Stockman (1989) and Eichengreen (1993) 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.
22. 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 (1994a) 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 9.1. For Bayoumi and Eichengreen (1994a) 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 stabilise 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.

23. 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.
24. Also see Dornbusch (1976).
25. 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.
26. Meltzer (1990), in a comparison of EMS and non-EMS contries in the floating rate period, also finds a strong correlation between changes in nominal and real exchange rates.
27. See also 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).
28. 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.
29. Eichengreen (1993) also presents these statistics for four of the countries.
30. 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 9.1.
31. Both variables were rendered stationary by first differencing.
32. Specifically, four restrictions are placed on the matrix of the shocks: two are simple normalisations, 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, that the cumulative effect of demand shocks on the rate of change in output must be zero.
33. See Keating and Nye (1991).
34. The impulse response functions were calculated from VARs run for the separate regime periods. Because the number of observations was limited, the Bretton Woods regime could not be split into the two sub-periods shown in preceding tables.
35. The results for the G-11 in the inter-war period figures are similar to those reported for the USA by Cecchetti and Karras (1992), who estimate a three-variable VAR with monthly data. The late 1920s and early 1930s 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.
36. Though the shocks are smaller, the rankings by regime for the weighted average of individual country shocks are similar to the G-11 aggregate.
37. These results are very similar to those presented for the G-7 in Bordo (1993b) and by Eichengreen and Bayoumi (1994a).

Data Appendix

For the G-7 countries, see data appendix in Bordo (1993a), except for the following series on government expenditures and revenues.

Canada

1880–1988, B. R. Mitchell (1993) *International Historical Statistics: The Americas, 1750–1988* (New York: Stockton Press).

France

1880–1988, B. R. Mitchell (1992) *International Historical Statistics: Europe, 1750–1988* (New York Stockton Press).

Germany

1880–1988, Mitchell (1992).

Italy

1880–1988, Mitchell (1992).

Japan

1880–1975, B. R. Mitchell, (1991) *International Historical Statistics: Asia* (New York: Stockton Press); 1976–90, *IFS Yearbook*, 1987 and 1992.

UK

1880–1988, Mitchell (1992).

USA

1880–1988, Mitchell (1993).

Additional Countries

Argentina

(1) Population: 1880–1988, B. R. Mitchell (1993); (2) Money: 1884–1913, G. della Paollera (1988). *How the Argentine Economy Performed During the International Gold Standard: A Reexamination*, Doctoral dissertation, University of Chicago; 1914–84: D. F. Cavallo and Y. Mundlak, *Estadisticas de la evolucion economica de Argentina 1913–1984*;

1985–90, *International Financial Statistics Yearbooks 1992*. (3) Real GDP: 1884–1913, G. della Paollera (1988); 1914–88, B. R. Mitchell (1993). (4) GDP deflator: 1884–1913, G. della Paollera (1988); 1914–88, B. R. Mitchell (1993): (5) GPI: 1913–84: D. F. Cavallo and Y. Mundlak; 1985–90, *International Financial Statistics Yearbook 1992*. (6) Exchange rate: 1884–1912, G. della Paollera (1988); 1913–84, D. F. Cavallo and Y. Mundlak ; 1985–90: *World Currency Yearbook*. (7) Government expenditures and revenues: 1880–1988, B. R. Mitchell (1993).

Belgium

(1) Population: 1880–1988, B. R. Mitchell (1992). (2) Money: 1919–88, *International Financial Statistics Yearbook*, 1973, 1987 and 1992. (3) Real GNP: 1913–88, B. R. Mitchell (1992). (4) GNP deflator: 1913–88, B. R. Mitchell (1992). (5) CPI: 1880–1988, B. R. Mitchell (1992). (6) Exchange rate: 1880–1914, supplied by Marc Flandreau, Stanford University; 1915–40, International Monetary Fund; 1948–90, *International Financial Statistics Yearbooks*, 1973, 1987 and 1992 . (7) Government expenditures and revenues: 1880–1988, B. R. Mitchell (1993).

Brazil

(1) Population: 1880–1988, B. R. Mitchell (1993). (2) Money: 1880–1988, IBGE (1990), *Estatisticas Historicas do Brasil: Series Economicas, Demograficas e Sociais de 1550 a 1988* (Rio de Janeiro: IBGE). (3) Real GDP: 1880–1988, B. R. Mitchell (1993). (4) GDP deflator: 1880–1988, B. R. Mitchell (1993). (5) CPI: 1912–88, B. R. Mitchell (1993). (6) Exchange rate: 1889–1989, M. de Paiva Abreu (ed.) (1990) *A Ordem do Progresso: Cem Anos de Politica Economica Republicana, 1889–1989* (Rio de Janeiro: Editora Campus). (7) Government expenditures and revenues: 1880–1988, B. R. Mitchell (1993).

Chile

(1) Population: 1880–1988, B. R. Mitchell (1993). (2) Money: 1880–94, A. L. Rodriguez (1991) *Chile During the Gold Standard: A Successful Paper Money Experience* ; B. R. Mitchell (1993). (3) Real GDP: 1880–94, A. L. Rodriguez (1991); 1909–88, B. R. Mitchell (1993). (4) GDP deflator: B. R. Mitchell (1993). (5) CPI: 1913–88, B. R. Mitchell (1993). (6) Exchange rate: 1880–1988, *Sinopsis Geografico: Estadisticas de la Republica de Chile* (annual series). (7) Government expenditures and revenues: 1880–1988, B. R. Mitchell (1993).

Israel

(1) Population: 1948–90, *International Financial Statistics Yearbooks*, 1973, 1987 and 1992 . (2) Money: 1948–90, *IFS Yearbooks*, 1973, 1987 and 1992. (3) Real GDP: 1948–90, *IFS Yearbooks*, 1973, 1987 and 1992. (4) GDP deflator: 1984–90, *IFS Yearbooks*, 1973, 1987 and 1992. (5) CPI: 1948–90, *IFS Yearbooks*, 1973, 1987 and 1992. (6) Exchange rate: 1948–90, *IFS Yearbooks*, 1973, 1987 and 1992. (7) Government expenditures and revenues: 1948–90, *IFS Yearbooks*, 1973, 1987 and 1992.

Netherlands

(1) Population: 1880–1988, B. R. Mitchell (1992). (2) Money: 1880–1988, *International Financial Statistics Yearbooks*, 1973, 1987 and 1992. (3) Real GNP: 1900–88, B. R. Mitchell (1992). (4) GNP deflator: 1900–1988, B. R. Michell (1992). (5) CPI: 1880–1988, B. R. Mitchell (1992). (6) Exchange rate: 1880–1914: Marc Flandreau Stanford University; 1915–40: International Monetary Fund; 1948–90: *IFS Yearbooks*, 1973, 1987 and 1992. (7) Government expenditures and revenues: 1880–1988, B. R. Mitchell (1992).

Sweden

(1) Population: 1880–1988, B. R. Mitchell (1992). (2) Money: 1880–1988, *International Financial Statistics Yearbooks*, 1973, 1987 and 1992. (3) Real GNP: B. R. Mitchell (1992). (4) GNP deflator: B. R. Mitchell (1992). (5) CPI: 1880–1988, B. R. Mitchell (1992). (6) Exchange rate: 1880–1914: Marc Flandreau, Stanford University; 1915–47: International Monetary Fund; 1948–90; *IFS Yearbooks*, 1973, 1987 and 1992. (7) Government expenditures and revenues: 1880–1988, B. R. Mitchell (1992).

Switzerland

(1) Population: 1880–1988, B. R. Mitchell (1992). (2) Money: 1919–88, *IFS Yearbooks*, 1973, 1987 and 1992. (3) Real GNP: 1913–88, B. R. Mitchell (1992). (4) GNP deflator: 1913–88, B. R. Mitchell (1992). (5) CPI: 1890–1988, B. R. Mitchell (1992). (6) Exchange rate: 1880–1914, Marc Flandreau, Stanford University; 1915–47: International Monetary Fund; 1948–90: *IFS Yearbooks*, 1973, 1987 and 1992. (7) Government expenditure and revenue: 1880–1988, B. R. Mitchell (1992).

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